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United States Department of Energy

Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Sites At Rifle, Colorado

Final

Volume V - Addenda D6 through D8 to Appendix D

Received by OSTI
JAN 19 1993

Appendix B of the
Cooperative Agreement
No. DE-FC04-85A120533

February 1990

Uranium Mill Tailings Remedial Action Project

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ADDENDUM D6

LABORATORY TEST DATA FROM MK-F INVESTIGATION, 1987
OLD RIFLE AND NEW RIFLE SITES

LABORATORY TEST DATA FROM MK-F INVESTIGATION, 1987-88
ESTES GULCH DISPOSAL SITE

LABORATORY TEST DATA FROM MKF INVESTIGATION, 1987

OLD RIFLE AND NEW RIFLE SITES

5025-RFL-R-01-00750-01
4256U/0125U

MKE DOCUMENT NO.5025-RFL-L-09-01059-00

Lambert and Associates

CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

February 29, 1988

Morrison Knudsen Engineers, Inc.
180 Howard Street
San Francisco, California 94105

PN: M87054GE

Attention: Mr. Grant Cherrington

Subject: UMTRA Project
Subcontract Number RFL-87-01

Mr. Cherrington:

This letter presents the results of our laboratory study in accordance with your subcontract number RFL-87-01. We received written authorization to proceed with the work on August 31, 1987.

The laboratory study, as requested by Mr. Atta Yiadom, consisted of ninety (90) grain size analysis tests without hydrometer analysis, sixty-one (61) grain size analysis tests with hydrometer analysis, fifty-eight (58) Atterberg limits tests, thirty-two (32) moisture-density relationship tests, seventy-seven (77) moisture content tests, thirty-nine (39) specific gravity tests, twelve (12) laboratory triaxial permeability tests, seven (7) unconsolidated undrained triaxial compression strength tests, five (5) consolidated undrained triaxial compression strength tests, five (5) dry density tests, four (4) one dimensional consolidation tests, and four (4) double hydrometer tests. Laboratory test results

ATTACHMENT: 5025-RFL-C-09-01060-00

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P.O. BOX 3986
GRAND JUNCTION, CO 81502
(303) 245-6506

P.O. BOX 0045
MONTROSE, CO 81402
(303) 249-2154

463 TURNER, 104 A
DURANGO, CO 81301
(303) 259-5095

and description of the test methods are presented in Appendix A.

We have limited sample material which was not tested. We will store this material until March 30, 1988 unless otherwise notified.

Thank you for the opportunity to perform geotechnical field and laboratory testing for you and your design team. If you have any questions please contact us.

Respectfully submitted,

LAMBERT AND ASSOCIATES

Norman W. Johnston, P.E.
Manager, Geotechnical Engineering

Reviewed by:

Dennis D. Lambert, P.E.
Principal Geotechnical Enginee

enclosures

NWJ/dkw

APPENDIX A

The laboratory testing program was determined by Mr. Atta Yiadom and Mr. Grant Cherrington, of Morrison Knudsen Engineers. The laboratory study consisted of performing grain size analysis tests, Atterberg limits tests, moisture-density relationship tests, moisture content tests, specific gravity tests, triaxial compression strength tests, laboratory triaxial permeability tests, one dimensional consolidation tests, and double hydrometer tests. The results of the laboratory tests are attached.

TESTING

Grain Size Analysis Tests Without Hydrometer Analysis

Grain size analysis tests were conducted on samples obtained during our field study. The grain size analysis tests were conducted in general accordance with ASTM Test Method C136.

Grain Size Analysis Tests With Hydrometer Analysis

Grain size analysis tests with hydrometer analysis were conducted on samples obtained during our field study. The grain size analysis tests with hydrometer analysis were conducted in general accordance with ASTM Test Method D422.

Double Hydrometer

Double hydrometer tests were conducted on samples obtained during the field study. The double hydrometer tests

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were conducted in accordance with ASTM Test Method D4221.

Atterberg Limits Tests

Atterberg limits tests were conducted on samples obtained during our field study. The Atterberg limits tests were conducted in general accordance with ASTM Test Method D4318.

Moisture-Density Relationship Tests

Moisture-density relationship tests were conducted on bulk samples obtained during our field study. The moisture-density relationship tests were conducted in general accordance with ASTM Test Method D698. The tests were conducted using a five and one half (5.5) pound hammer with a twelve (12) inch drop.

Moisture Content and Dry Density

Moisture content and dry density were determined of the thin walled tube samples obtained. The moisture content was determined according to ASTM Test Method D2216. The dry density of the samples was determined by using the weight of the entire sample.

Specific Gravity Tests

Specific gravity tests were conducted on samples obtained during the field study. The specific gravity tests were conducted in general accordance with ASTM Test Method D854.

Triaxial Compression Strength Tests

Triaxial compression strength properties of remolded and undisturbed samples were evaluated in general accordance with testing procedures defined by ASTM Test Method D2850. An unconsolidated undrained test or a consolidated undrained test was performed on each sample tested. During the consolidated undrained test the sample was allowed to consolidate prior to testing the sample to failure. The tests were performed using a strain controlled triaxial compression testing machine. The confining pressures used were as directed by Mr. Yiadom.

Laboratory Triaxial Permeability Tests

Laboratory permeability tests were conducted on remolded samples obtained during our field study. The permeability tests were conducted in general accordance with ASTM Test Method D2434, for constant head permeability.

Consolidation Tests

One dimensional consolidation properties of thin walled tube samples were evaluated according to the provisions of ASTM Test Method D2435. Water was added in all cases during the test. Readings during an increment of load were taken regularly until the change in sample height was less than 0.001 inch over a two hour period.

It should be noted that the graphic presentation of consolidation data is a presentation of volume change with change in axial load. As a result, both expansion and consolidation can be illustrated.

RIFLE PROCESSING SITES

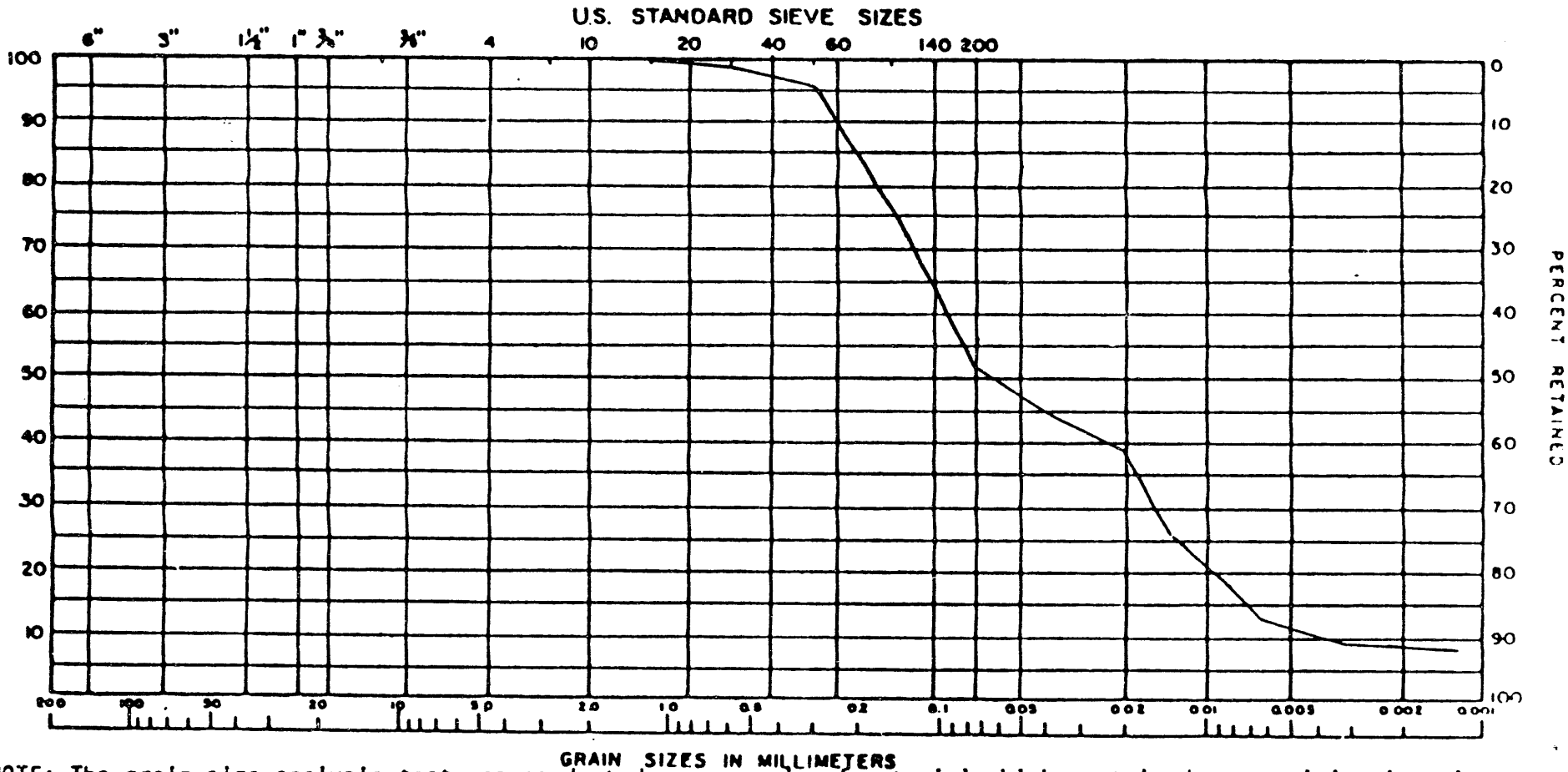
Project: Rifle RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNB-1	20' to 24'	22	NP	--	21.6	2172
CLASSIFICATION						

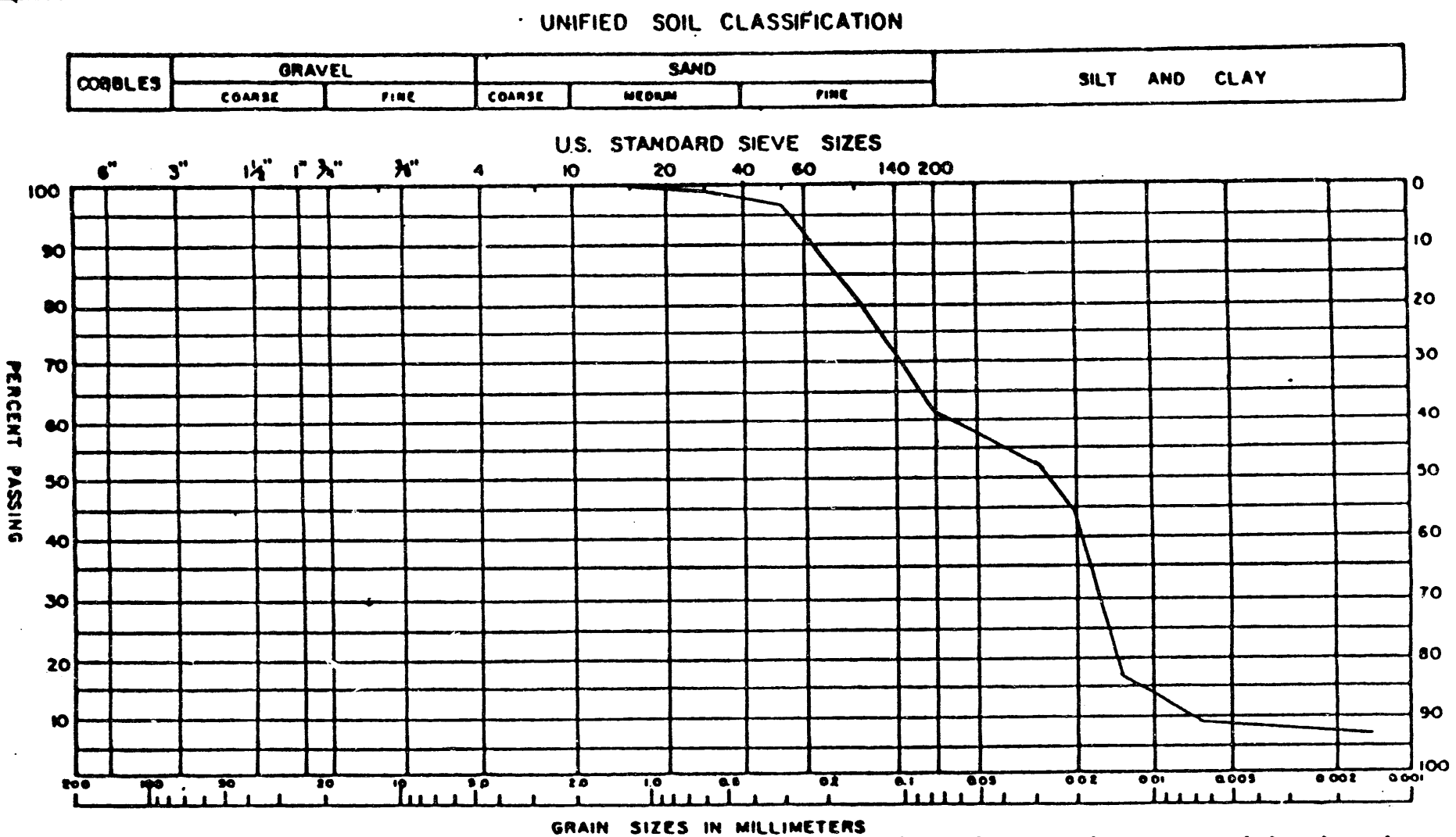
Fig

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNB-1	30' to 34'	22	NP	2.73	24.9	2173
CLASSIFICATION						

Project: Rifle-RFL-87-01

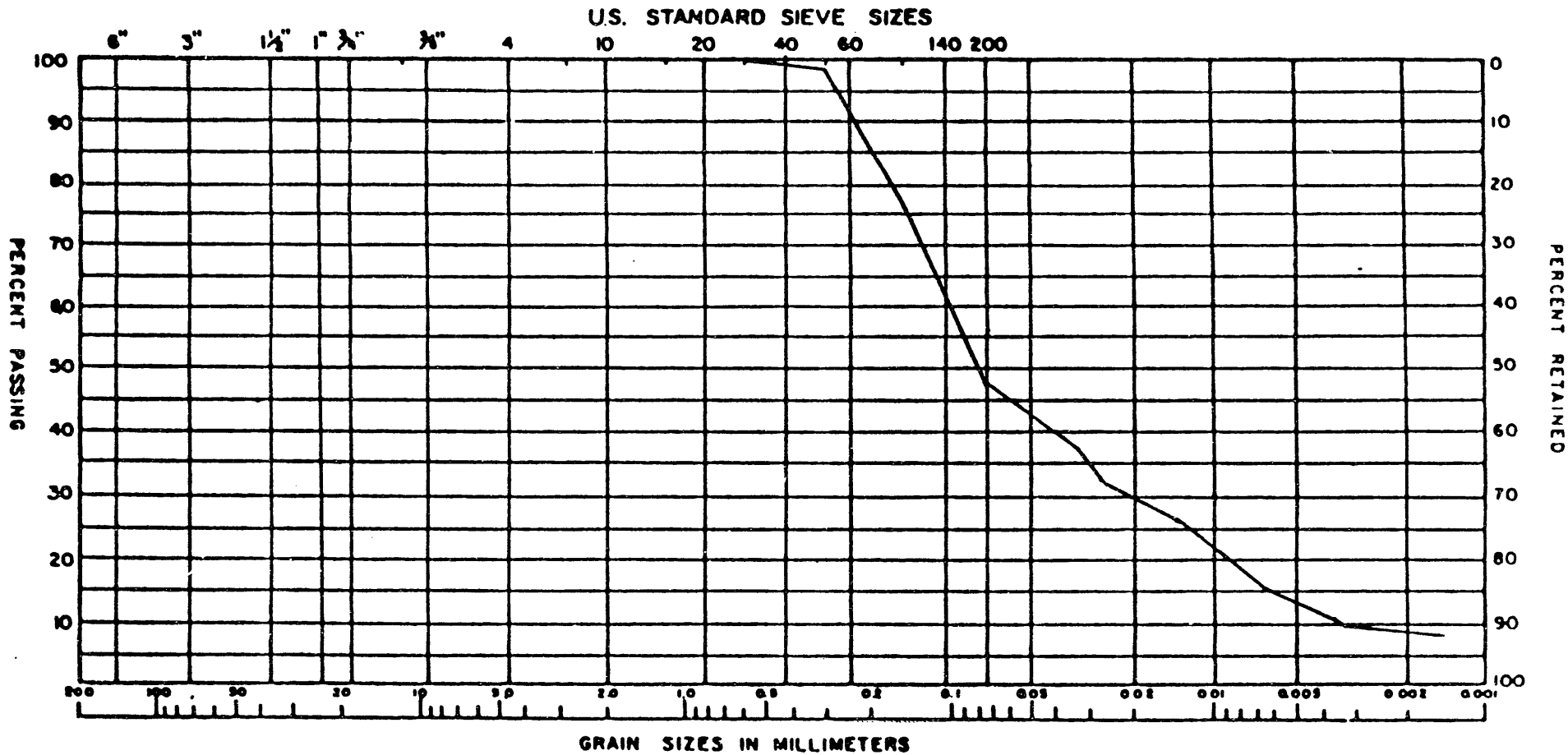
Job Number: M8705 4GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNB-1	48 1/2'	NP	NP	--	--	2174
CLASSIFICATION						

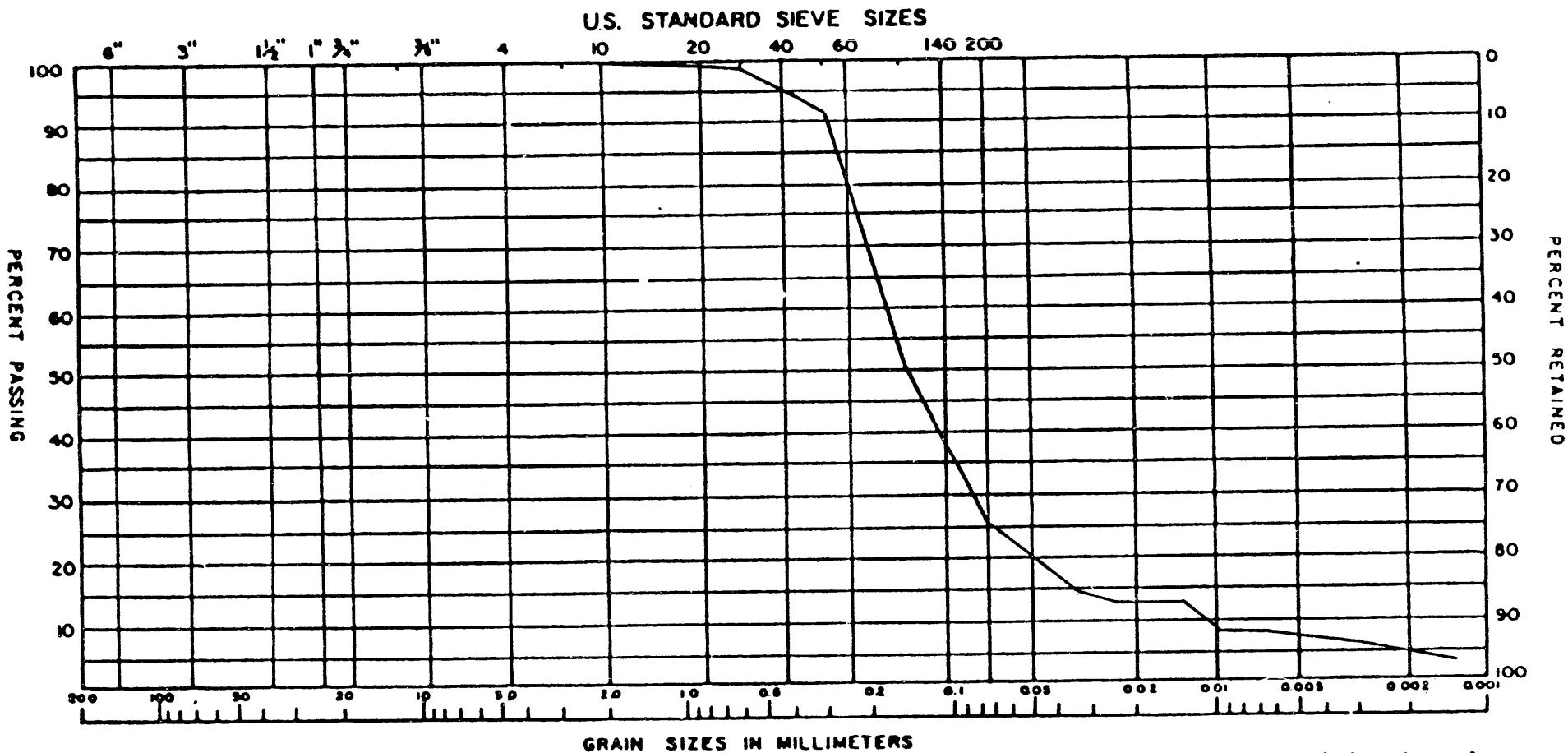
Project:

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNB-5	18' to 28'	NP	NP	2.73	9.7	2175
CLASSIFICATION						

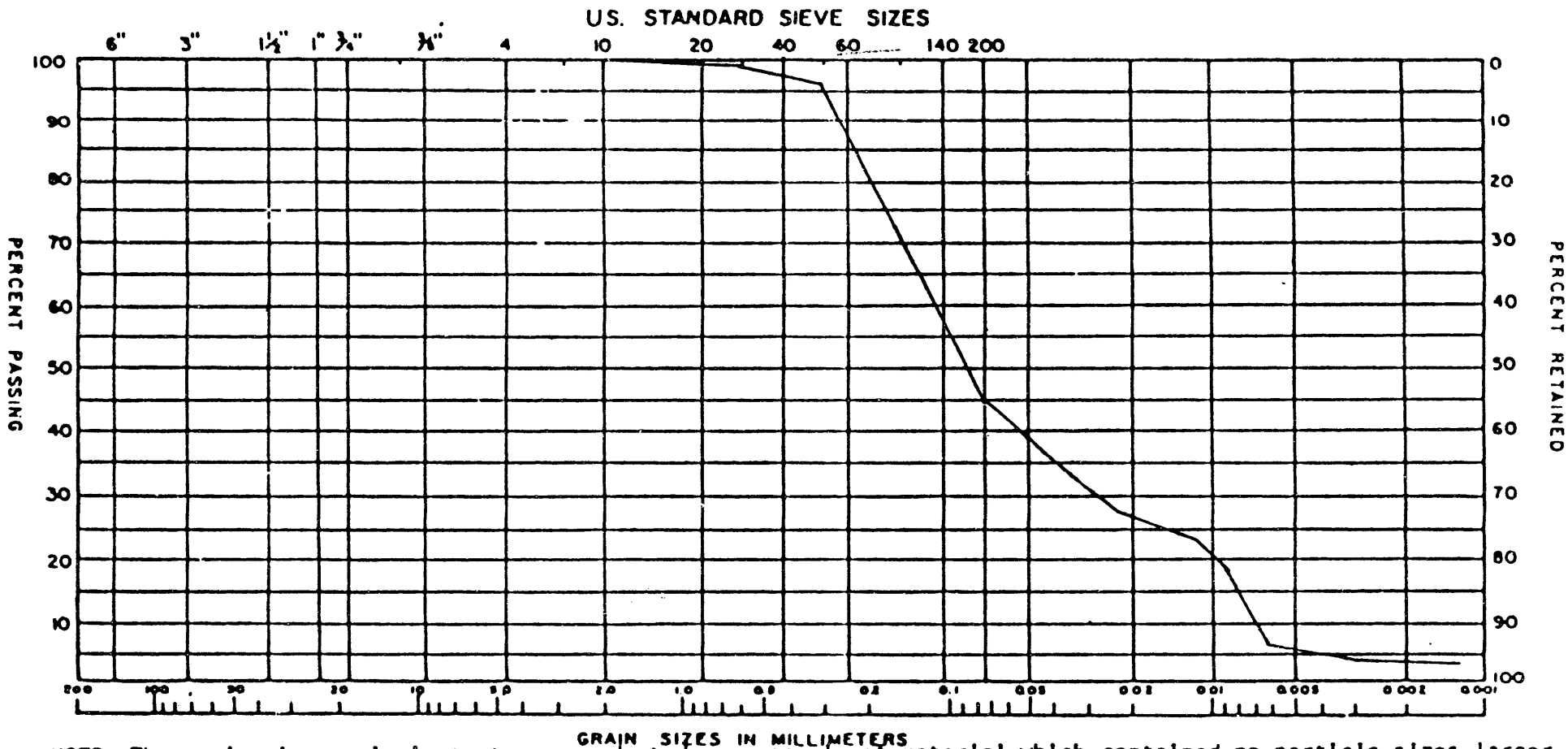
Project: RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



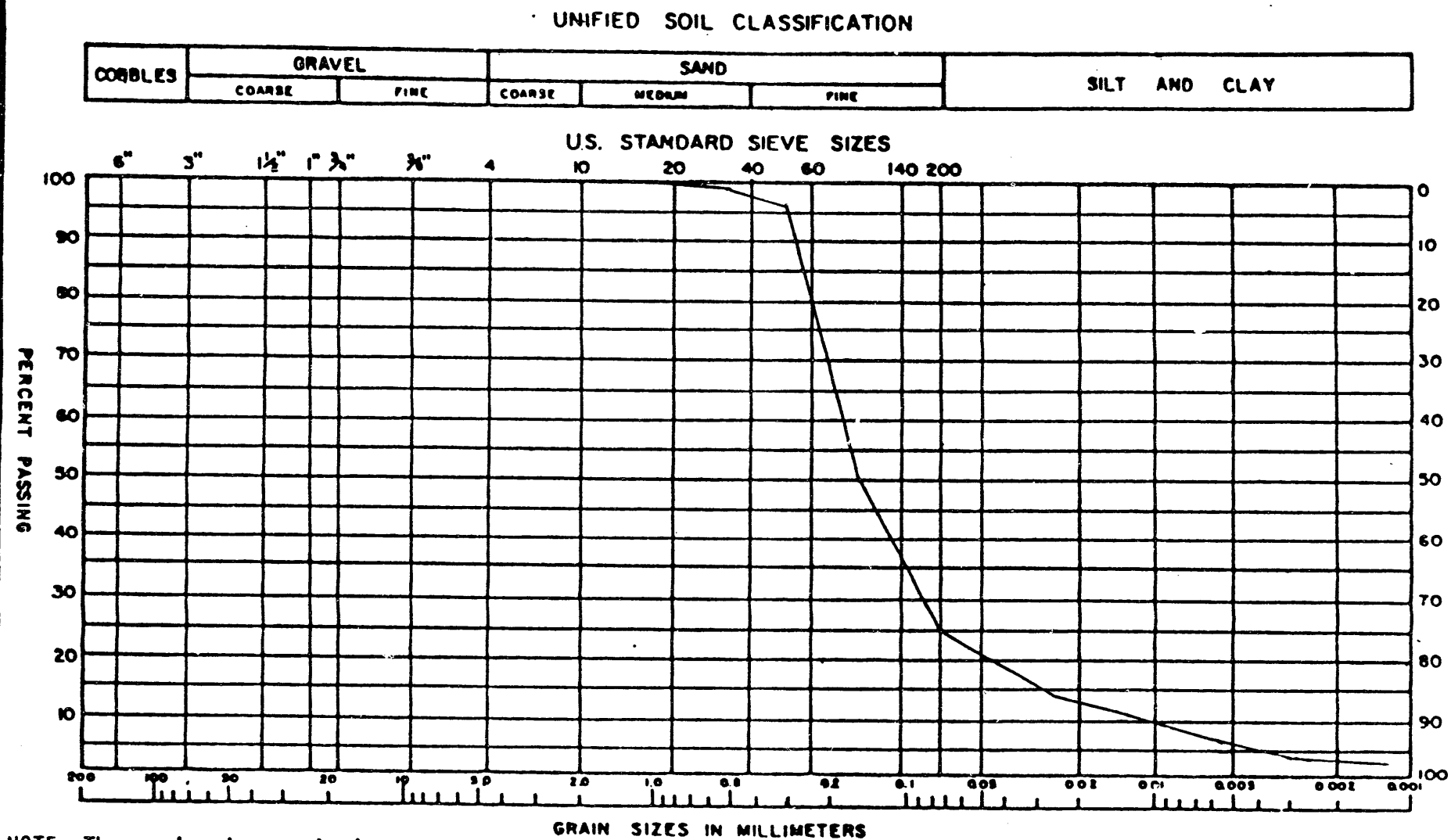
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNB-5	63 to 68	--	--	----	16.1	2176
CLASSIFICATION						

Project: RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNB 6	9 - 19	NP	NP	2.77	8.8	2177
CLASSIFICATION						

Fig.

Project: Rifle-RFL-87-01

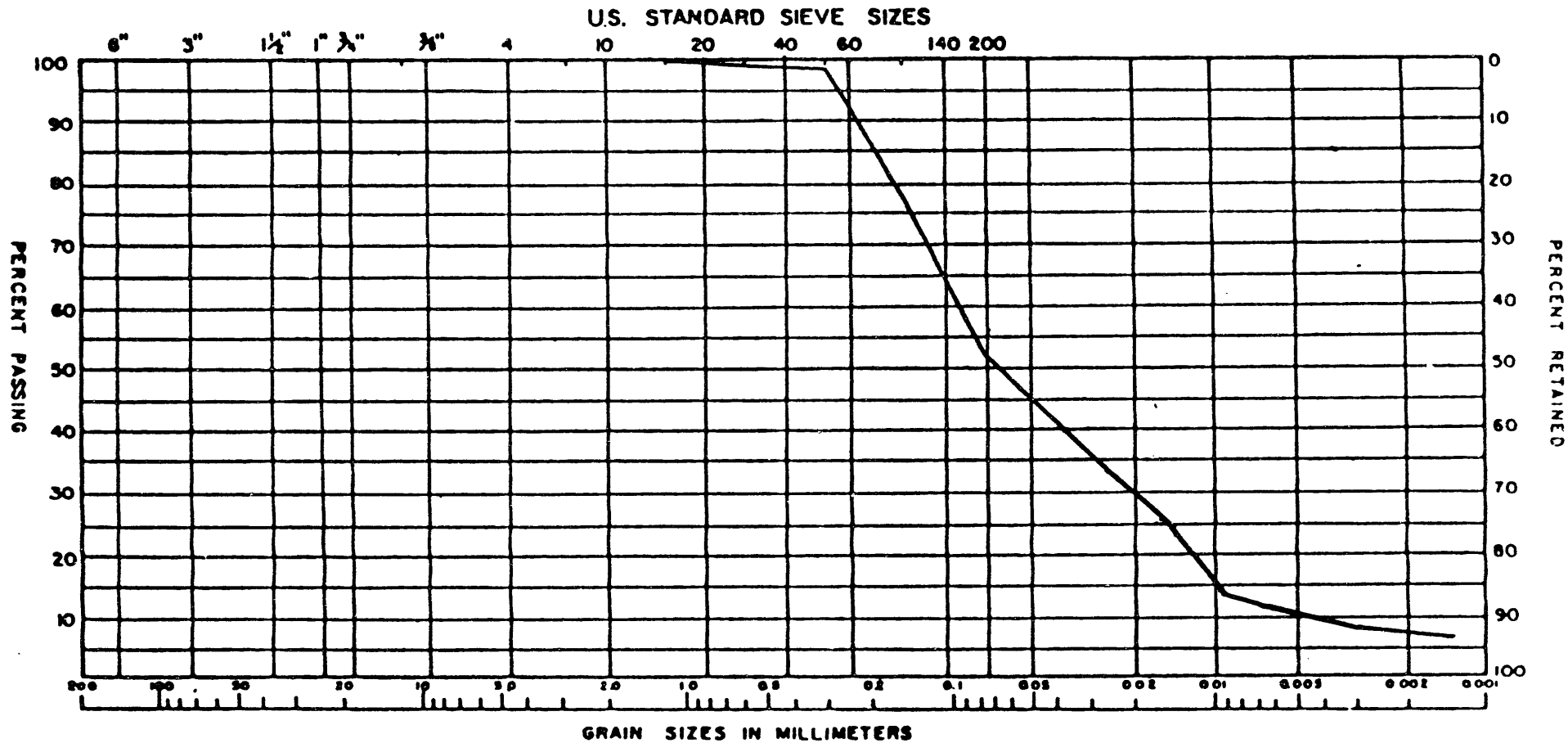
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

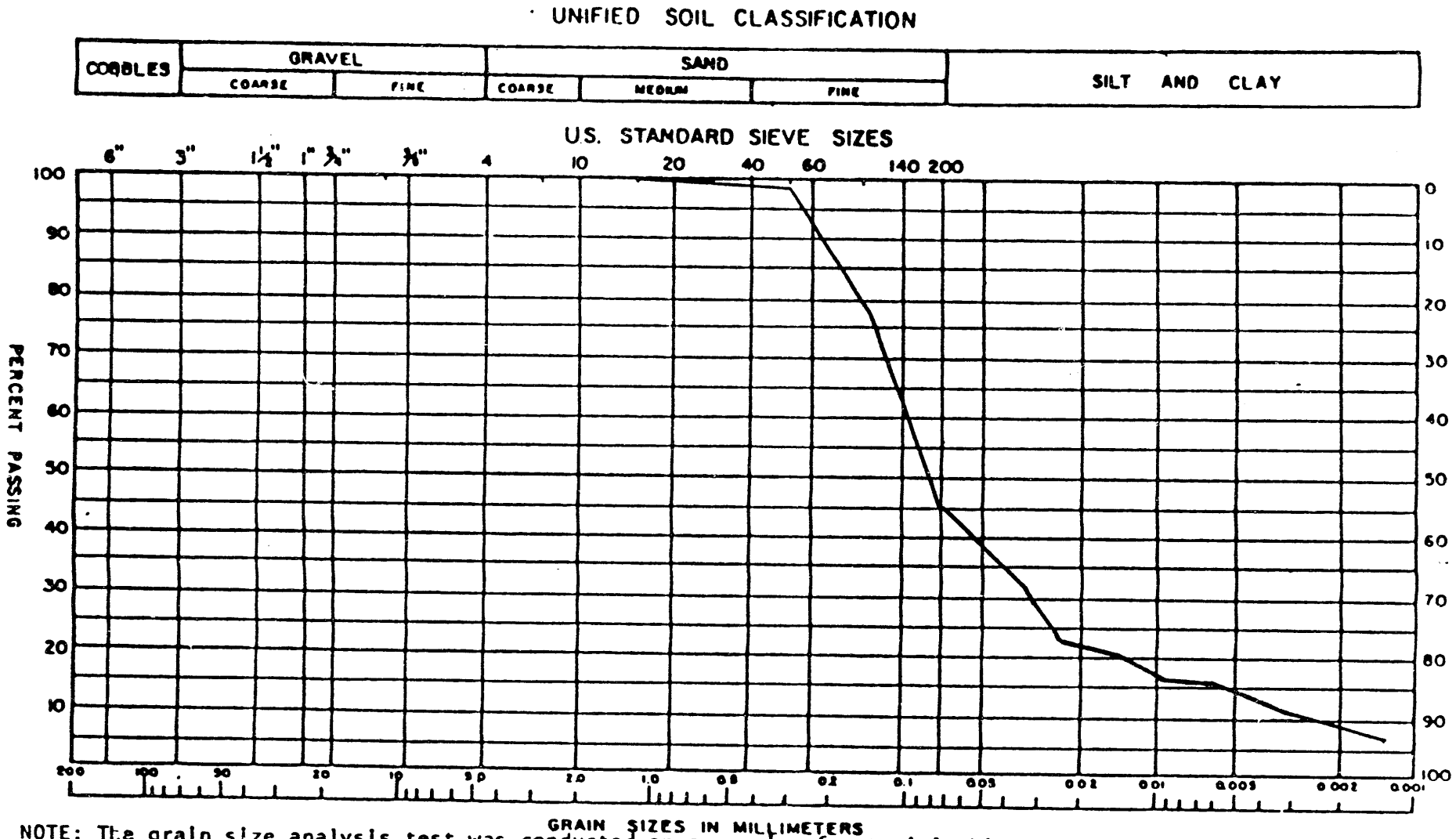
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNB-6	29' to 39'	NP	NP	--	18.0	2178
CLASSIFICATION						

Project: Rifle-RFL-87-01

Job Number M87-54GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

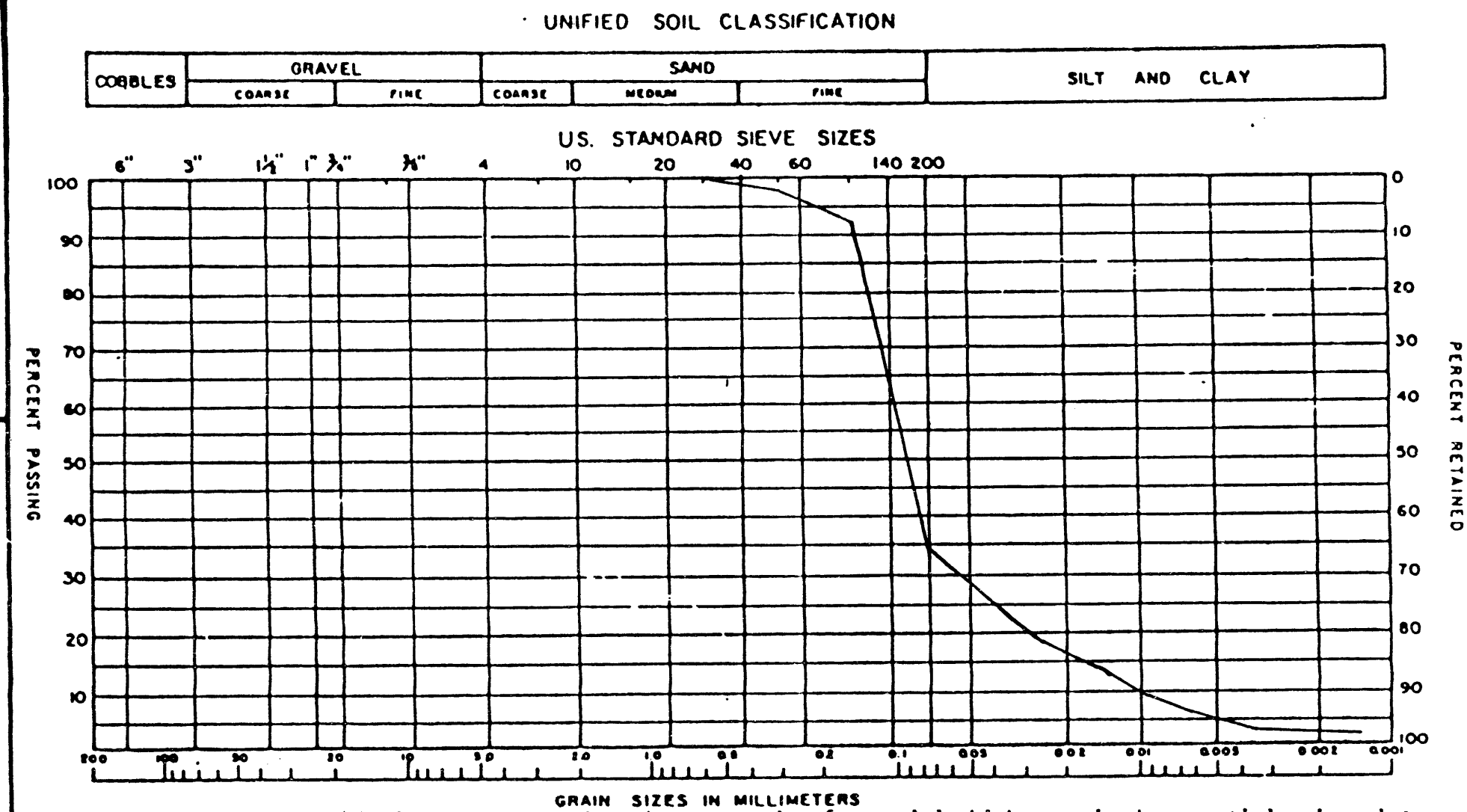


NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNB-6	49	NP	NP	--	15.6	2179
CLASSIFICATION						

Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNB-7	11' to 19'	--	--	--	11.3	2180
CLASSIFICATION						

Fig

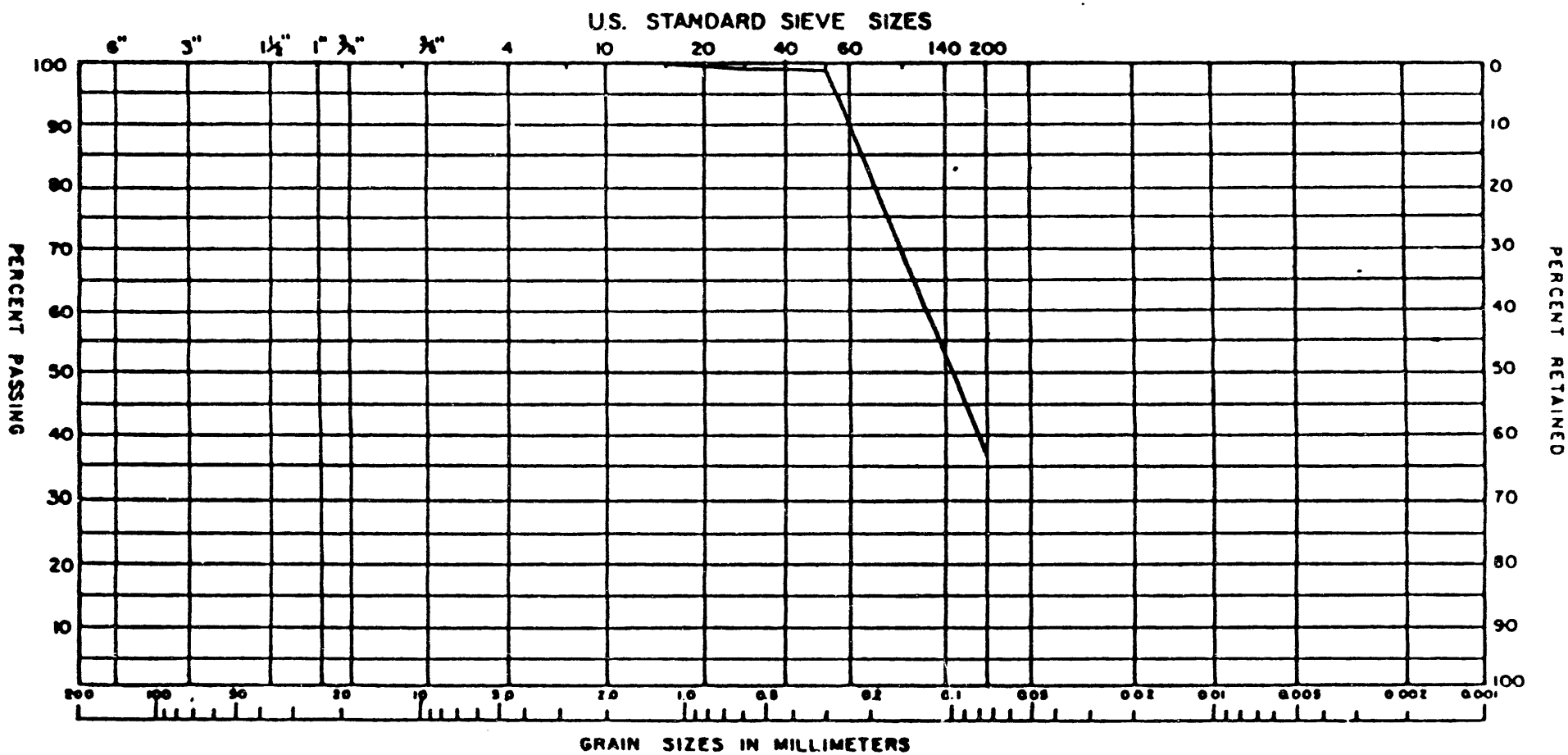
Project: Rifle-RFL-87-01
Job Number: M8705408

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

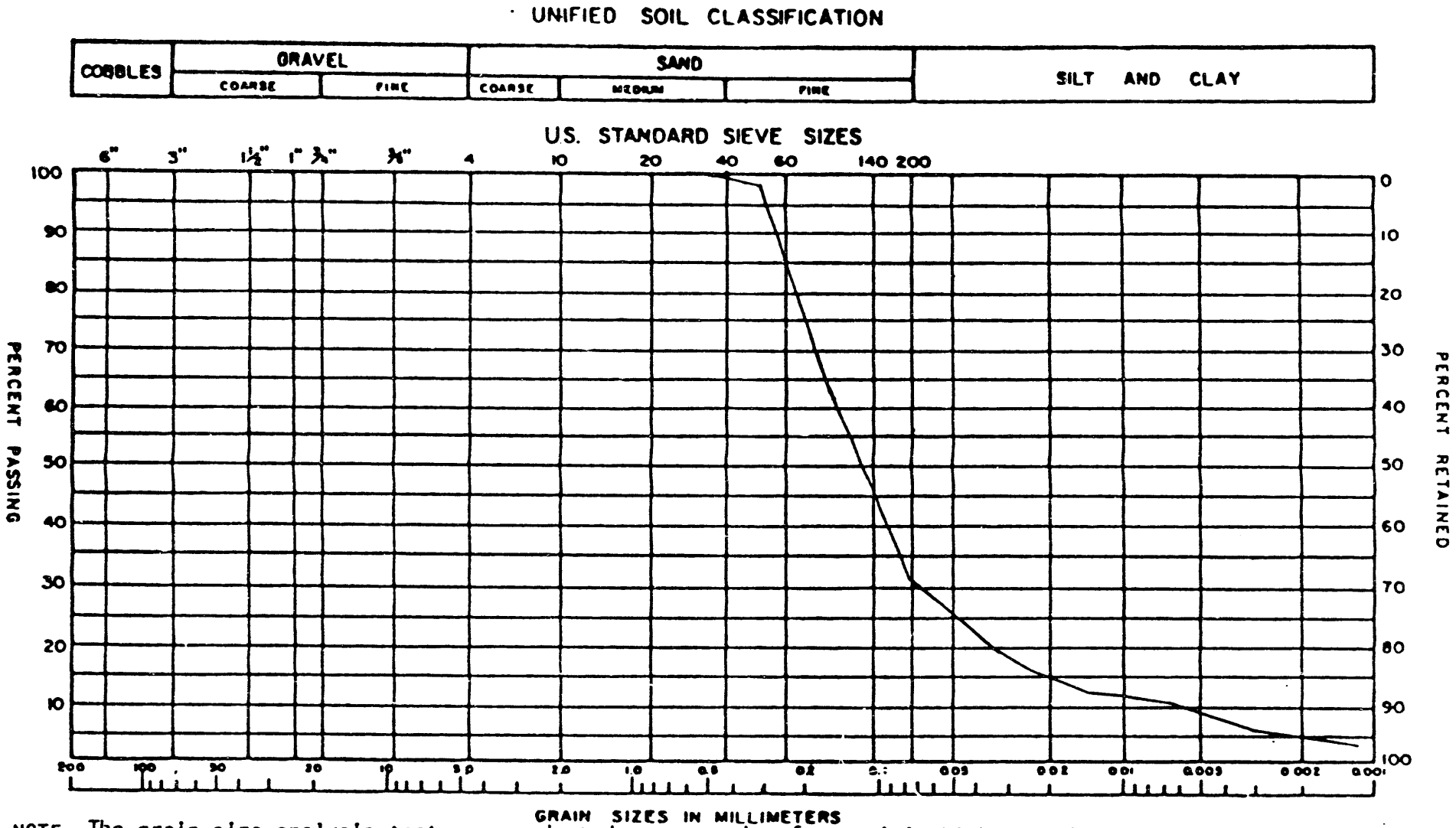
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNB-7	19' to 29'	--	--	----	10.3	2181
CLASSIFICATION						

Project: RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNB 7	29-39	--	--	2.72	9.5	2182
CLASSIFICATION						

Project: Rifle-RFL-87-01

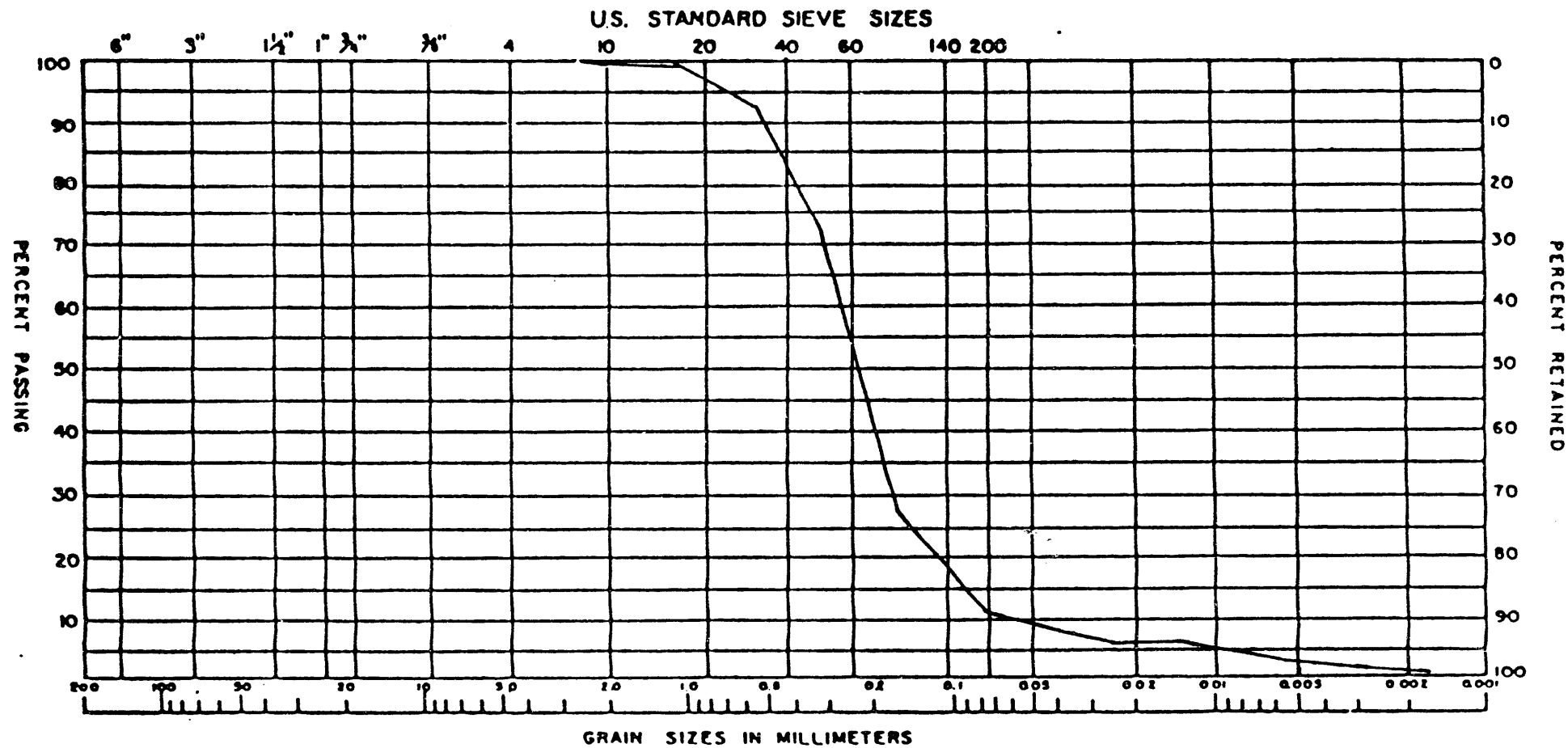
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	
MOB-1	2½' to 7½'	NP	NP	2.70	4.9	2152
CLASSIFICATION						

Project: Rifle-RFL-87-01

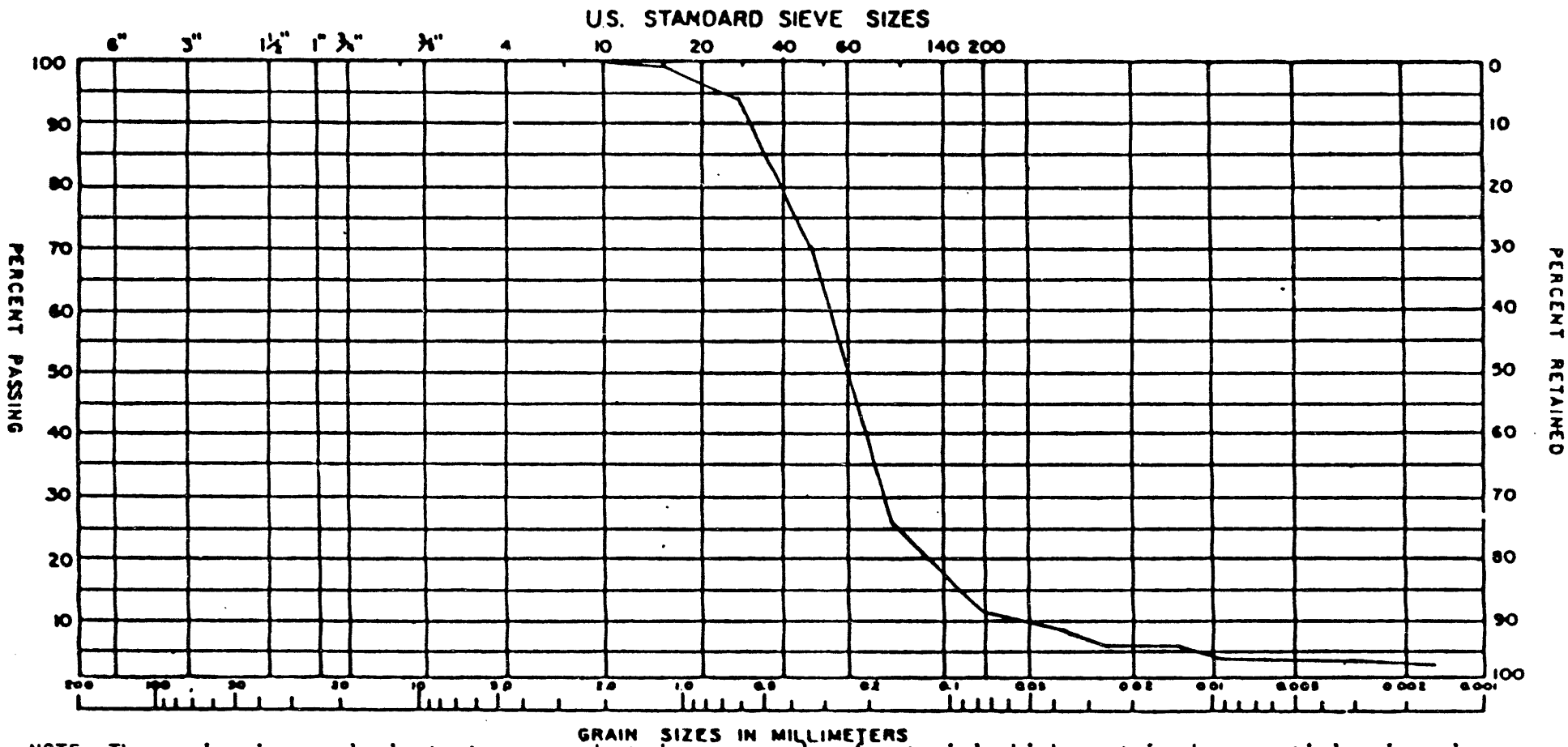
Lab Number: MR7-54CF

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB-1	7½' to 12½'	--	--	--	--	2153
CLASSIFICATION						

Project: RFL-87-01, Rifle, Colorado

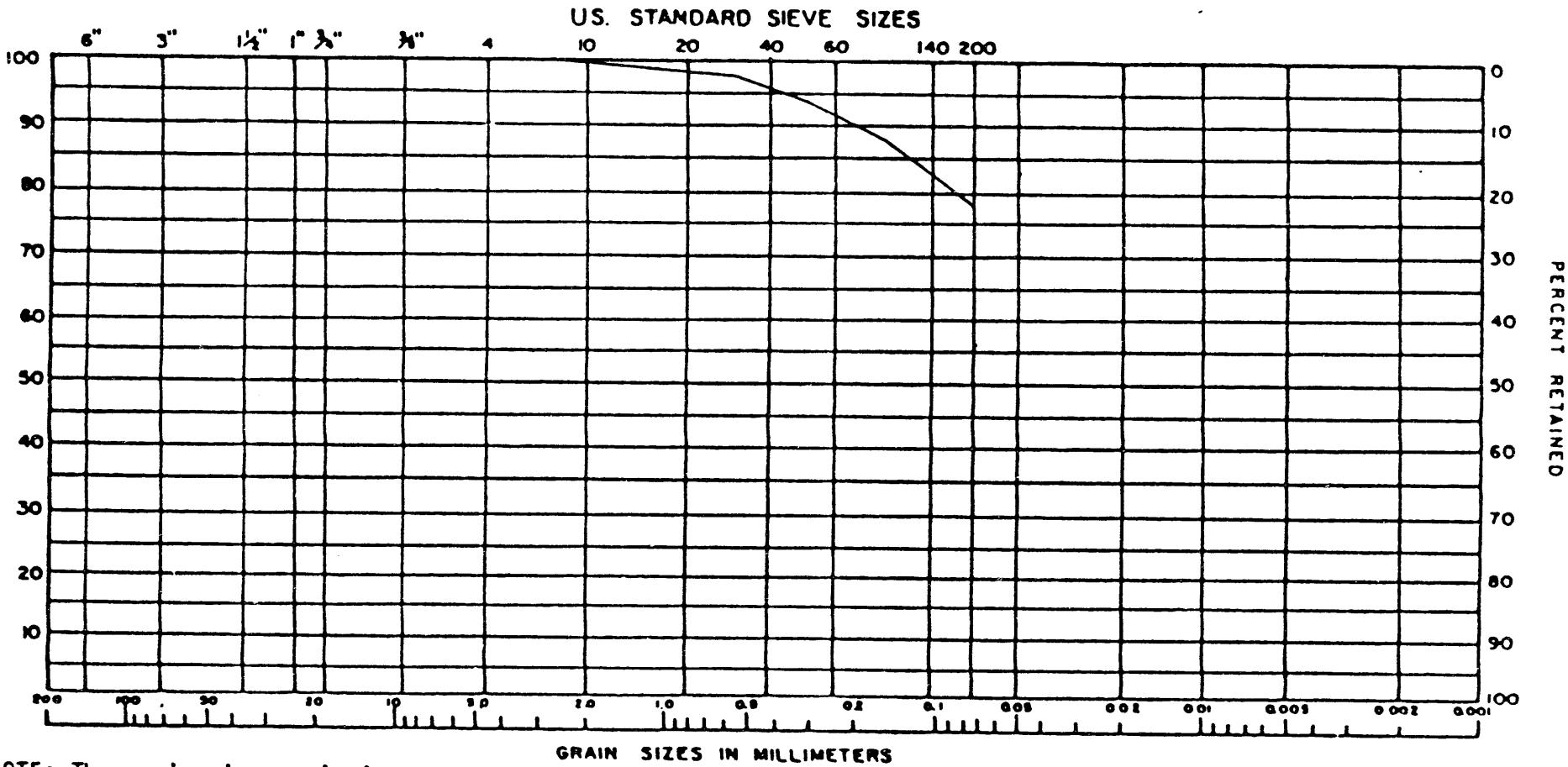
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



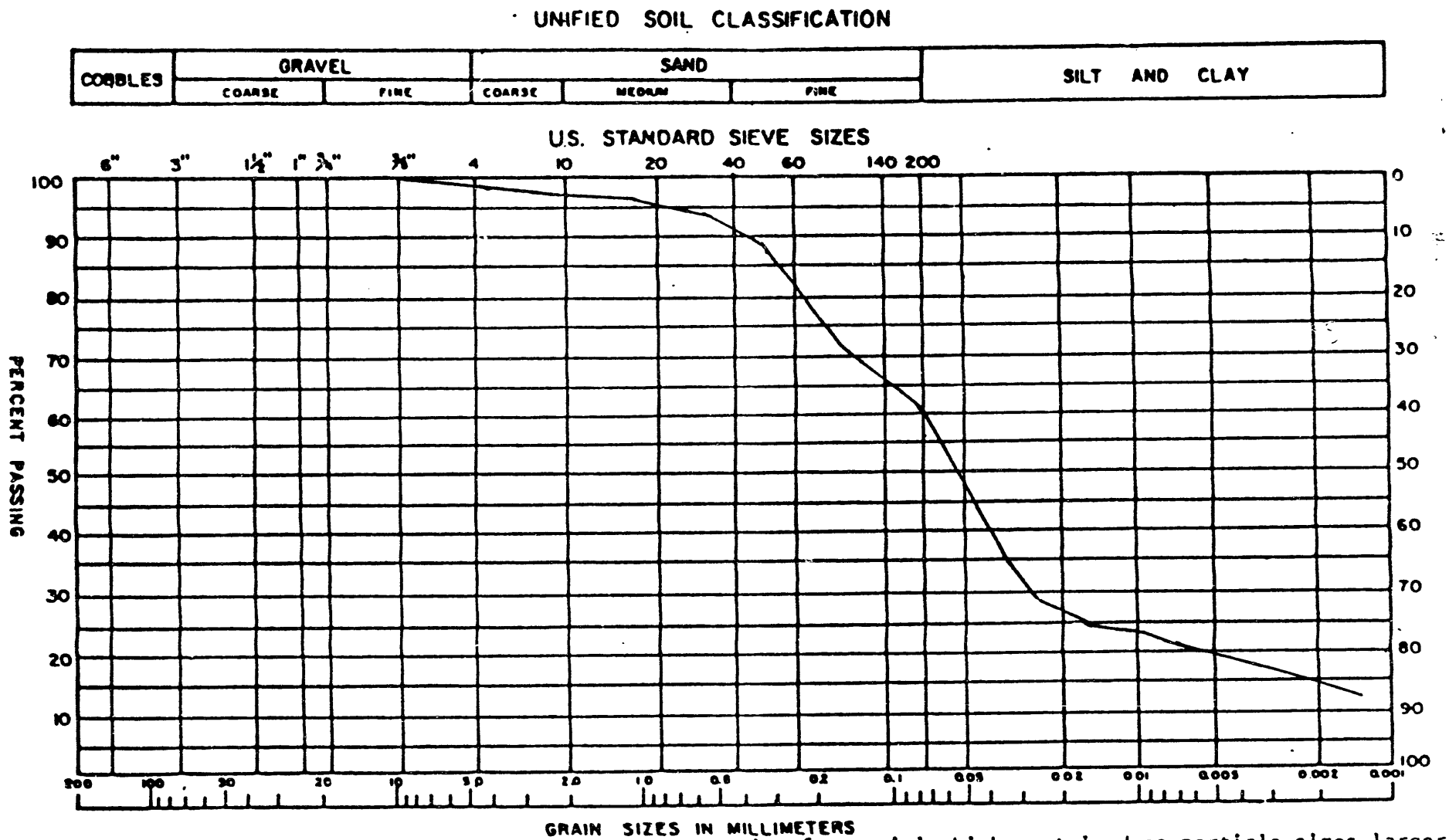
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB 1	20	--	--	----	41.5	2154
CLASSIFICATION	Clay, silty, sandy, (CL)					

Project: RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB 3	11 1/2	24	5	----	7.4	2155
CLASSIFICATION						

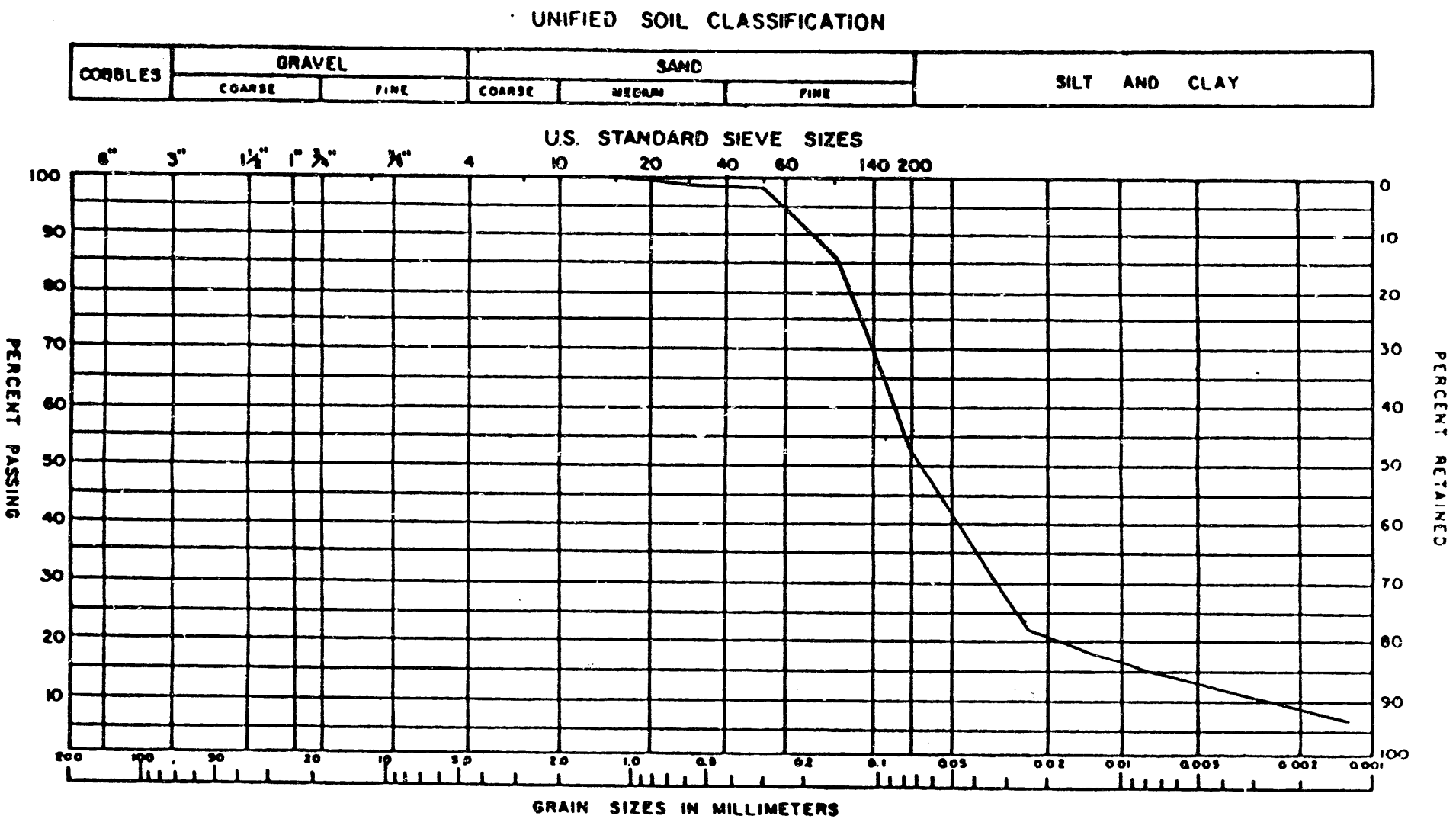
Fig

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



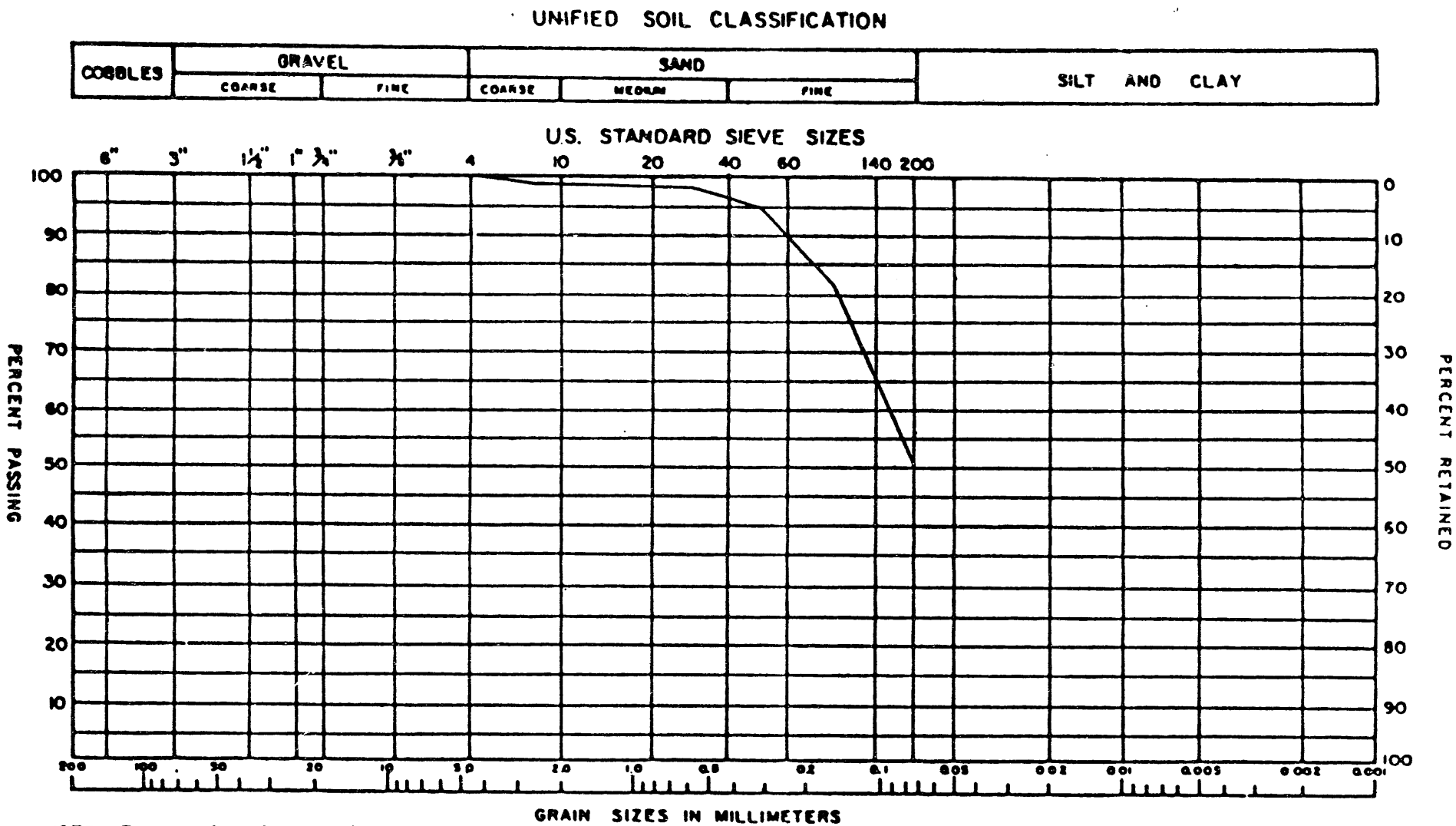
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB-3	16½'	--	--	--	--	2156
CLASSIFICATION						

Project: RFL-87-01, Rifle, Colorado

Job Number: M8705LGE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/8 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB 3	21 1/2	--	--	----	36.3	2157
CLASSIFICATION	Silt, very sandy, (SM-ML)					

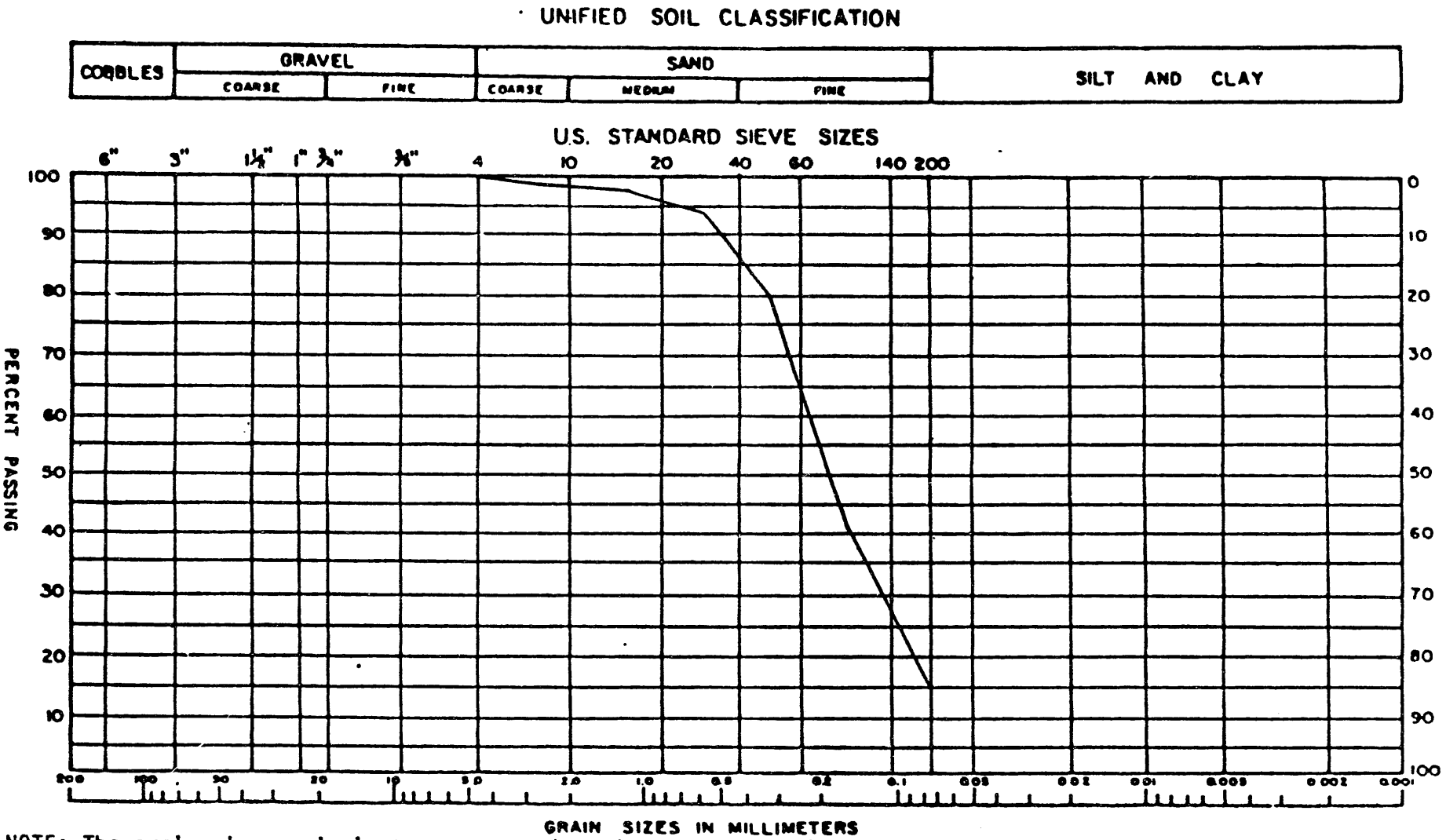
Fig

Project: RFL-87-01, Rifle, Colorado

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/8 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

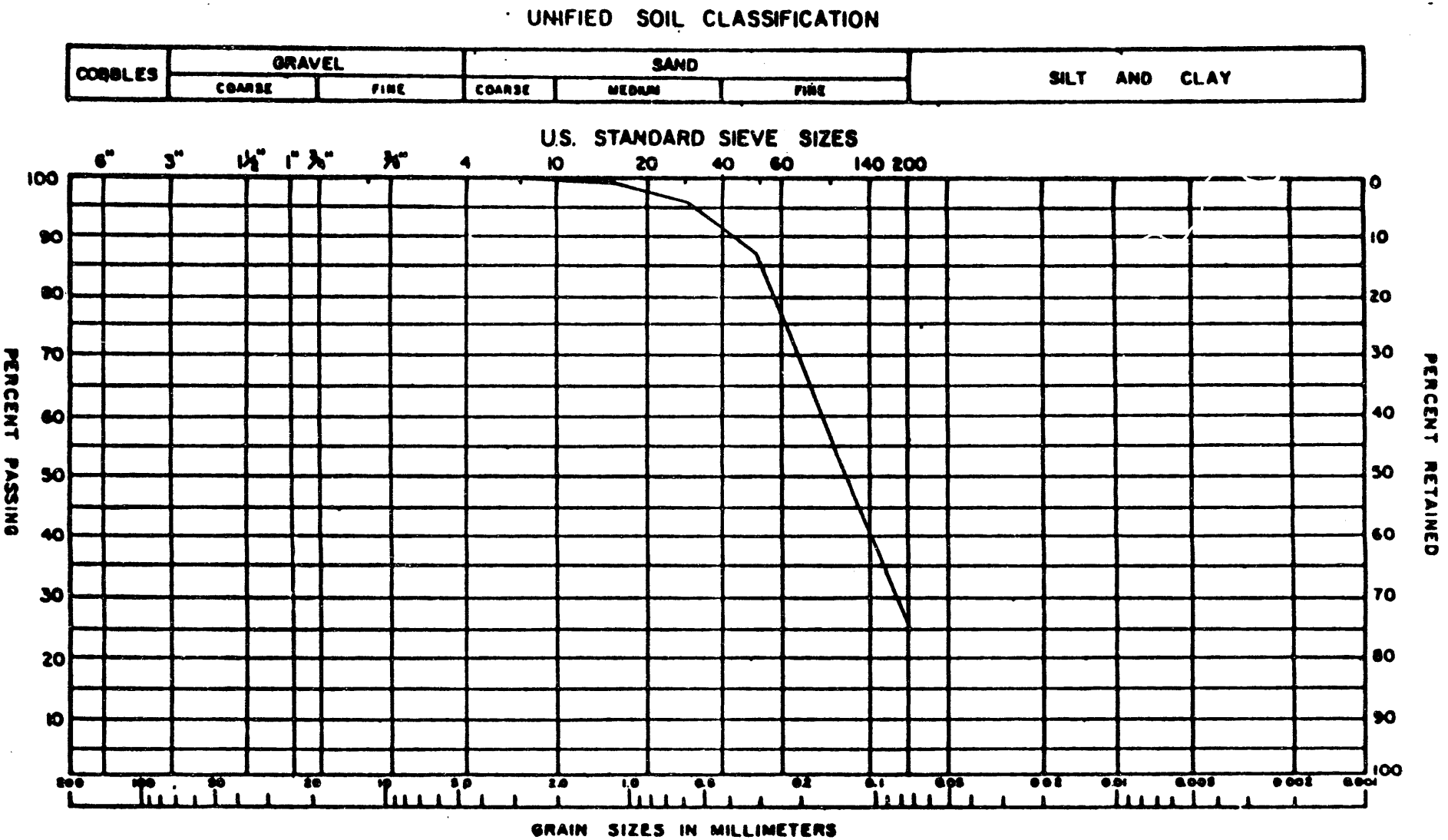
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB 4	4	--	--	----	5.5	2158
CLASSIFICATION	Sand, silty, (SP-SM)					

Project: RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

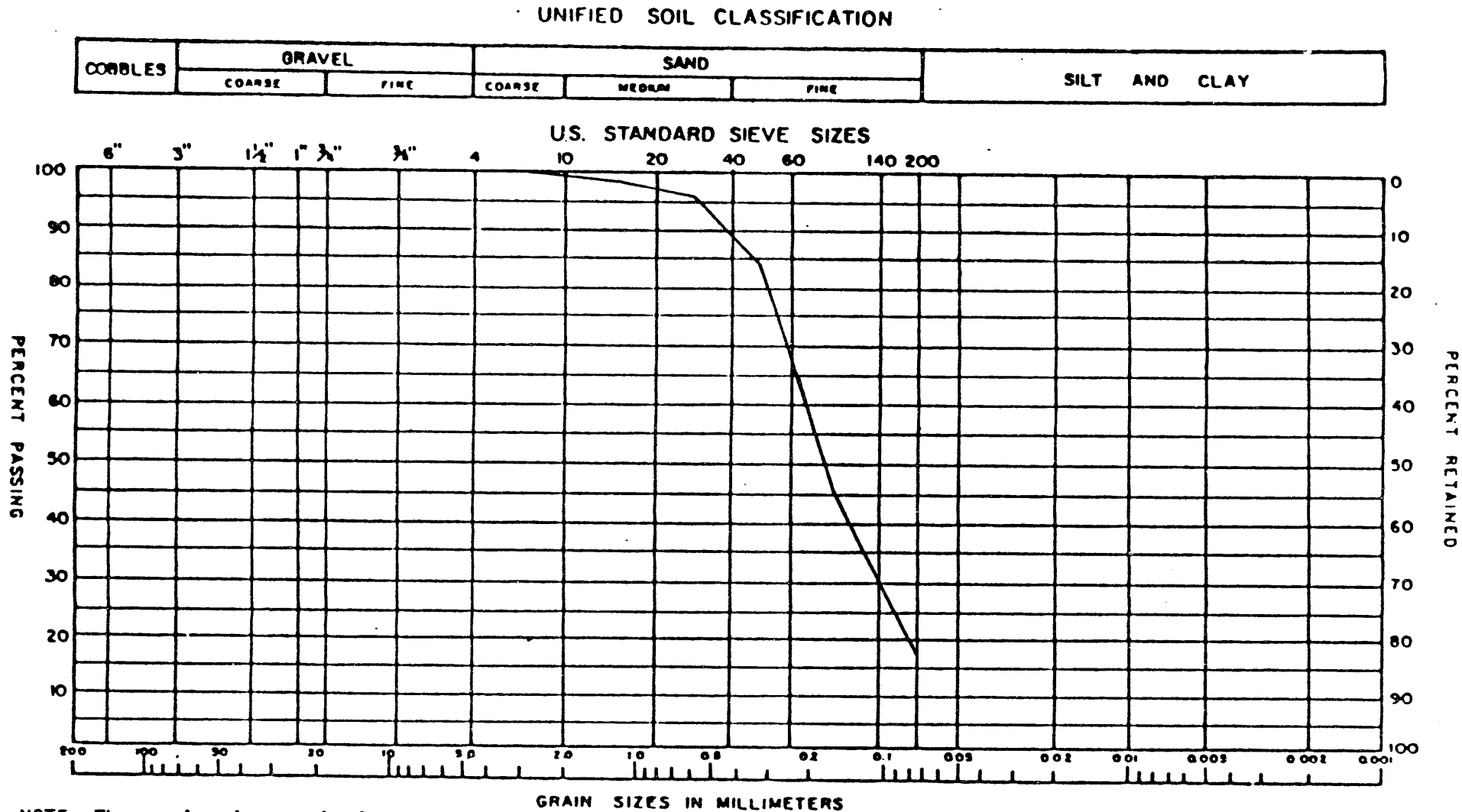


TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB-4	14' to 19'	--	--	---	11.4	2237
CLASSIFICATION						

Project: Rifle-RFL-87-01

Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB-4	9' to 14'	--	--	2.71	6.8	2159
CLASSIFICATION	Sand, silty (SP)					

Fig

Project: Rifle-RFL-87-01

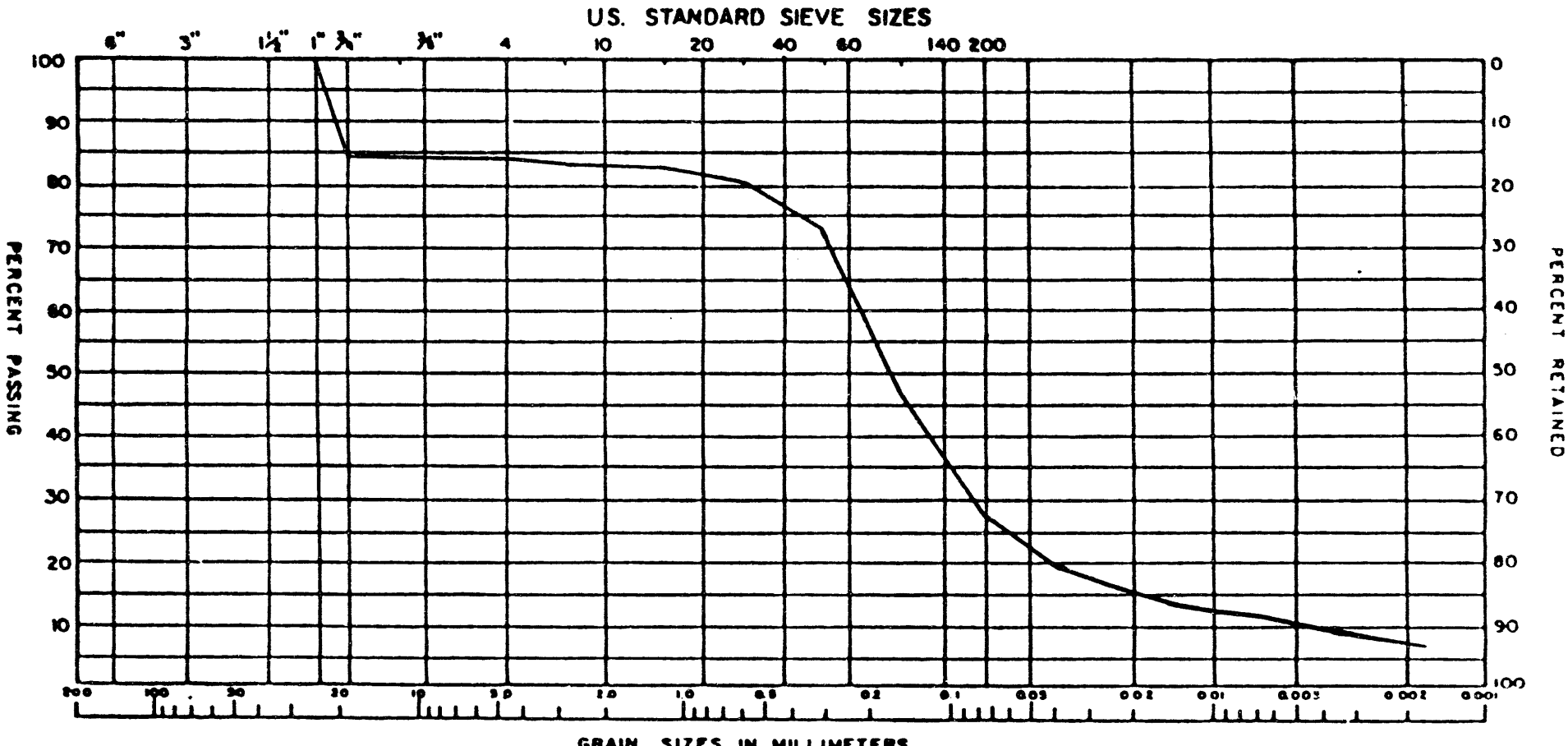
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

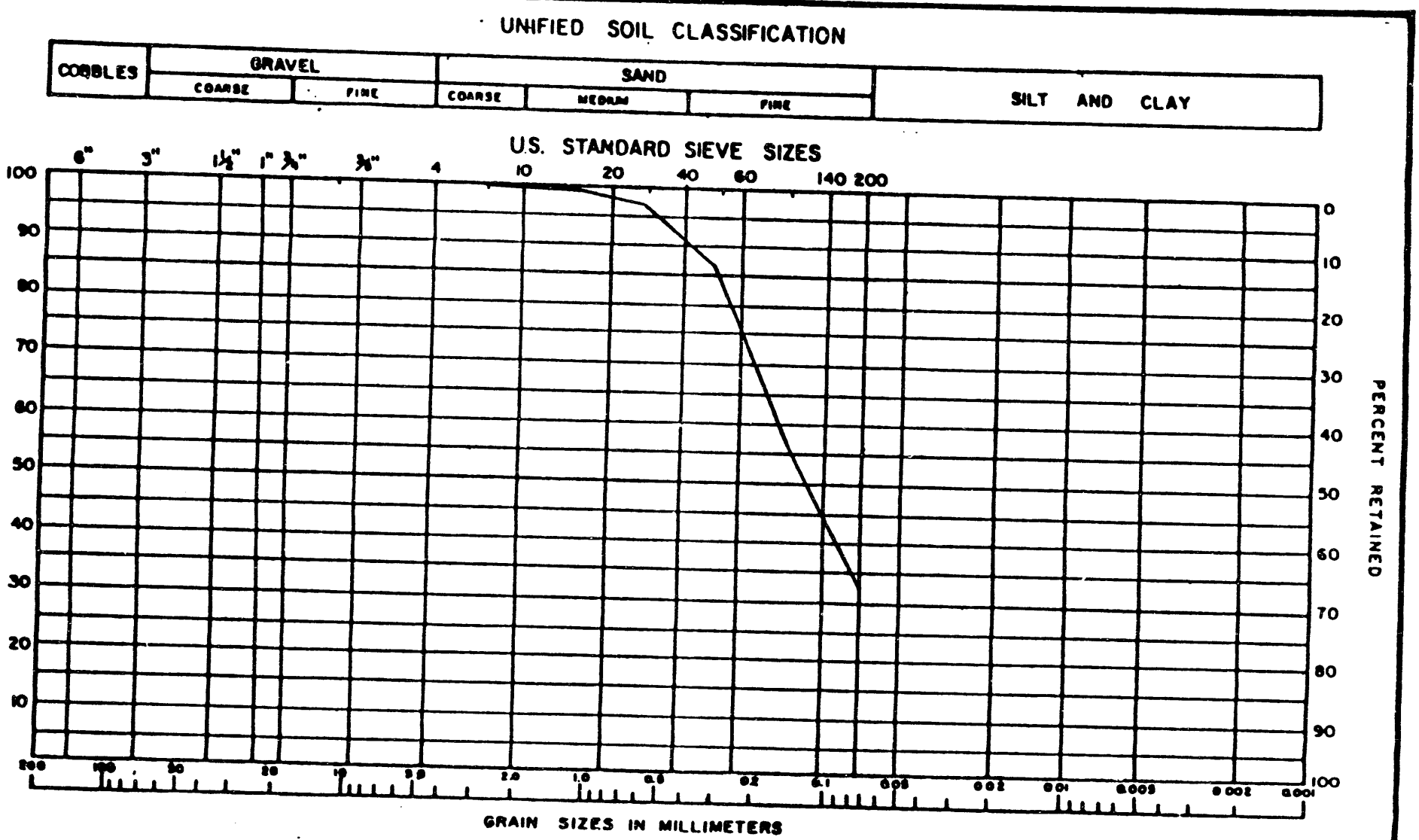
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB-4	24'	NP	NP	- -	--	2160
CLASSIFICATION						

Project: RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



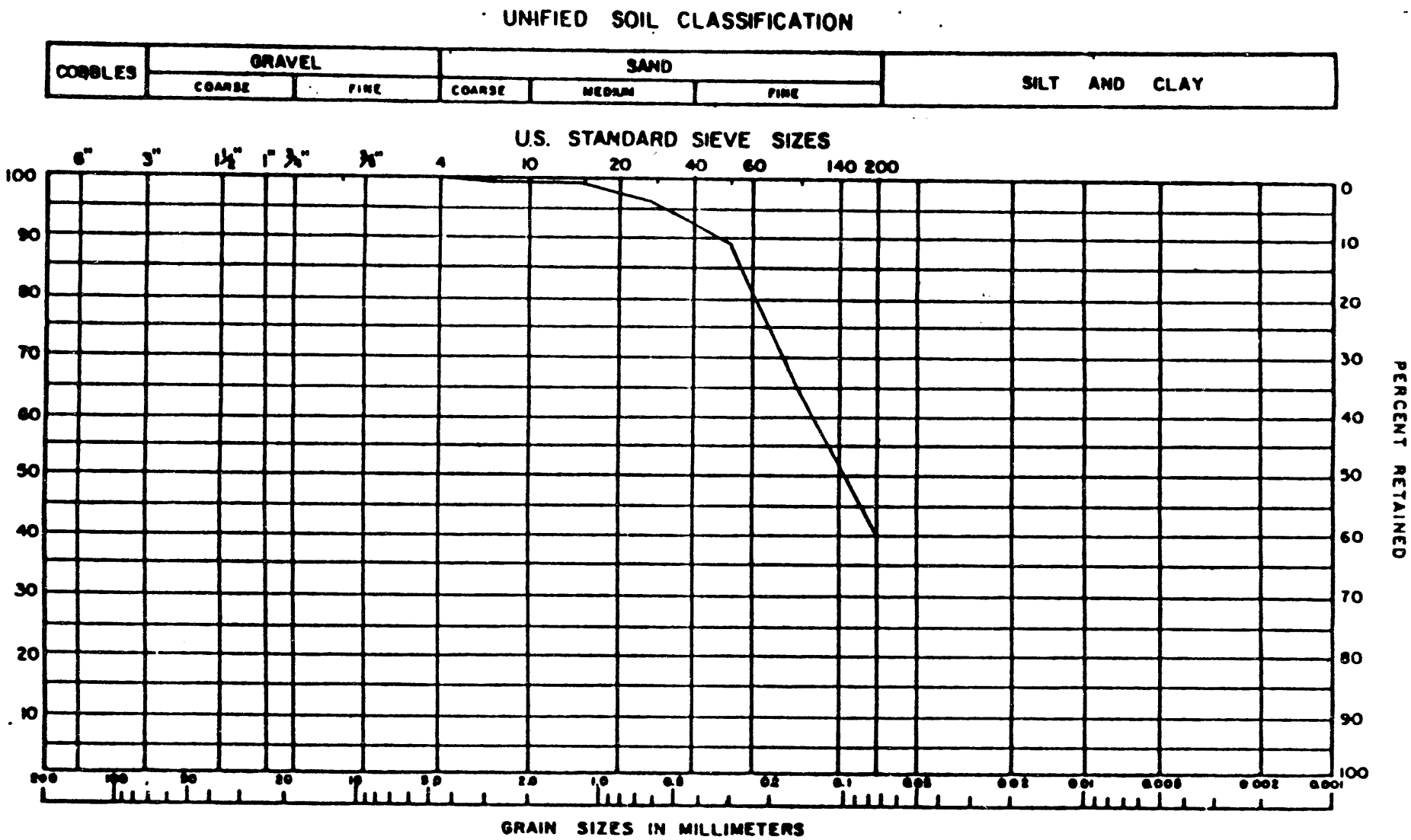
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
C-1	Blend	--	--	----	6.5	2237
CLASSIFICATION Blend of MOB 14 at 9 to 14 and 14 to 19 feet with 30 to 40 percent fines						

Project: RFL-87-01

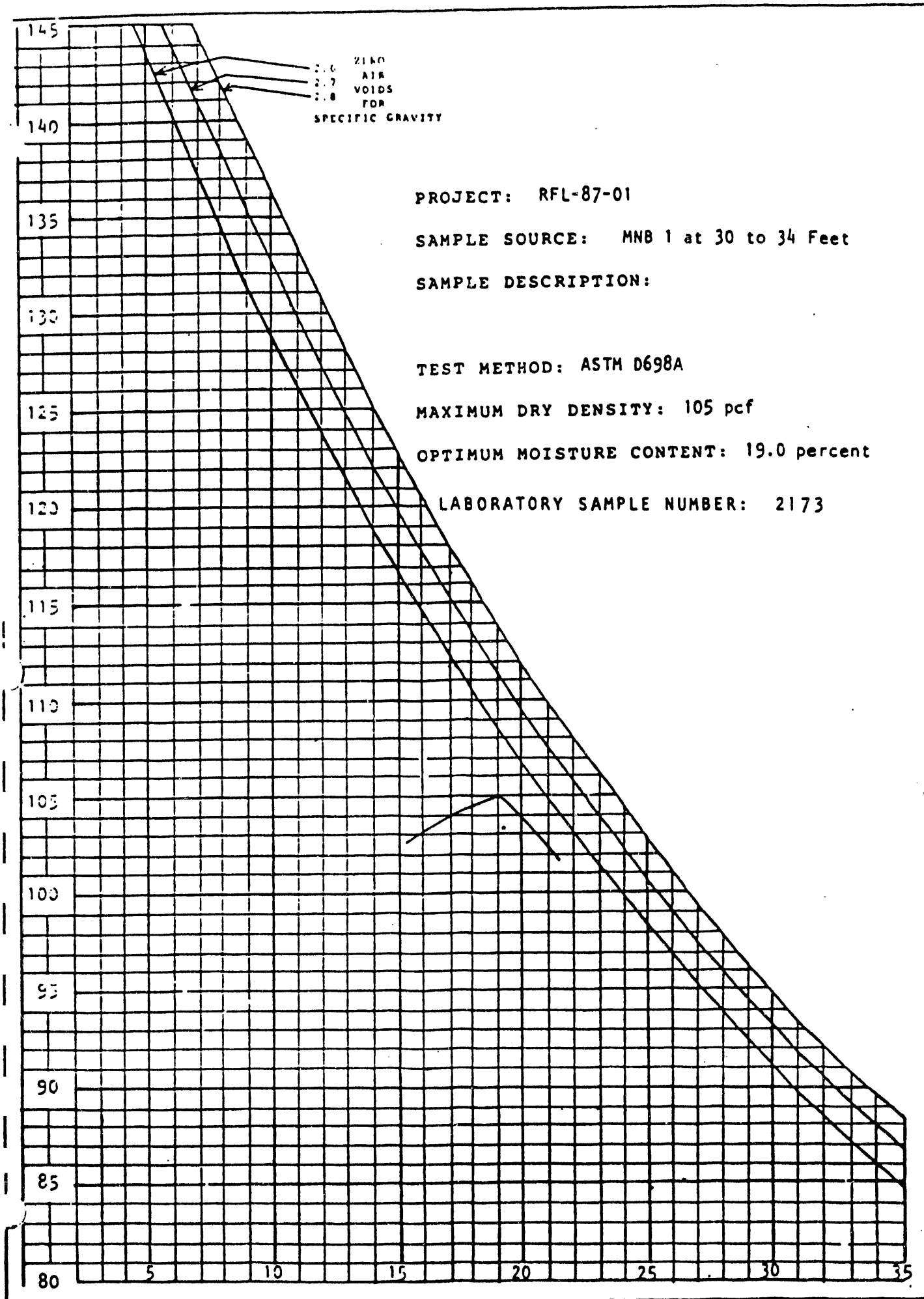
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
C-2	Blend	--	--	----	10.6	2238
CLASSIFICATION	Blend of MOB 14 at 9 to 14 and 14 to 19 feet with 40 to 50 percent fines					



PROJECT: RFL-87-01

SAMPLE SOURCE: MNB 1 at 30 to 34 Feet

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 105 pcf

OPTIMUM MOISTURE CONTENT: 19.0 percent

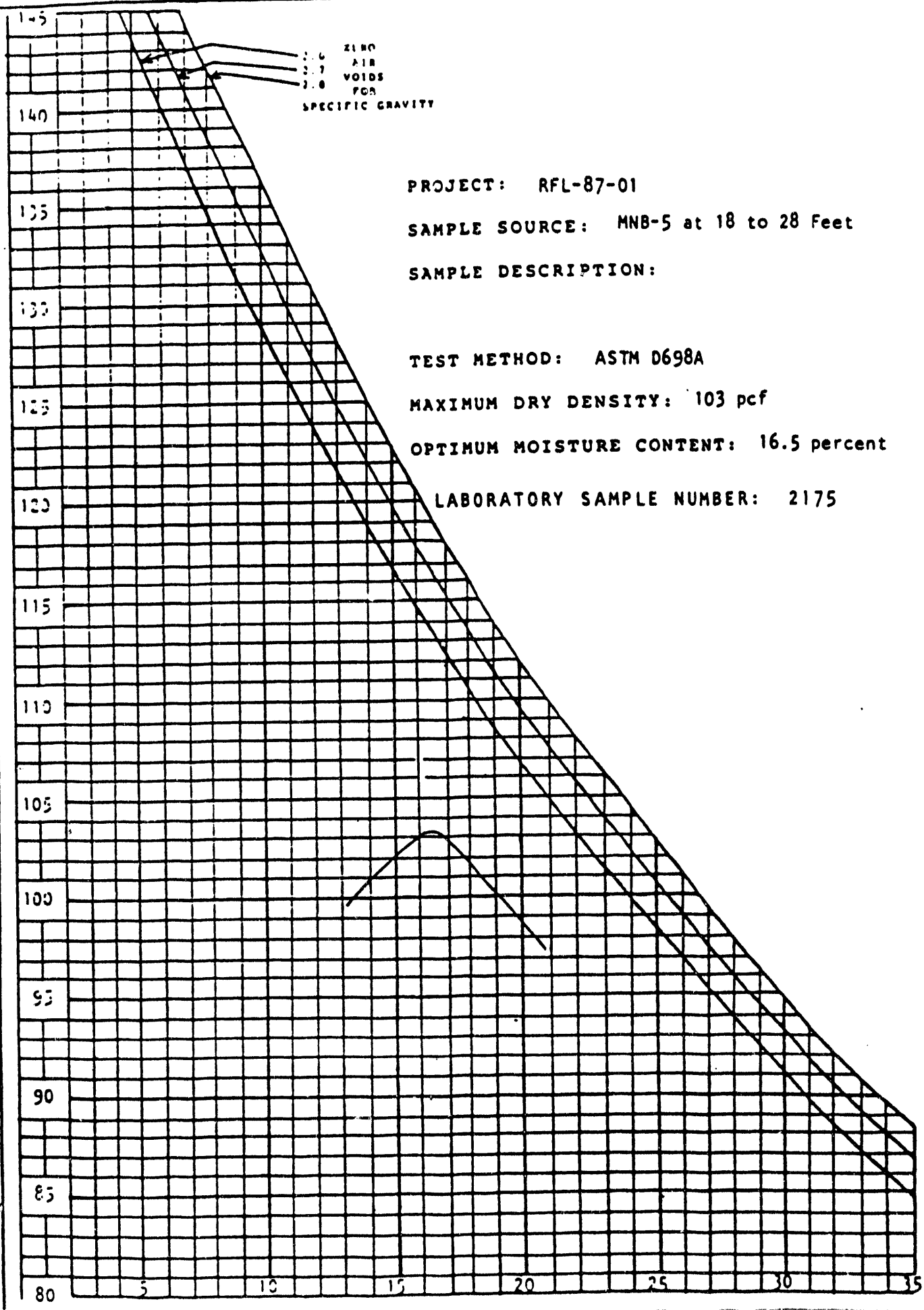
LABORATORY SAMPLE NUMBER: 2173

Lambert and Associates

Project No.: M87054GE

Date:

Figure:



PROJECT: RFL-87-01

SAMPLE SOURCE: MNB-5 at 18 to 28 Feet

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 103 pcf

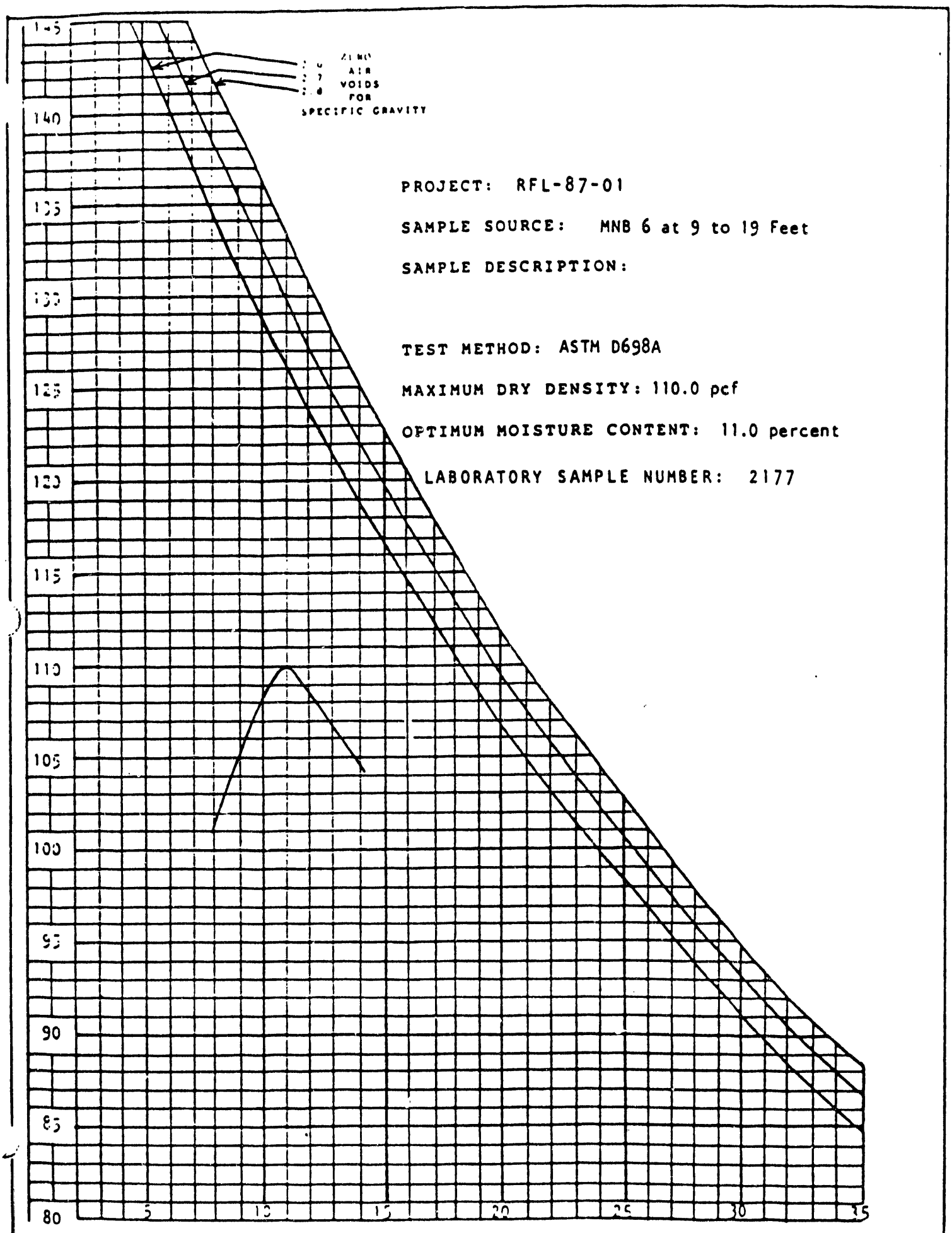
OPTIMUM MOISTURE CONTENT: 16.5 percent

LABORATORY SAMPLE NUMBER: 2175

Lambert and Associates

Project No.: M87054GE

Date:



PROJECT: RFL-87-01

SAMPLE SOURCE: MNB 6 at 9 to 19 Feet

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 110.0 pcf

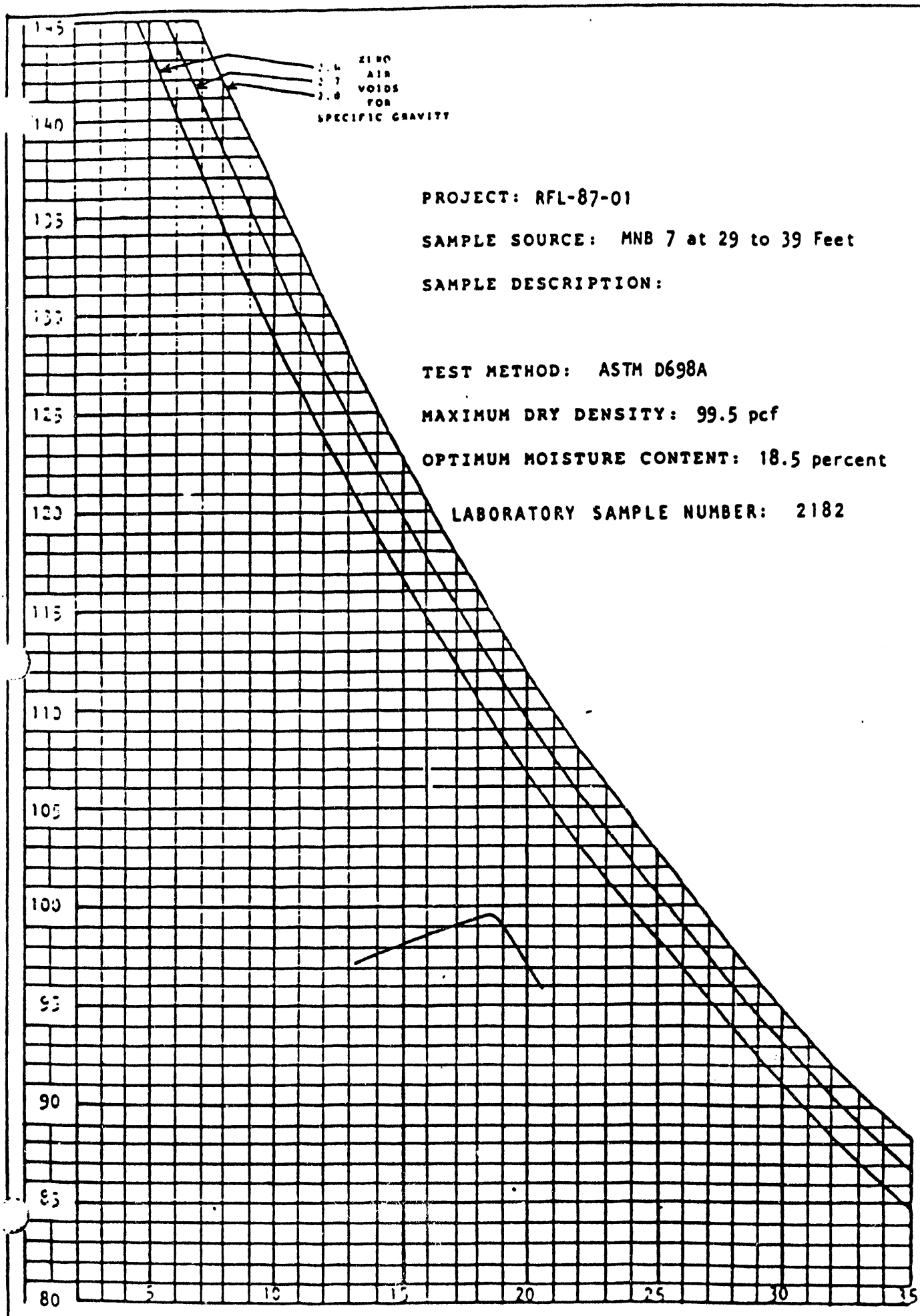
OPTIMUM MOISTURE CONTENT: 11.0 percent

LABORATORY SAMPLE NUMBER: 2177

Lambert and Associates

Project No.: M87054GE

Date:



PROJECT: RFL-87-01

SAMPLE SOURCE: MNB 7 at 29 to 39 Feet

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 99.5 pcf

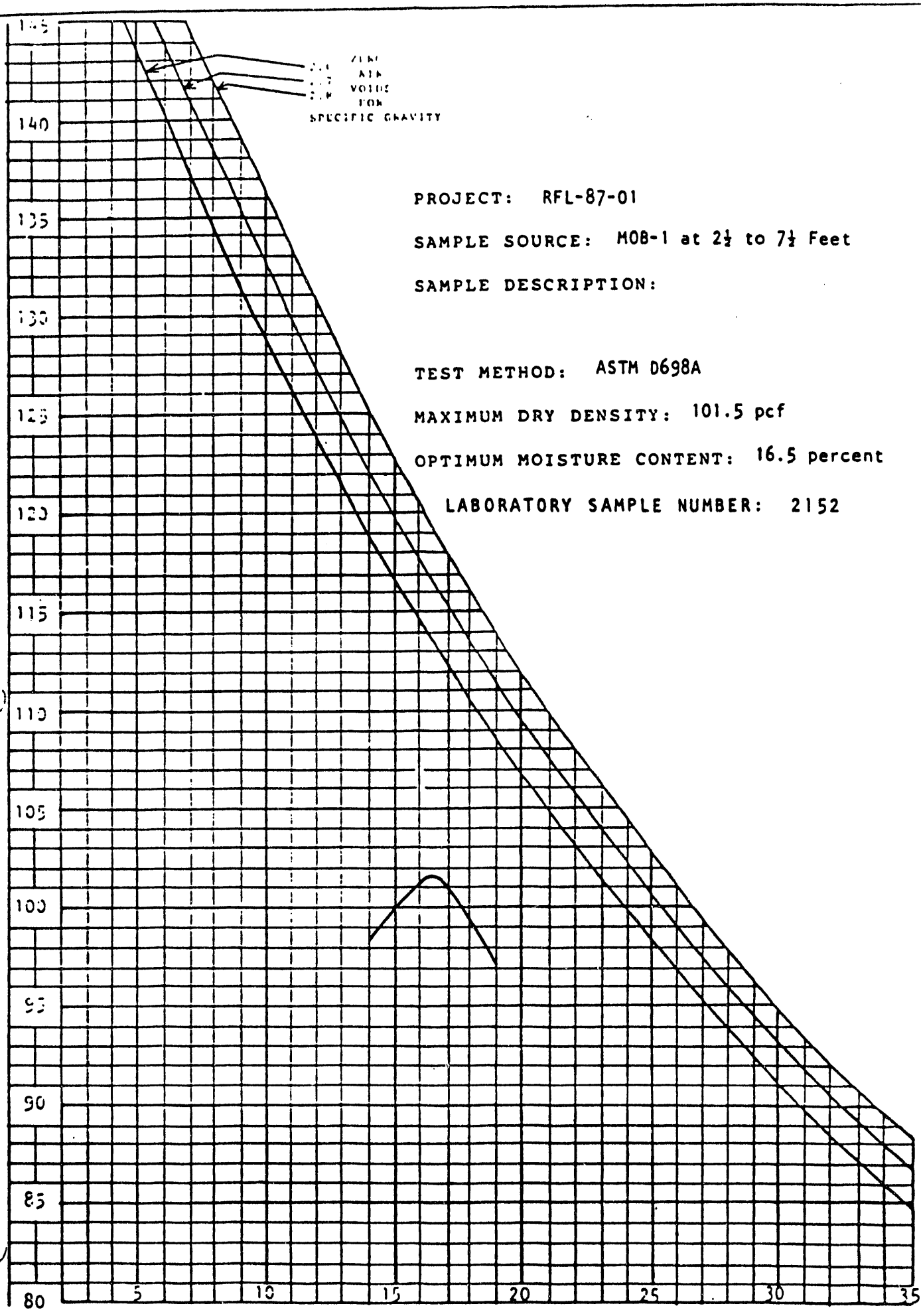
OPTIMUM MOISTURE CONTENT: 18.5 percent

LABORATORY SAMPLE NUMBER: 2182

Lambert and Associates

Project No.: M870543E

Date:



PROJECT: RFL-87-01

SAMPLE SOURCE: MOB-1 at 2½ to 7½ Feet

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

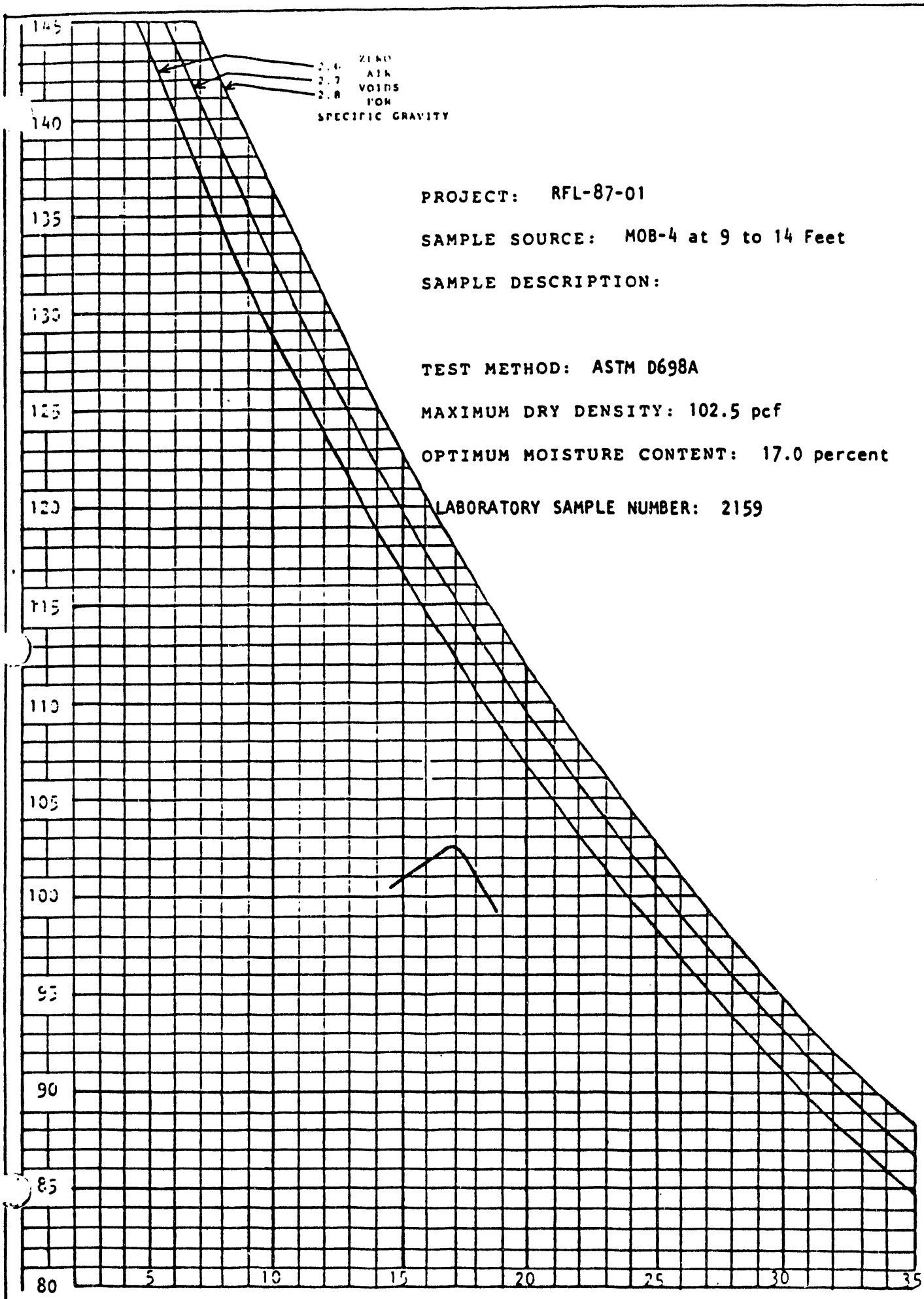
MAXIMUM DRY DENSITY: 101.5 pcf

OPTIMUM MOISTURE CONTENT: 16.5 percent

LABORATORY SAMPLE NUMBER: 2152

Lambert and Associates

Project No.:	M870543E
Date:	
Figure:	



PROJECT: RFL-87-01

SAMPLE SOURCE: MOB-4 at 9 to 14 Feet

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

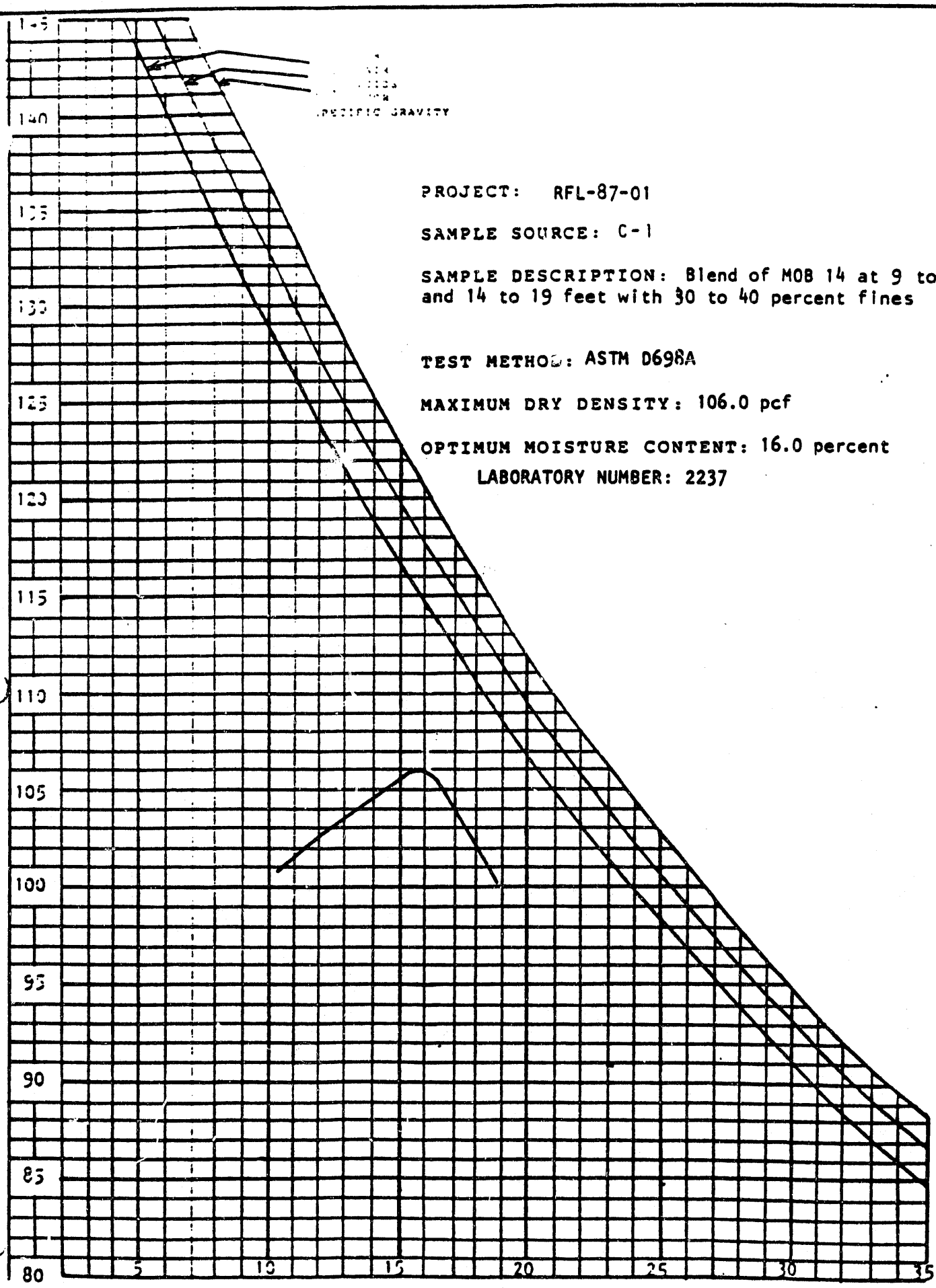
MAXIMUM DRY DENSITY: 102.5 pcf

OPTIMUM MOISTURE CONTENT: 17.0 percent

LABORATORY SAMPLE NUMBER: 2159

Lambert and Associates

Project No.: M87054GE



PROJECT: RFL-87-01

SAMPLE SOURCE: C-1

SAMPLE DESCRIPTION: Blend of MOB 14 at 9 to 14 and 14 to 19 feet with 30 to 40 percent fines

TEST METHOD: ASTM D698A

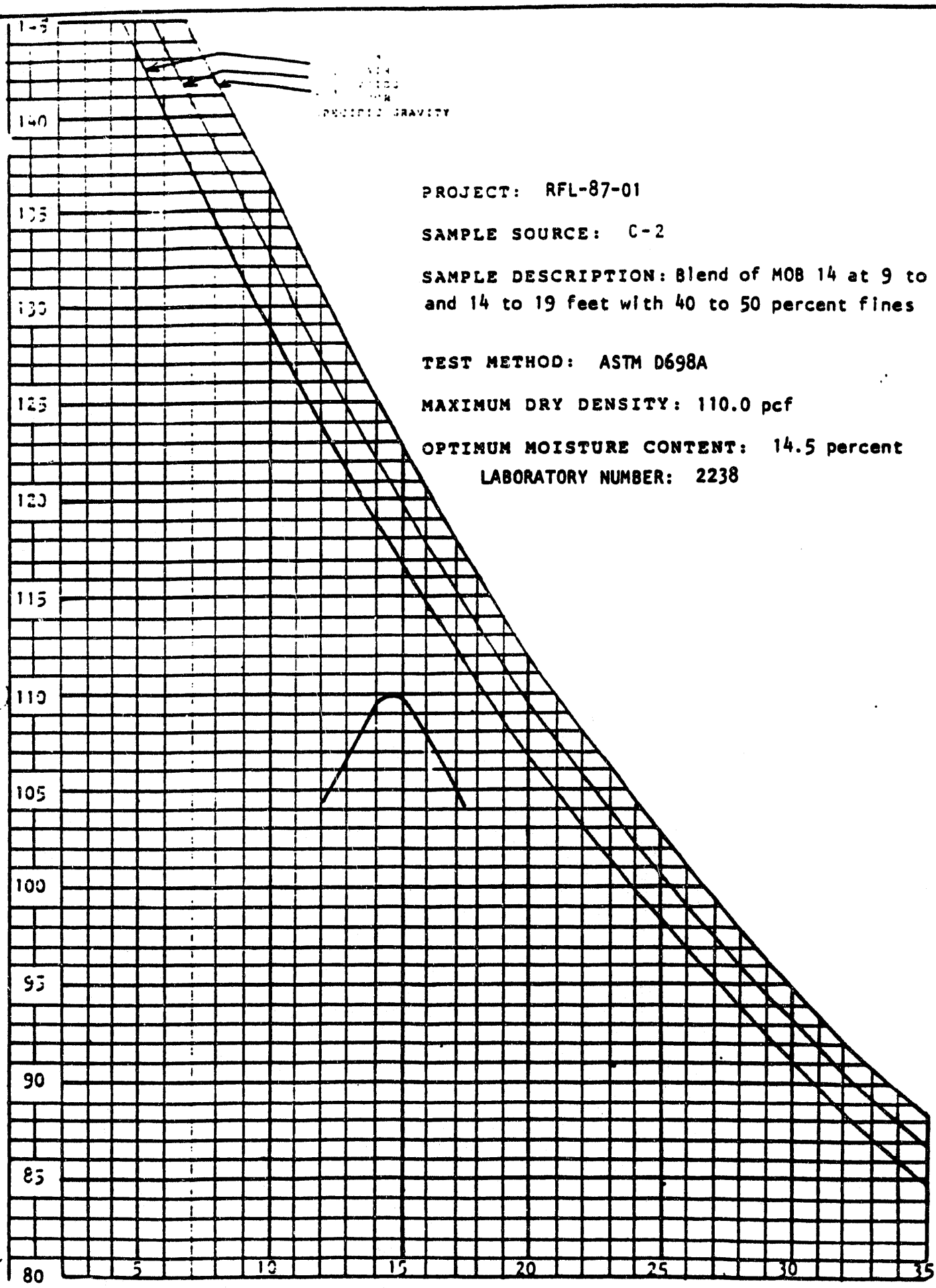
MAXIMUM DRY DENSITY: 106.0 pcf

OPTIMUM MOISTURE CONTENT: 16.0 percent

LABORATORY NUMBER: 2237

Lambert and Associates

Project No.:	M87054GE
Date:	
Figure:	



PROJECT: RFL-87-01

SAMPLE SOURCE: C-2

SAMPLE DESCRIPTION: Blend of MOB 14 at 9 to 14 and 14 to 19 feet with 40 to 50 percent fines

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 110.0 pcf

OPTIMUM MOISTURE CONTENT: 14.5 percent

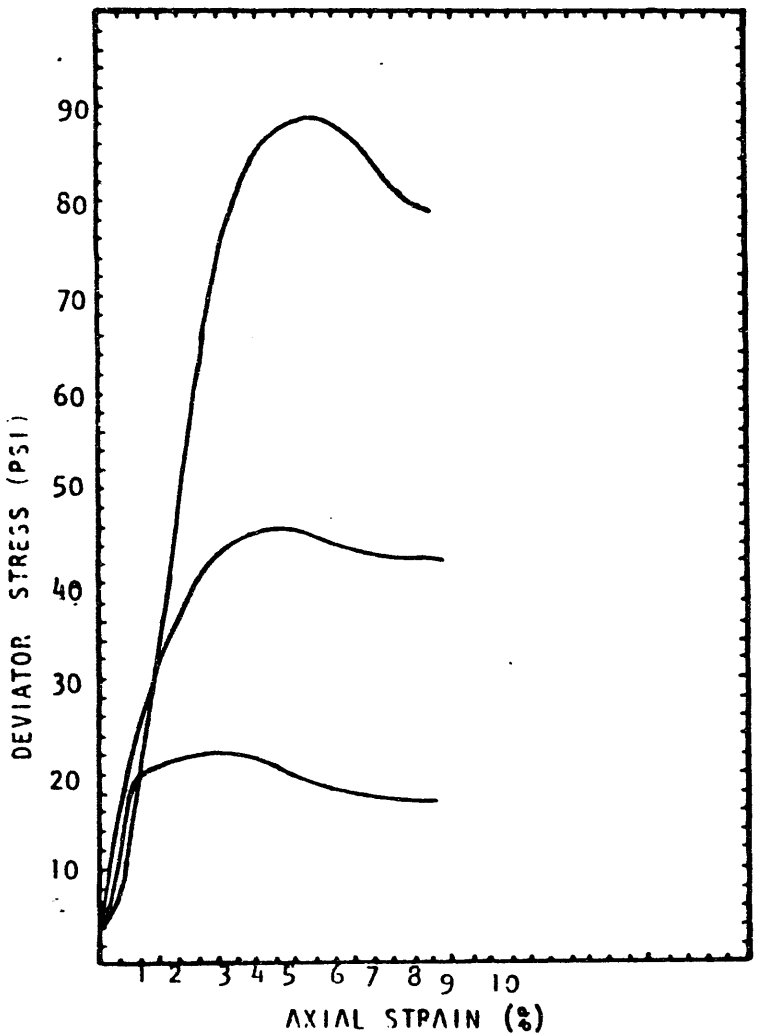
LABORATORY NUMBER: 2238

Lambert and Associates

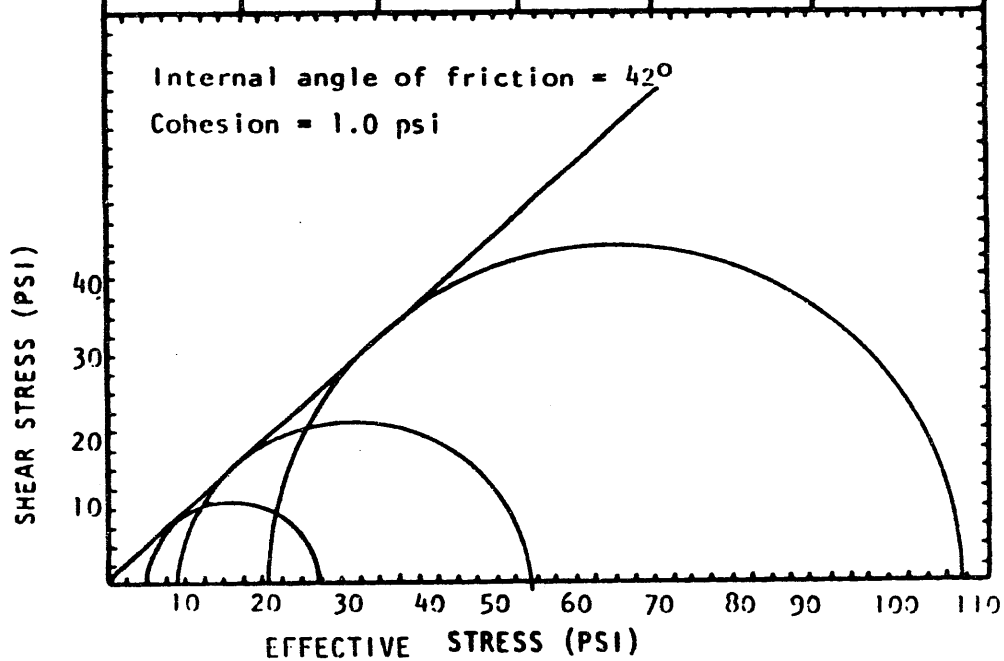
Project No.:	M87054GE
Date:	
Figure:	

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	11.0	99.0	23 1/2	22.6	19
2	11.0	99.0	27	45.7	18
3	11.0	99.0	41	88.5	20



LABORATORY SAMPLE NUMBER: 2177

TEST HOLE: MNB-6 at 9 feet to 19 feet

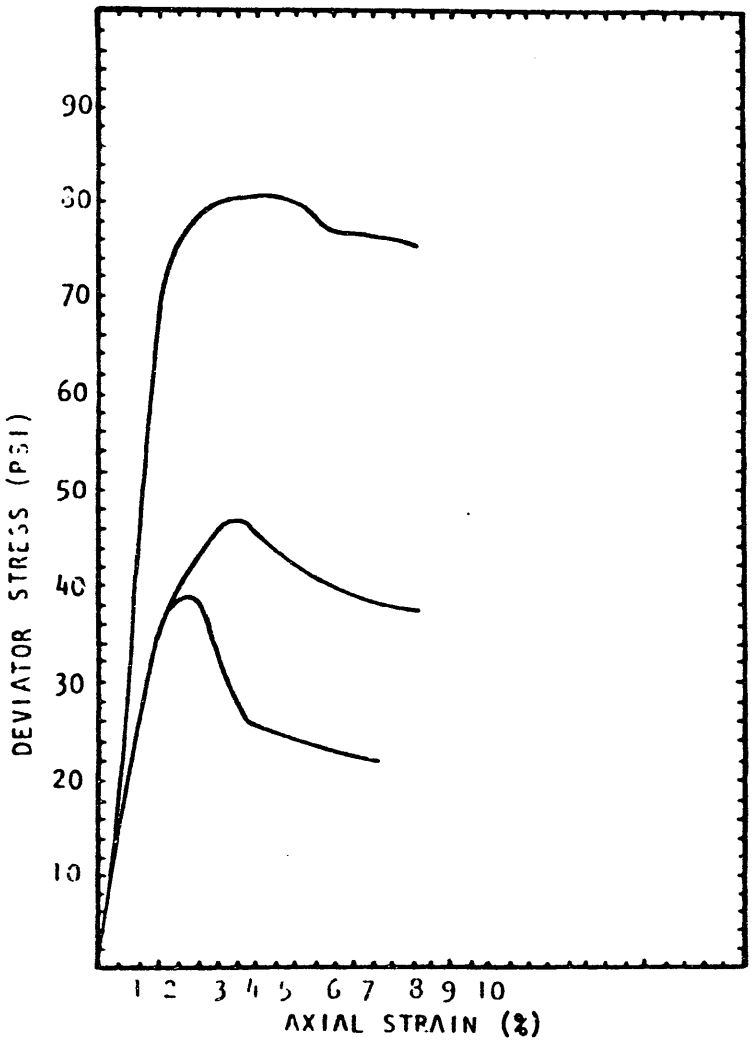
SAMPLE DESCRIPTION:

TYPE OF TEST: Consolidated-Undrained

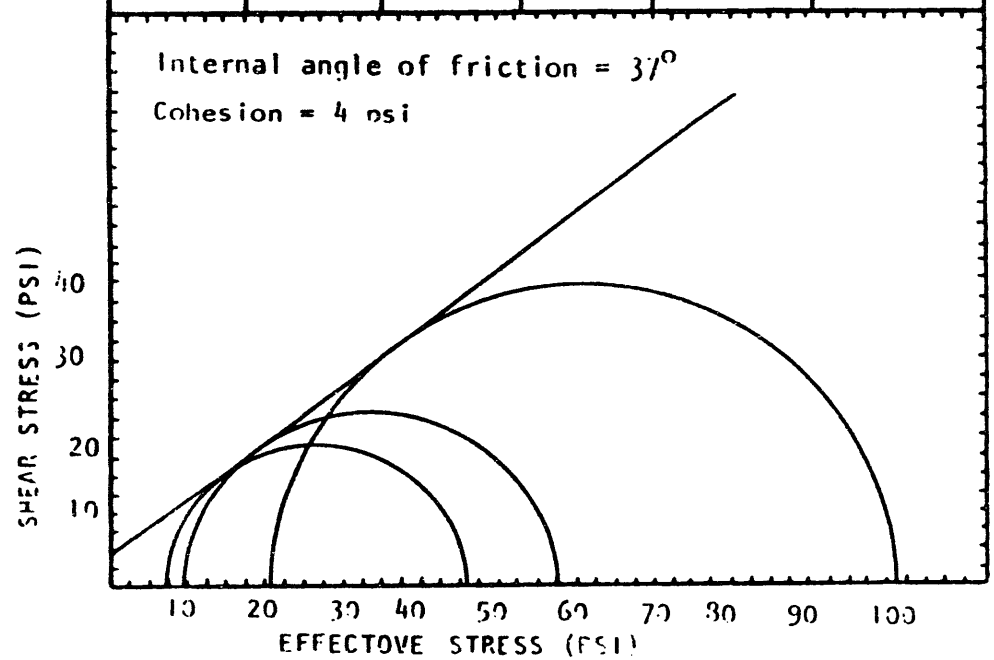
Project No.: 43702-1E
Date:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	11.0	99.0	23.5	39.3	16
2	11.0	99.0	27	47.6	17
3	11.0	99.0	41	82	20



LABORATORY SAMPLE NUMBER: 2177

TEST HOLE: MNB-6 at 9 feet to 19 feet

SAMPLE DESCRIPTION:

TYPE OF TEST: Unconsolidated-Undrained

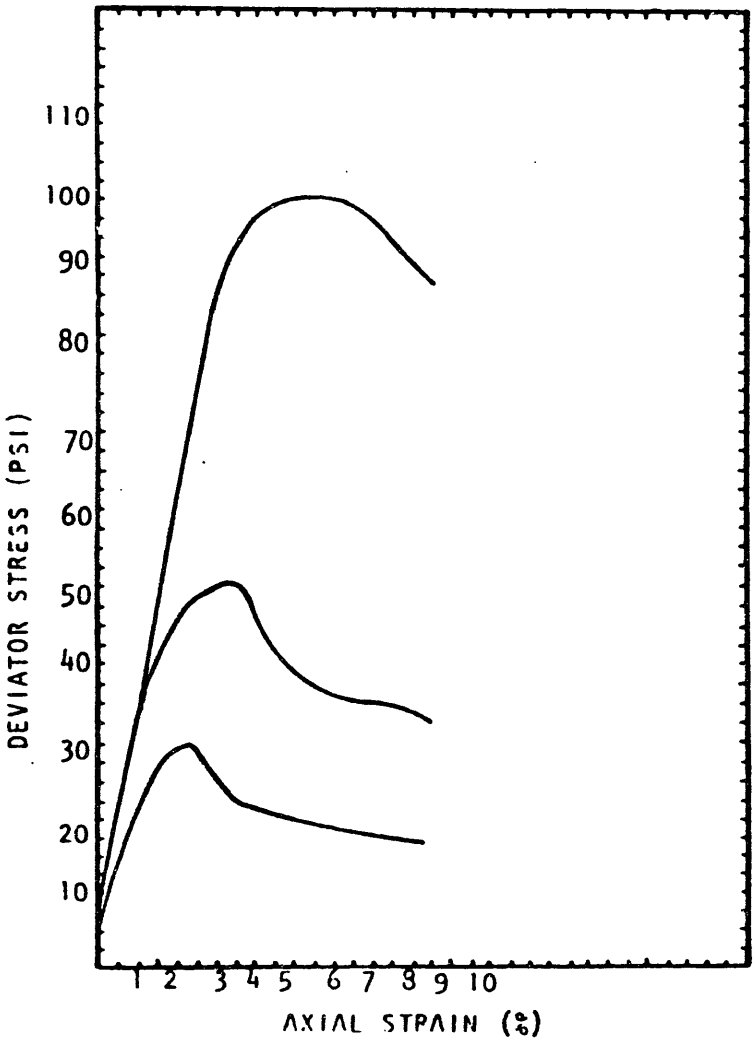
Project No: [illegible]

Date:

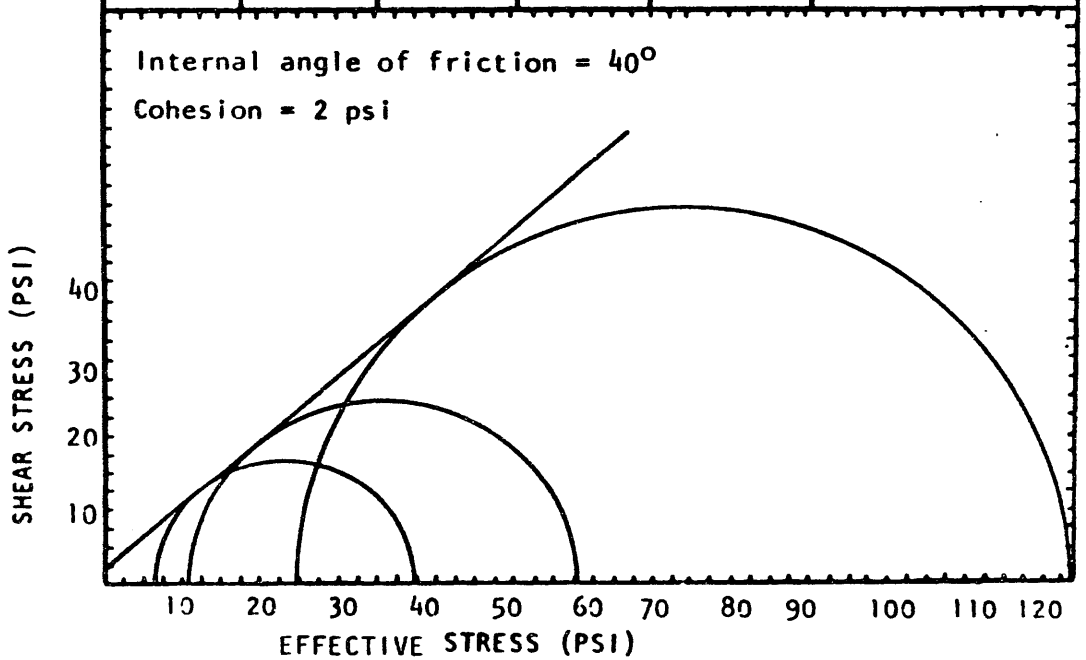
Figure:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	16.5	91.4	23.5	30.2	17
2	16.5	91.4	25	50.6	14
3	16.5	91.4	39	101.1	15



LABORATORY SAMPLE NUMBER: 2152

TEST HOLE: MOB-1 at 2 1/2 feet to 7 1/2 feet

SAMPLE DESCRIPTION:

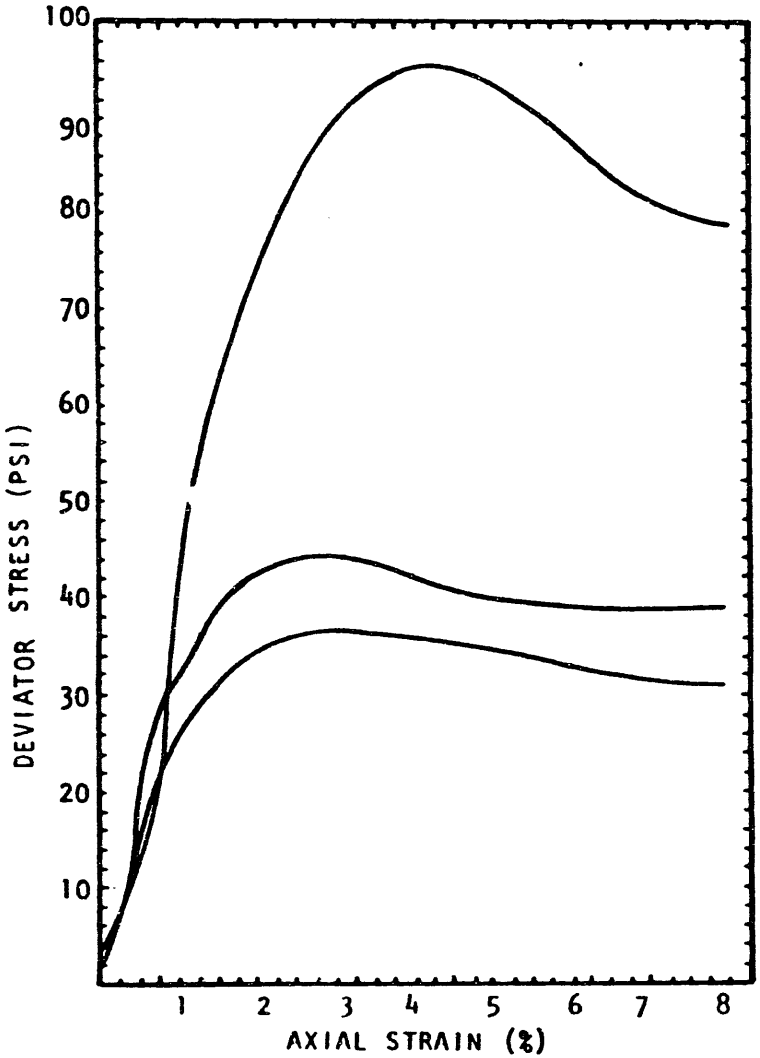
TYPE OF TEST: Consolidated-Undrained

Project No.: M3705 4GE

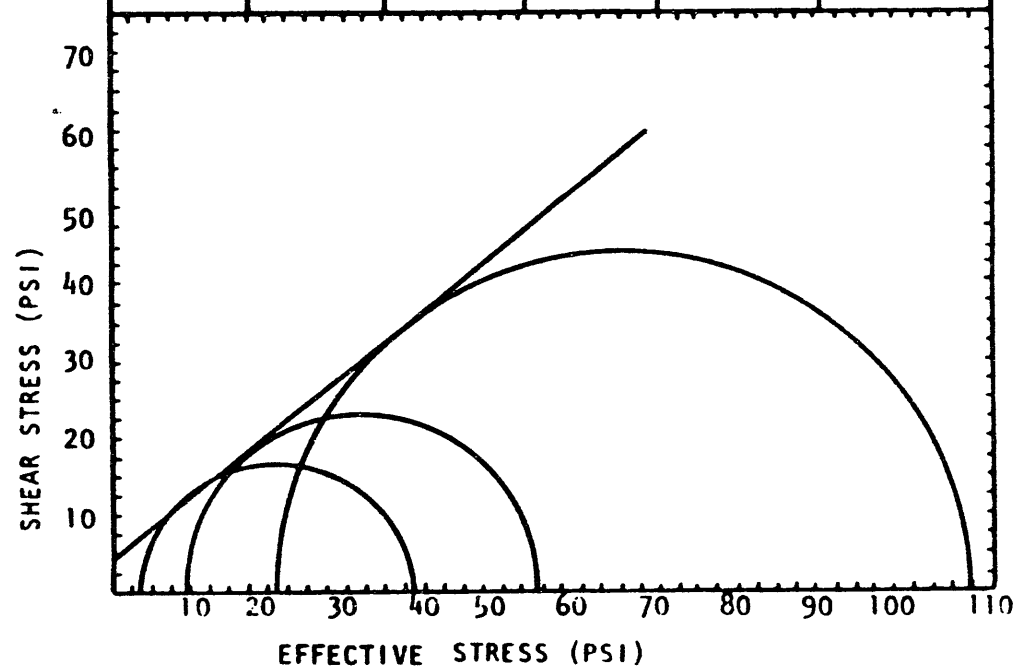
Date:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	16.5	91.4	23.5	33.6	19
2	16.5	91.4	25	44.4	15
3	16.5	91.4	38	89.1	17



LABORATORY SAMPLE NUMBER: 2152

TEST HOLE: MOB-1 at 2½ feet to 7½ feet

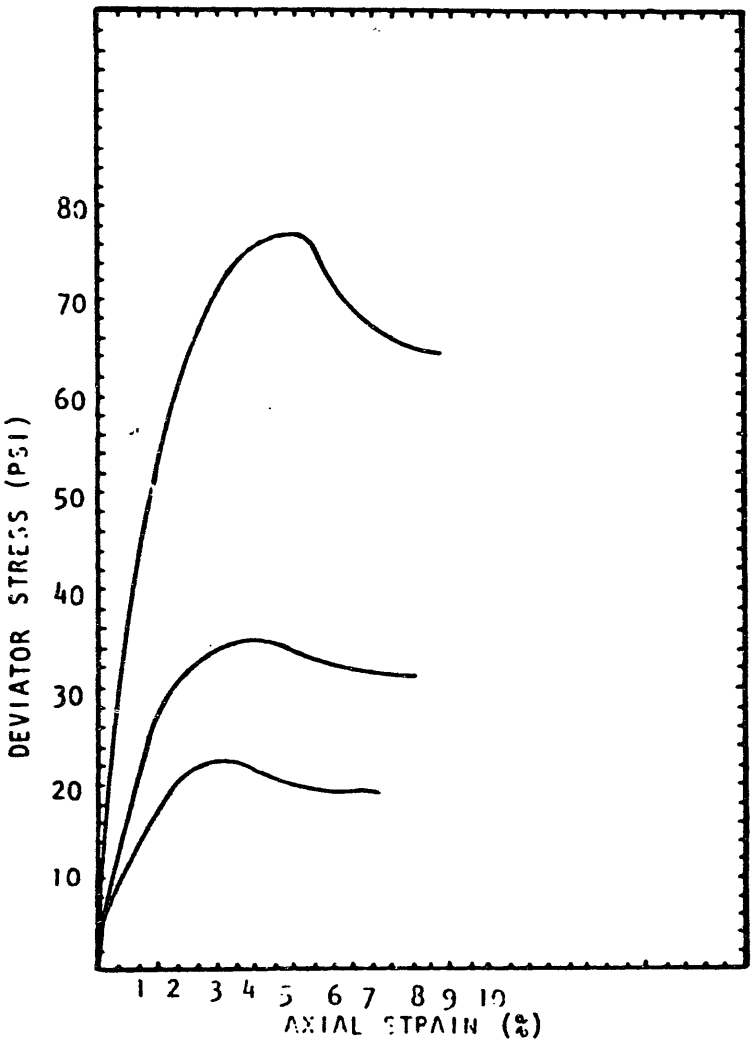
SAMPLE DESCRIPTION:

TYPE OF TEST: Unconsolidated undrained

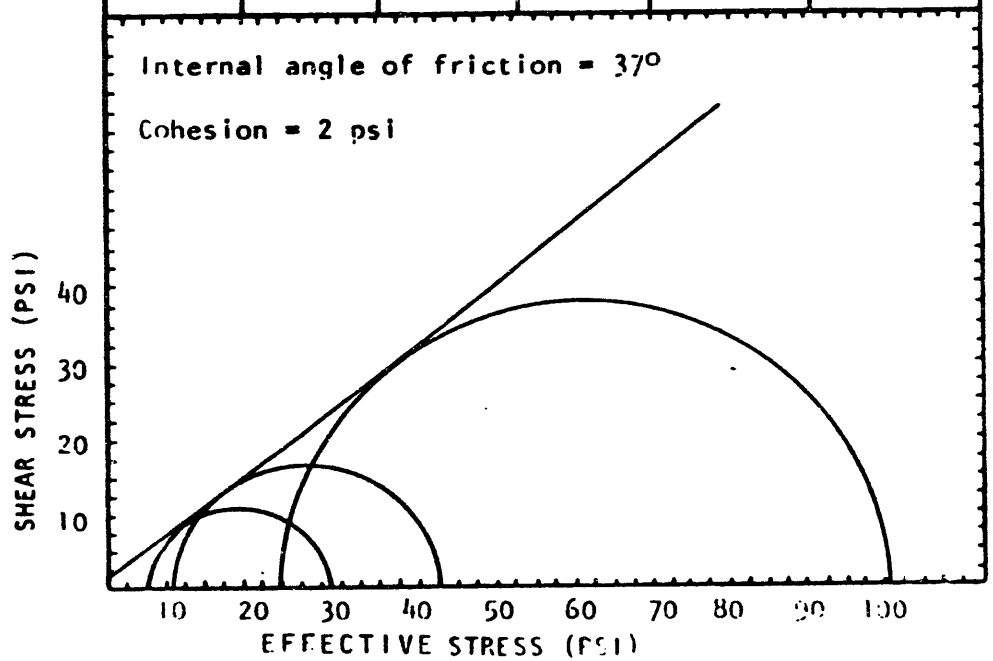
Project No.: M87054GE
Date:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	17.0	92.2	23.5	23.3	18
2	17.0	92.2	22	34.7	14
3	17.0	92.2	33	77.6	11



LABORATORY SAMPLE NUMBER: 2159

TEST HOLE: MOB-4 at 9 feet to 14 feet

SAMPLE DESCRIPTION:

TYPE OF TEST: Consolidated-Undrained

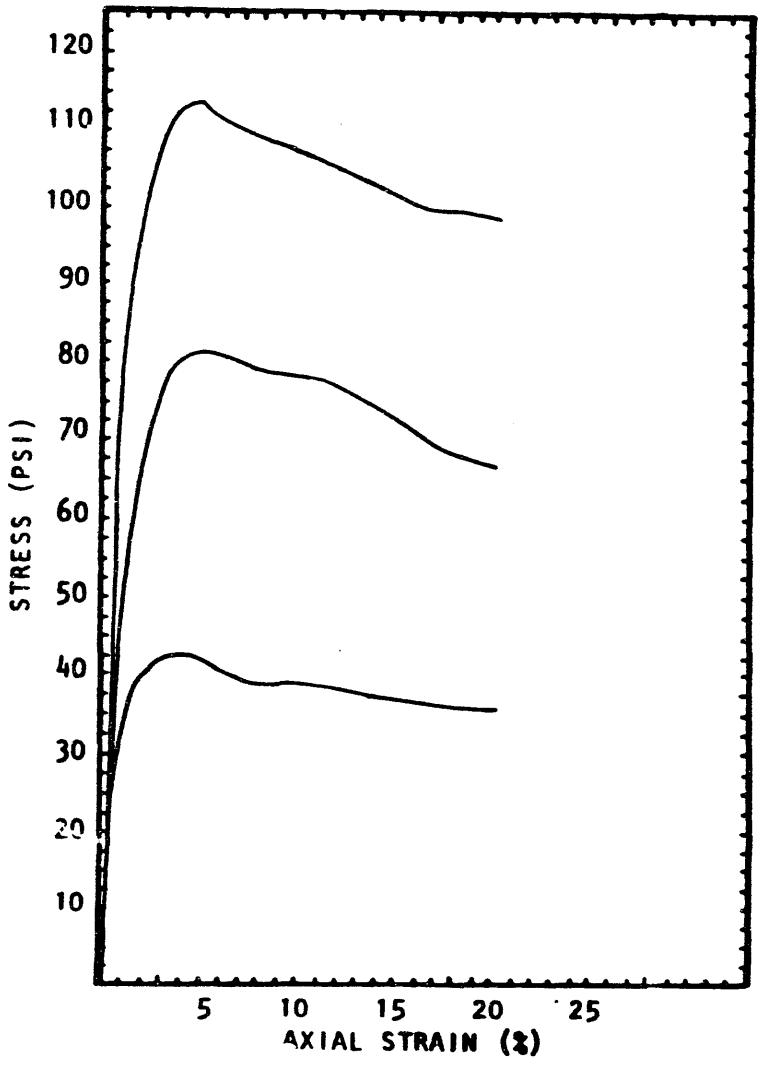
Project No: M-70545E

Date:

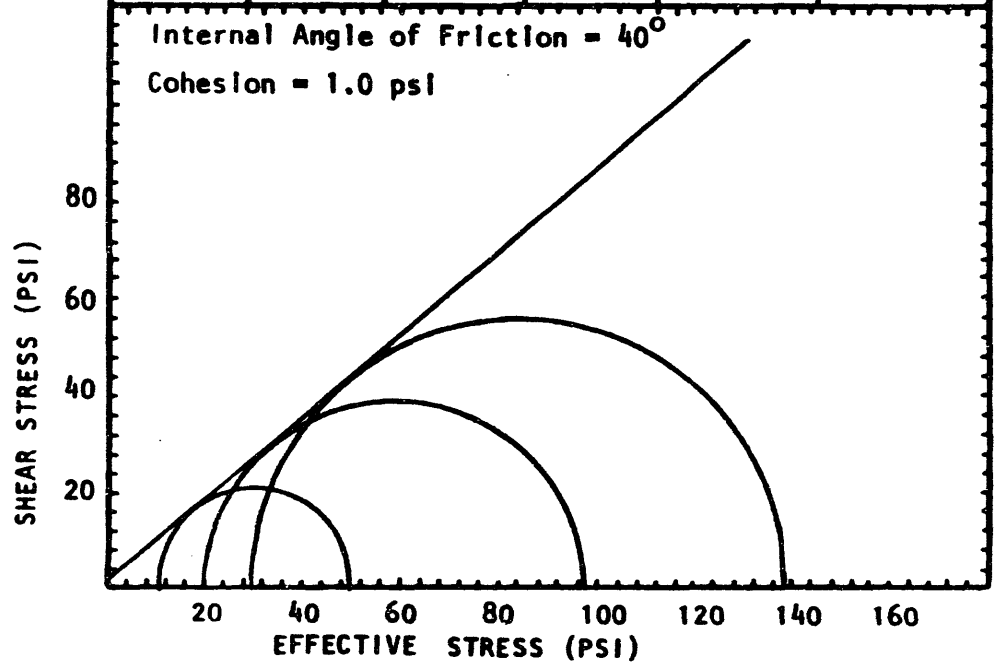
Figure:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



Sample Number	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	16.0	95.4	28.5	41.4	18
2	16.0	95.4	39	78.4	18
3	16.0	95.4	49	111.3	19



Project No.: M82054GE

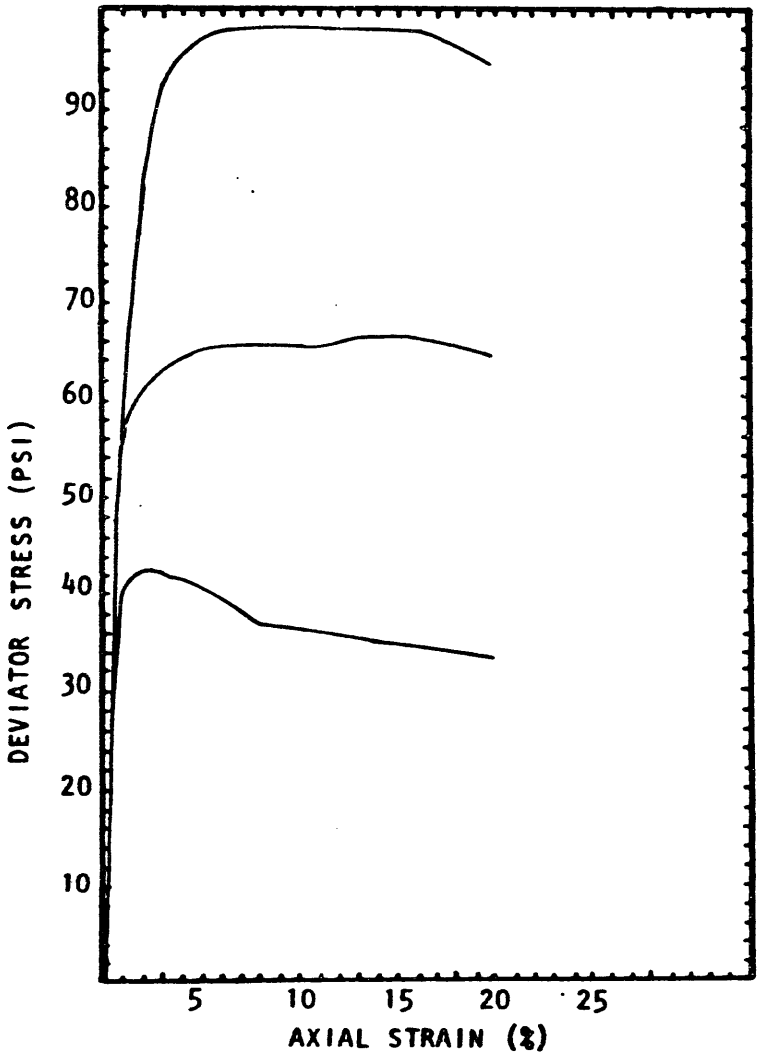
SAMPLE DESCRIPTION: C-1 Blend
old Rifle tailings

TYPE OF TEST: Consolidated, Undrained

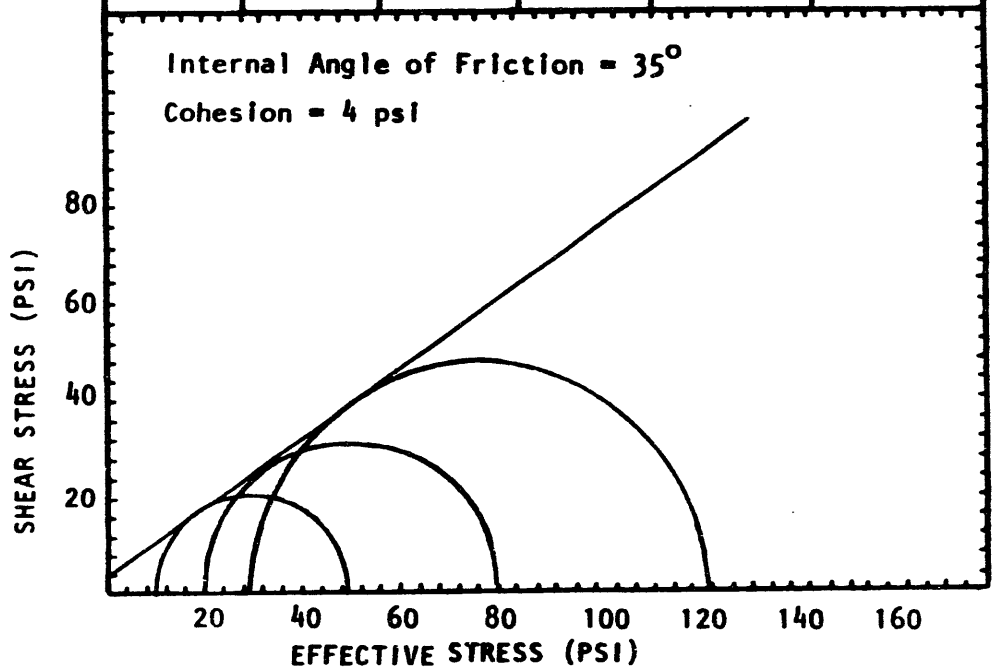
LABORATORY NUMBER: 2237

Lambert and Associates

TRIAXIAL COMPRESSION TEST



Sample Number	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	14.5	99.0	28.5	40.9	18
2	14.5	99.0	39	63.0	19
3	14.5	99.0	48	95.2	18



SAMPLE DESCRIPTION: C-2 Blend
old Rifle tailings

TYPE OF TEST: Unconsolidated, Undrained

LABORATORY NUMBER: 2238

Project No.: M87054GE
Date:

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MNT-1 at 2 Feet

LABORATORY SAMPLE NUMBER: 2023

TRIAXIAL PERMEABILITY: 3.96×10^{-7} cm/sec

CONFINING PRESSURE: 2 psi

INITIAL DRY DENSITY: 106.7 pcf

INITIAL MOISTURE CONTENT: 14.5 percent

Project: Rifle -RFL-87-01

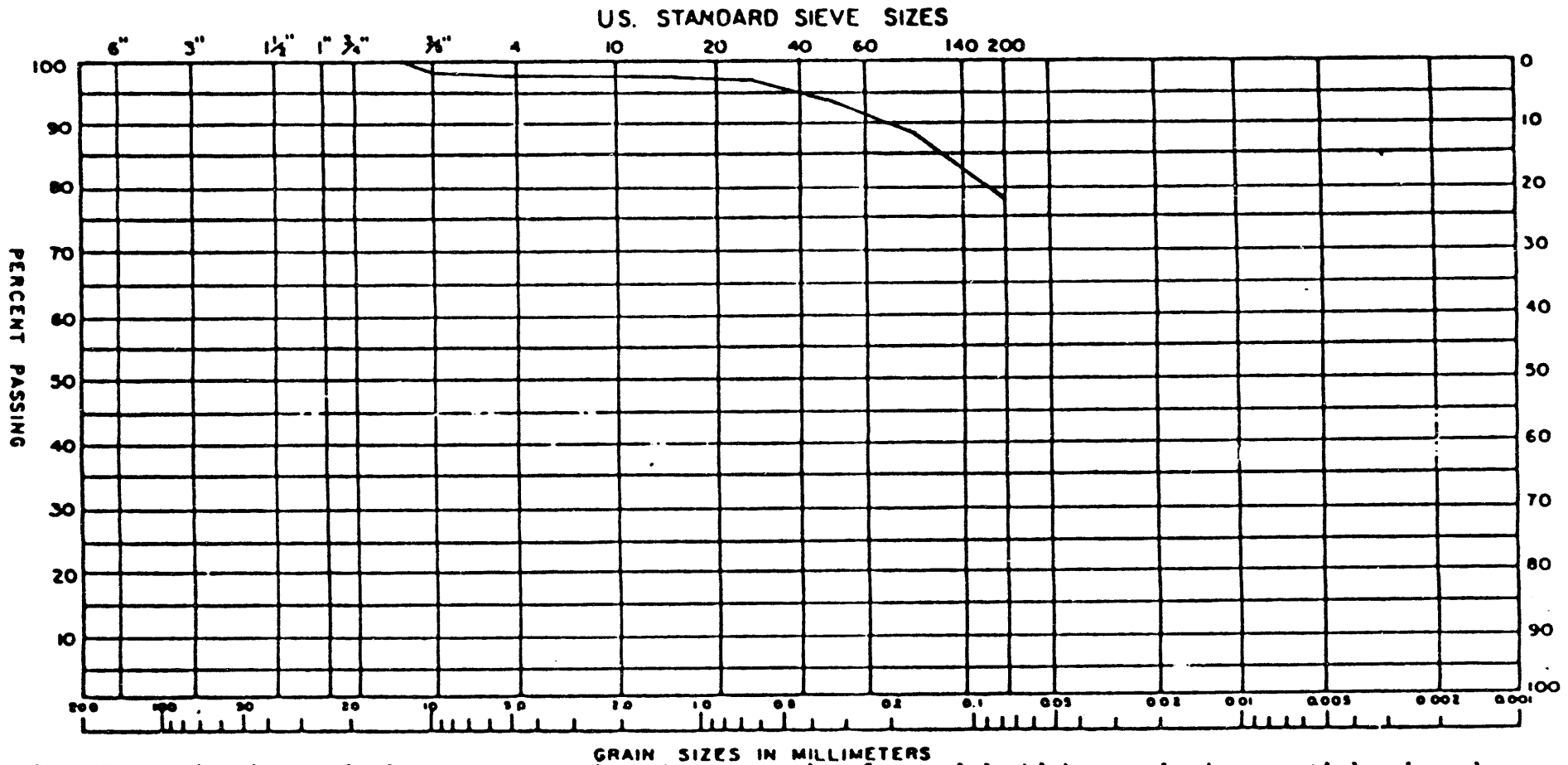
Job Number: 87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-1	2	--	--	2.66	29.2	2023
CLASSIFICATION						

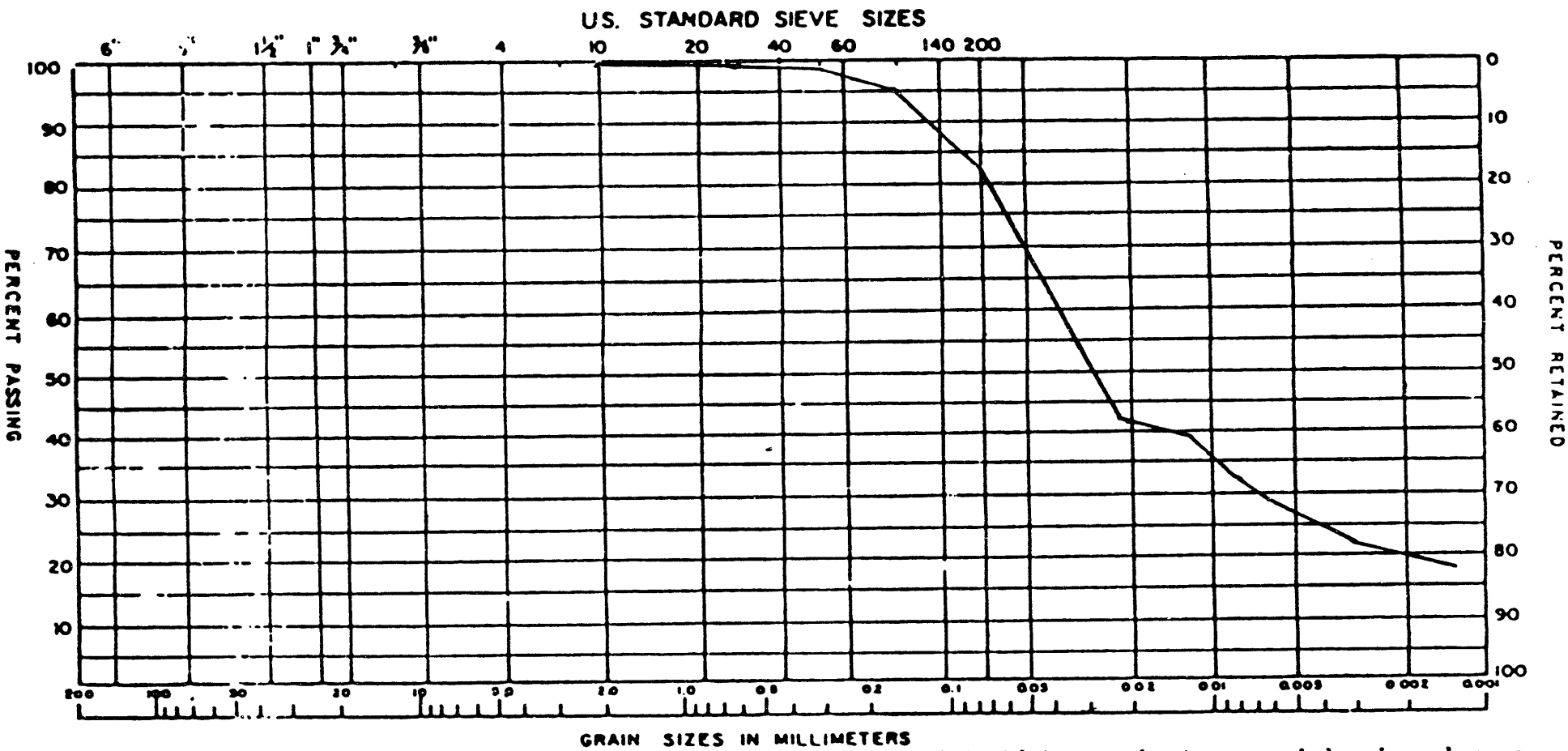
Project: PFL-87-01

Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than .1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-1	5	23	7	----	16.8	2024
CLASSIFICATION						

Fig.

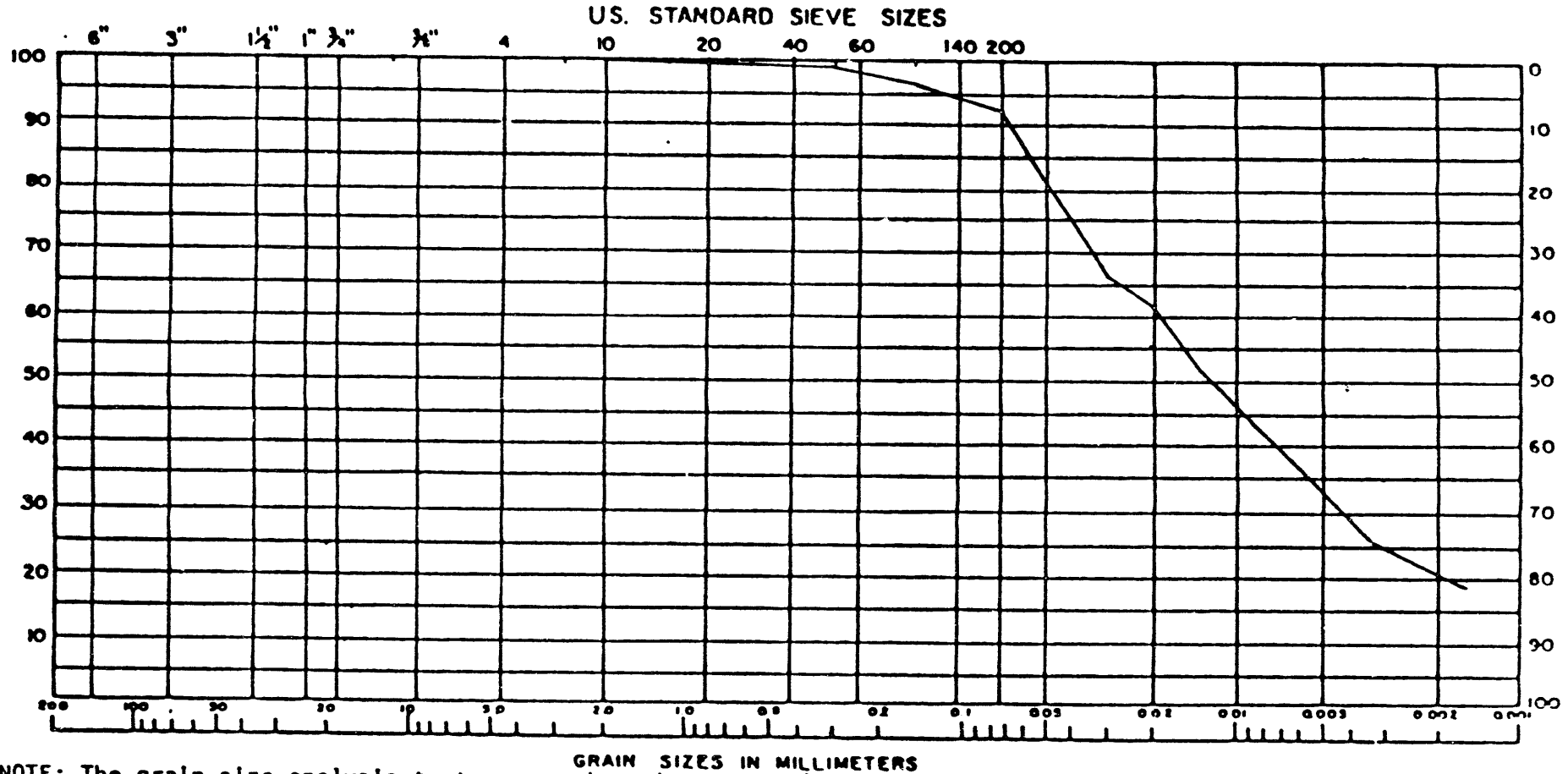
Project: RFL-87-01
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-2	2 1/2	29	12	----	14.2	2025
CLASSIFICATION						

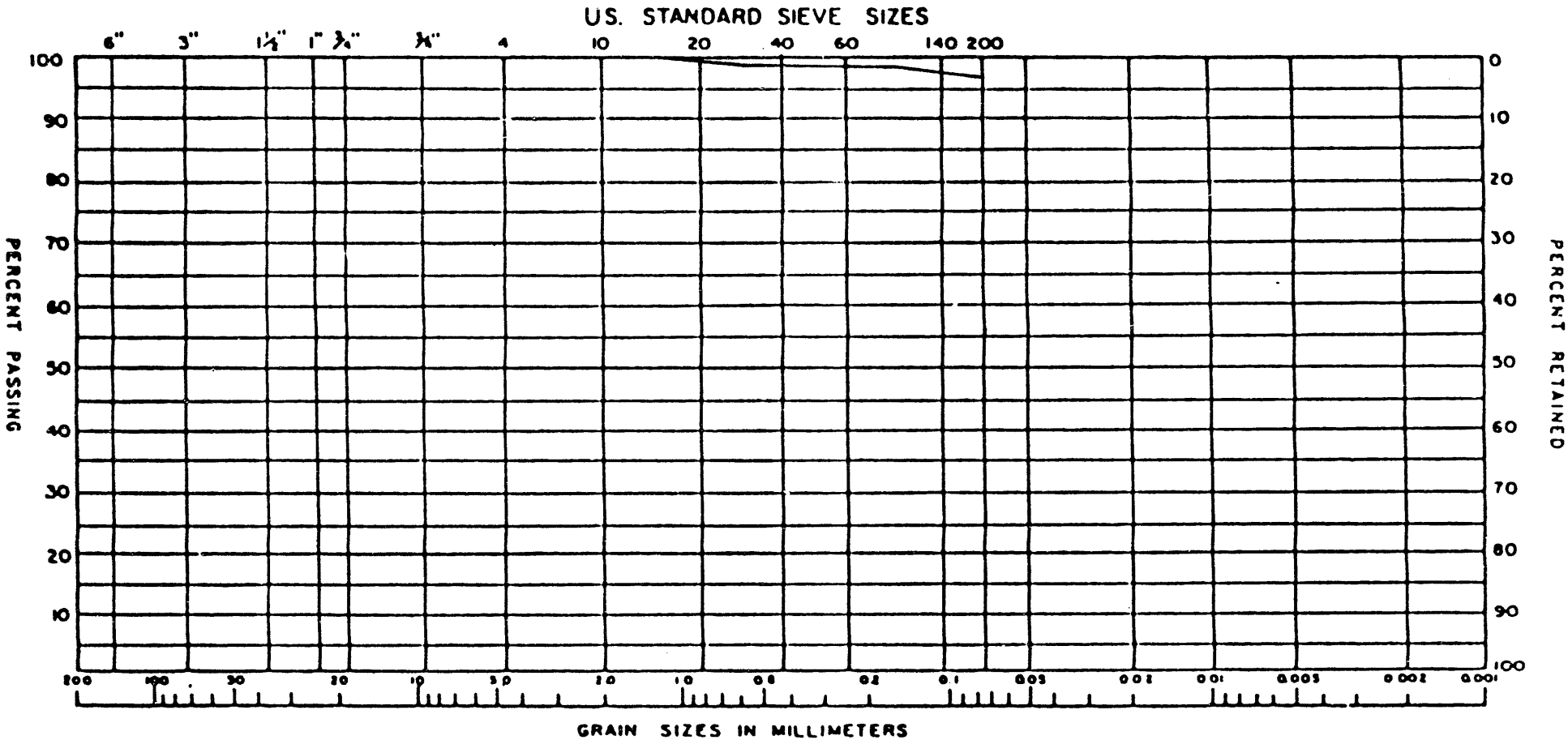
Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

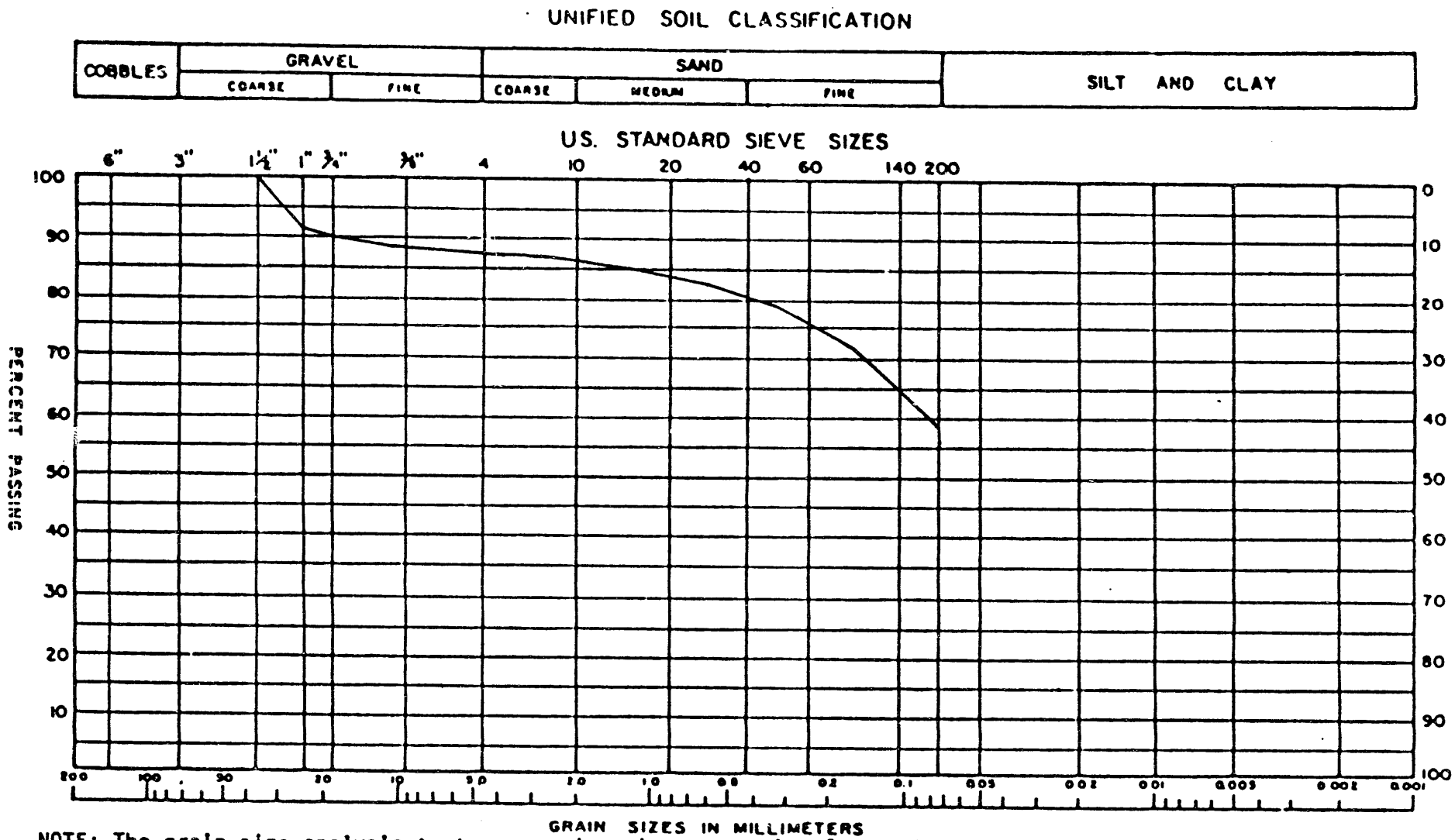
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-2	5	--	--	--	14.5	3026
CLASSIFICATION						

Project: Rifle-RFL-87-01

Job Number 87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

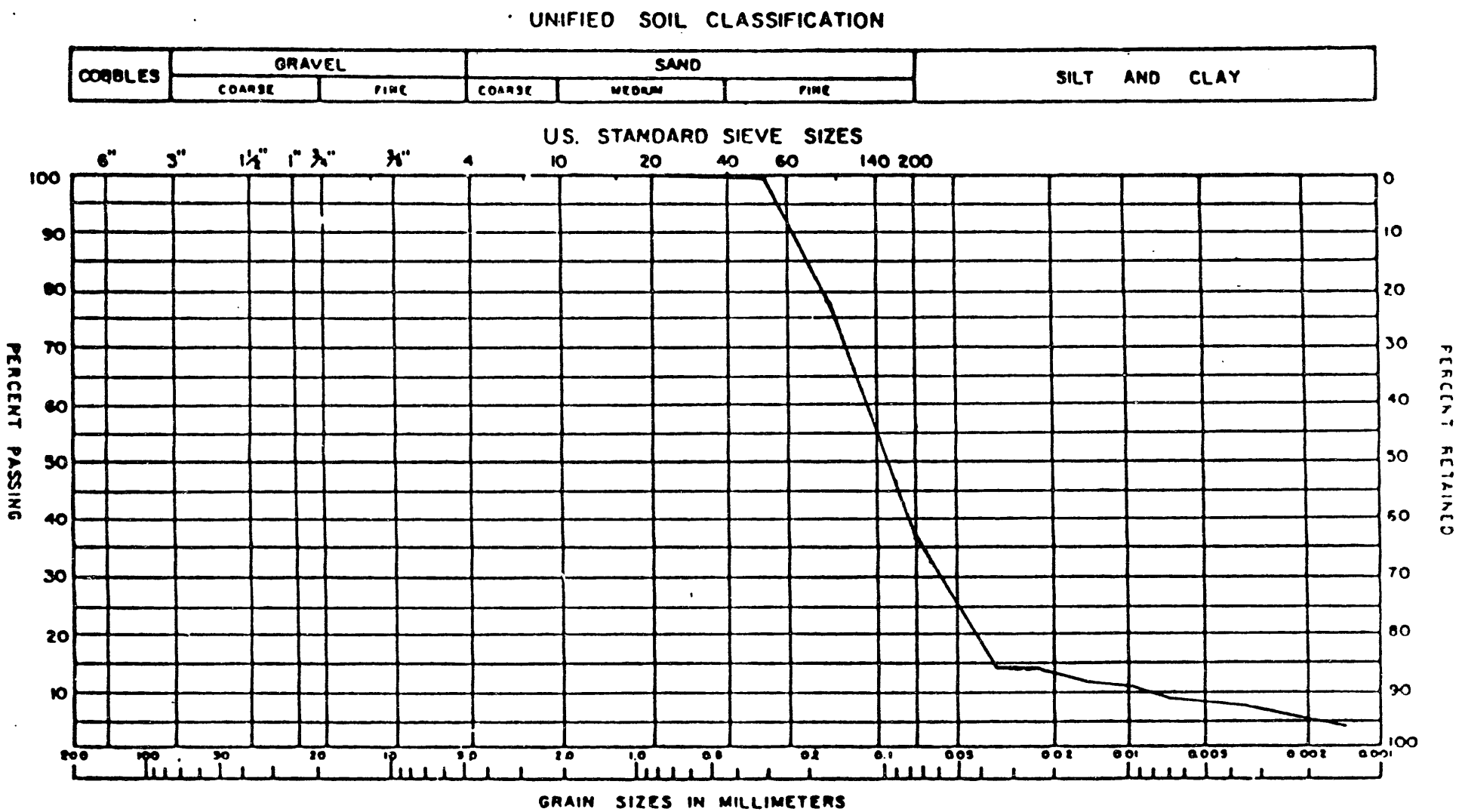
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-3B	1/2	--	--	2.62	10.3	2027
CLASSIFICATION	Silt, sandy, slightly gravelly, (ML)					

Project: RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-4	5	21	NP	----	28.5	2028
CLASSIFICATION						

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MNT-4 at 6 Feet

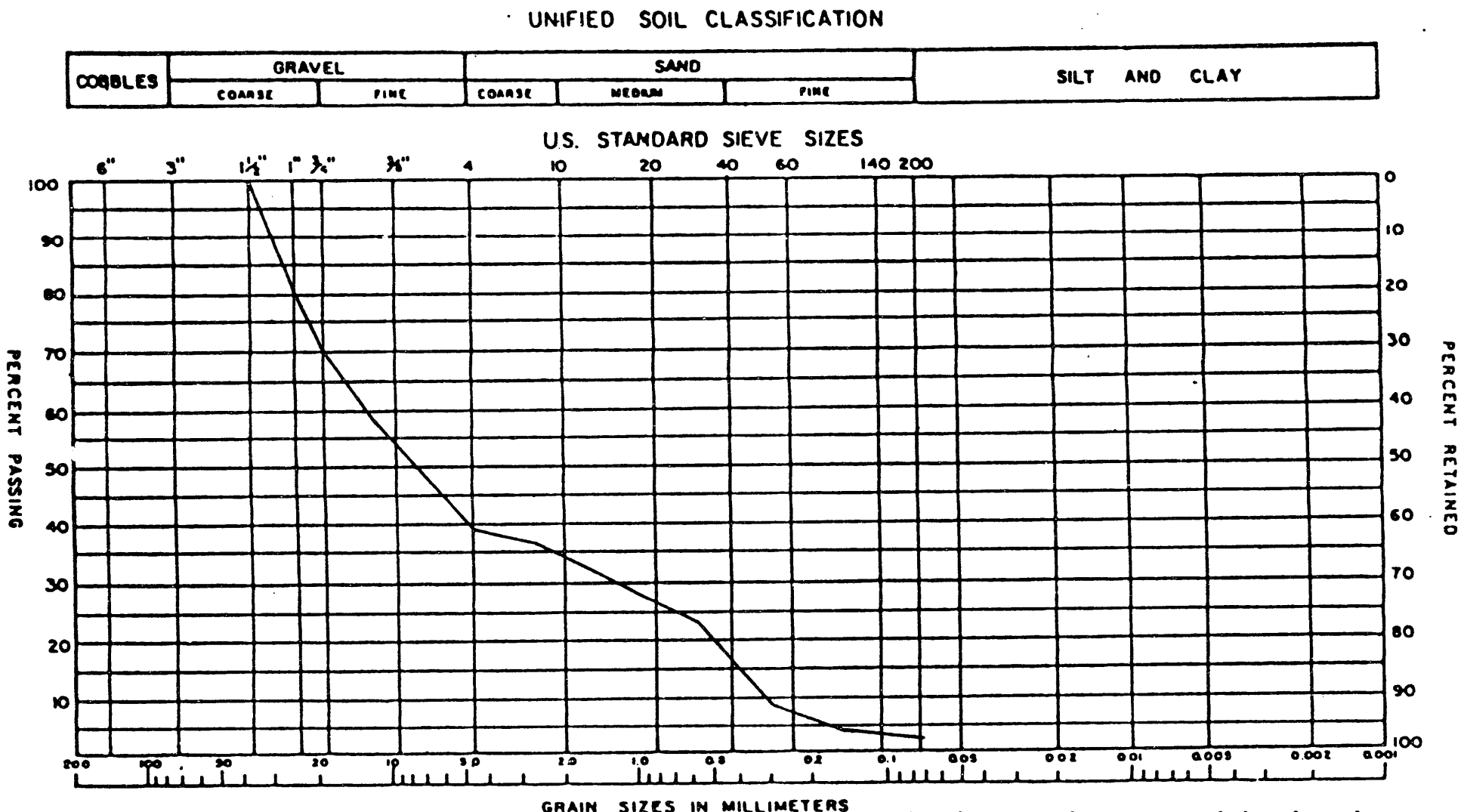
LABORATORY SAMPLE NUMBER: 2029

SAMPLE DESCRIPTION: Silt,clayey,slightly sandy,(ML)

INITIAL MOISTURE CONTENT: 39.3 percent

Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-4	8	--	--	--	8.9	2030
CLASSIFICATION	Gravel, sandy (GP)					

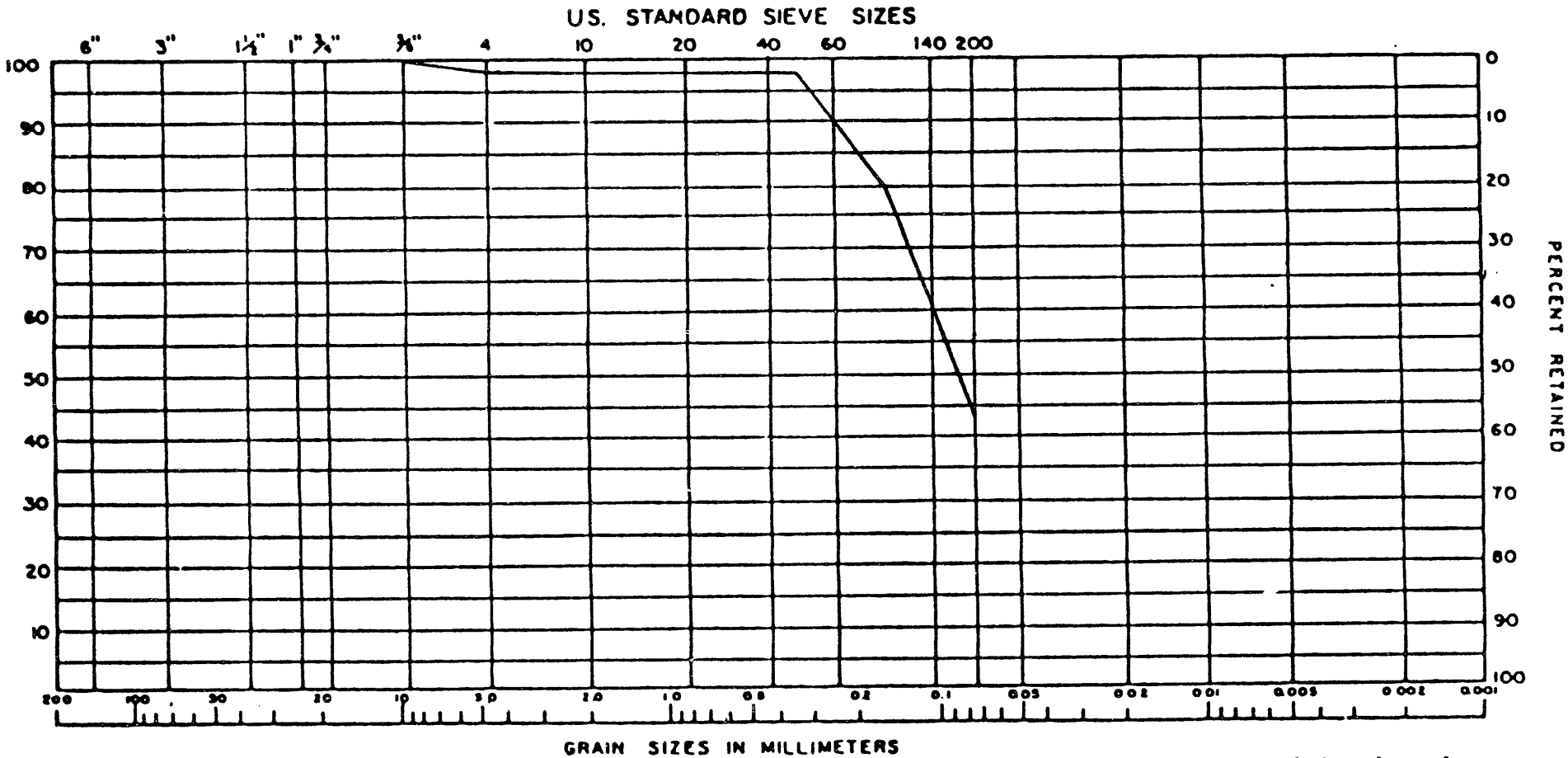
Fig

Project: Rifle-RFL-87-01
Job Number 87054GE

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

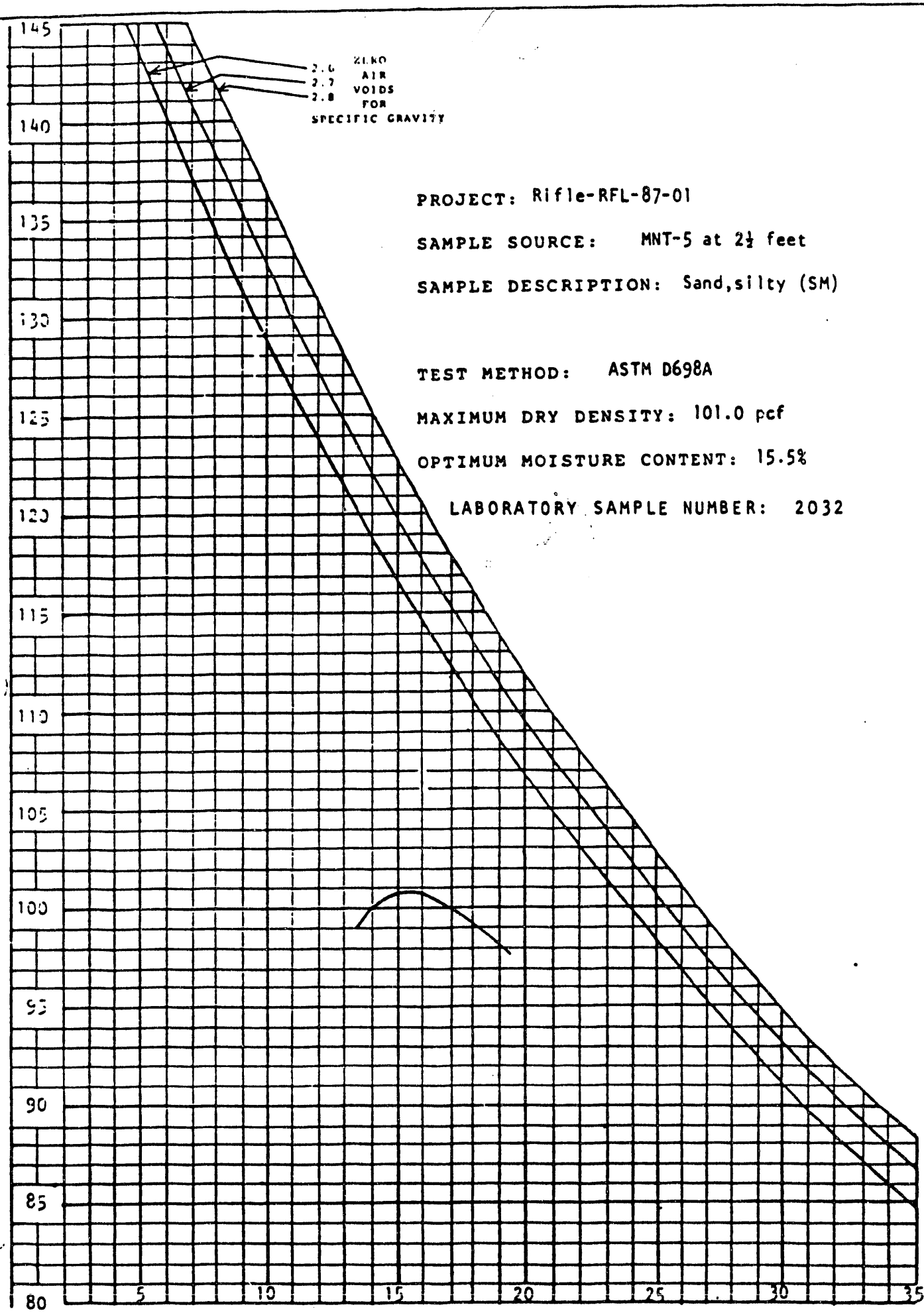
COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-5	2 1/2	--	--	--	16.7	2031
CLASSIFICATION	Sand, silty (SM)					

Fig



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MNT-5 at 2½ feet

SAMPLE DESCRIPTION: Sand,silty (SM)

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 101.0 pcf

OPTIMUM MOISTURE CONTENT: 15.5%

LABORATORY SAMPLE NUMBER: 2032

Lambert and Associates

Project No.: M87054GE

Date:

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MNT-5 at 2 1/2 Feet

LABORATORY SAMPLE NUMBER: 2032

TRIAXIAL PERMEABILITY: 3.8×10^{-5} cm/sec

CONFINING PRESSURE: 2 psi

INITIAL DRY DENSITY: 90.9 pcf

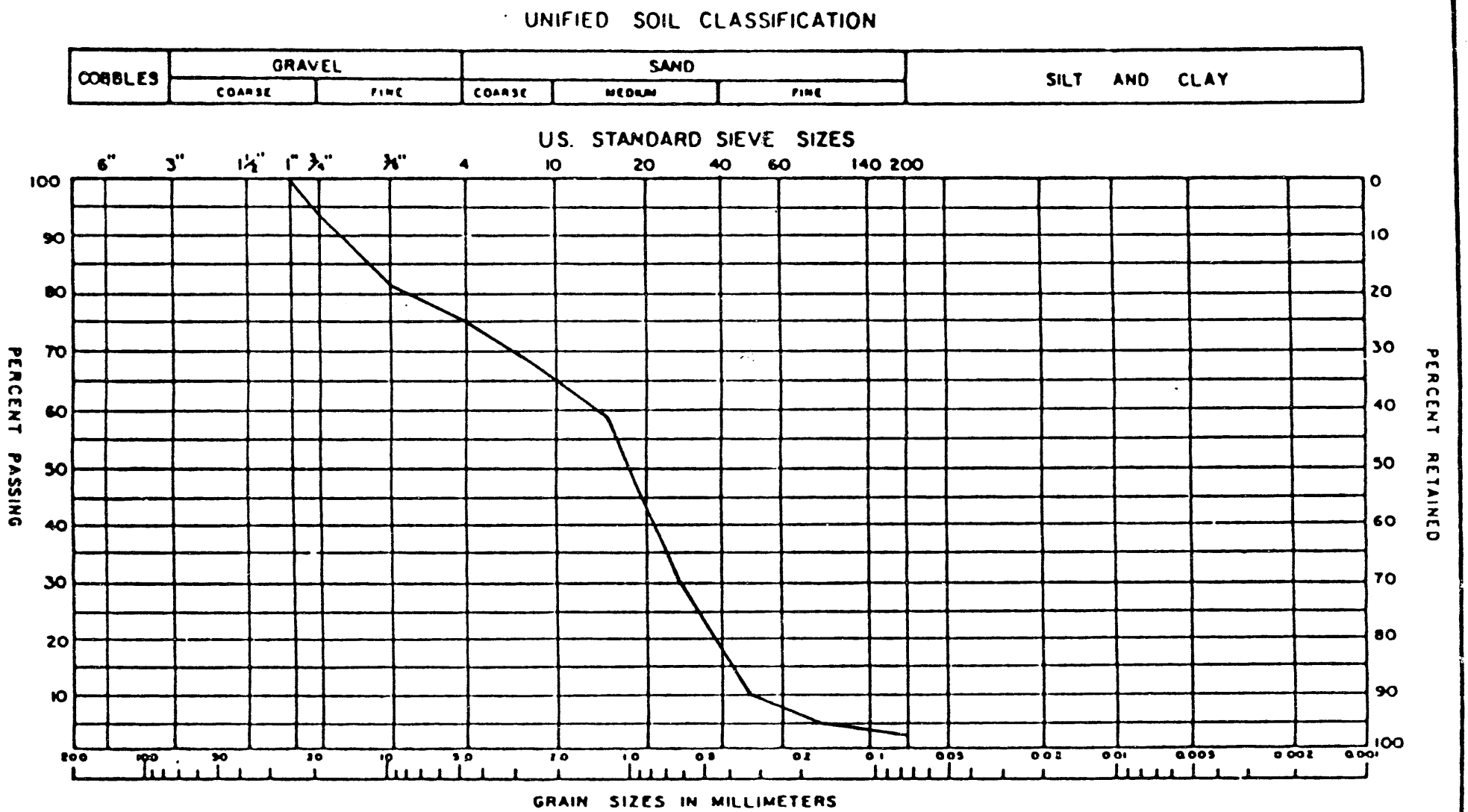
INITIAL MOISTURE CONTENT: 15.5 percent

SPECIFIC GRAVITY: 2.69

Project: Rifle-RFL-87-01

Job Number M8-0054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-5	9	--	--	--	16.7	2033
CLASSIFICATION	Sand, gravelly (SP)					

Fig.

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MNT-6 at 2 1/2 Feet

LABORATORY SAMPLE NUMBER: 2034

SAMPLE DESCRIPTION: Silt,sandy,(ML)

INITIAL MOISTURE CONTENT: 22.0 percent

Project: Rifle-RFL-87-01

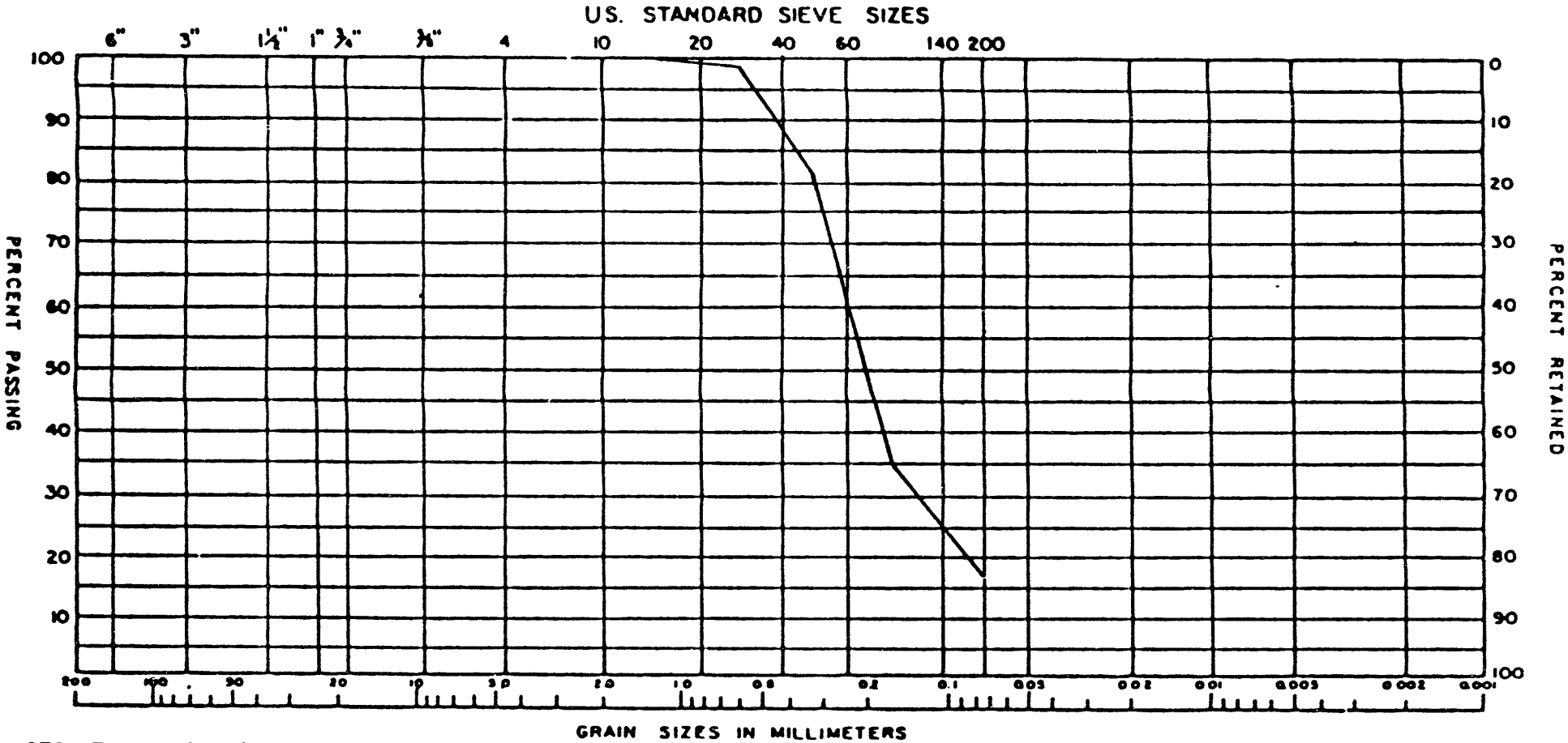
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-6	5	--	--	--	8.0	2035
CLASSIFICATION	Sand, silty (SM)					

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MNT-8 at 2 1/2 Feet

LABORATORY SAMPLE NUMBER: 2036

INITIAL MOISTURE CONTENT: 25.3 percent

SAMPLE DESCRIPTION: Silt,sandy,(ML)

Project Rifle-RFL-87-01

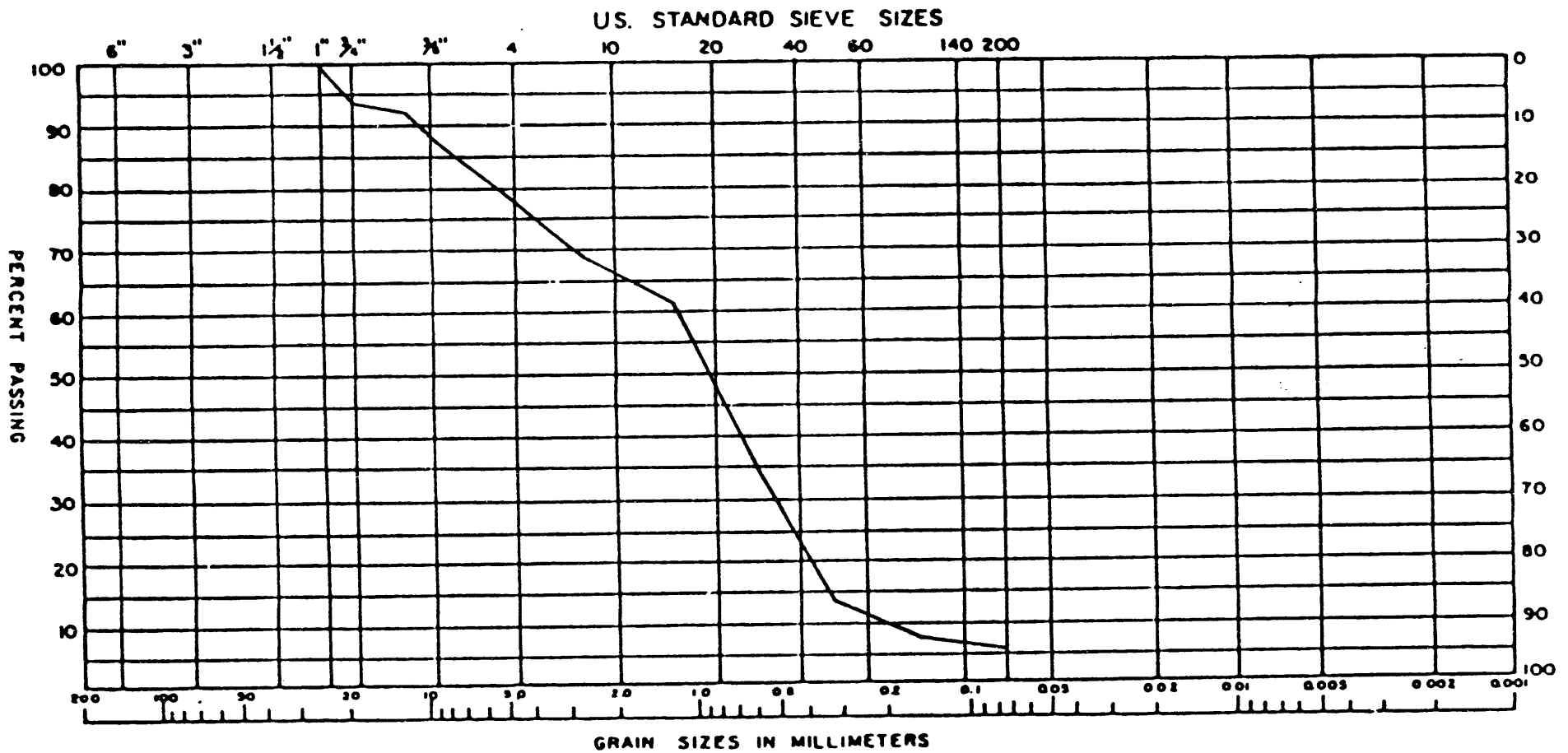
Job Number 19705-13E

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-8	5	--	--	--	5.6	2037
CLASSIFICATION	Sand, gravelly (SW)					

Project: Rifle-RFL-87-01

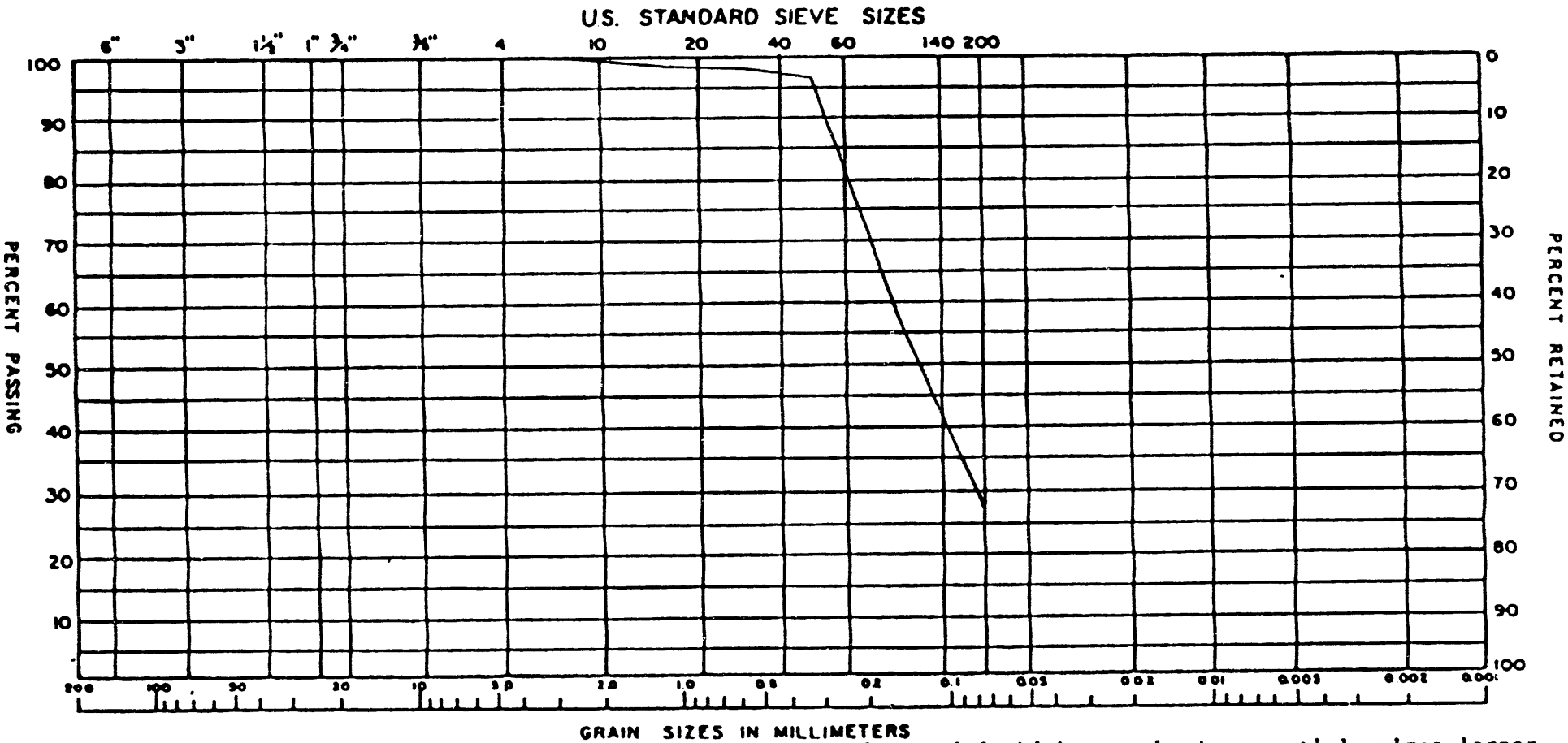
Job Number: M8705-GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-9	1/2 to 1	--	--	2.70	3.6	2038
CLASSIFICATION Sand, silty, (SM)						

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MNT-9 at 3 Feet

LABORATORY SAMPLE NUMBER: 2039

SAMPLE DESCRIPTION: Gravel,sandy,(GP)

INITIAL MOISTURE CONTENT: 2.2 percent

Project: Rifle-RFL-87-01

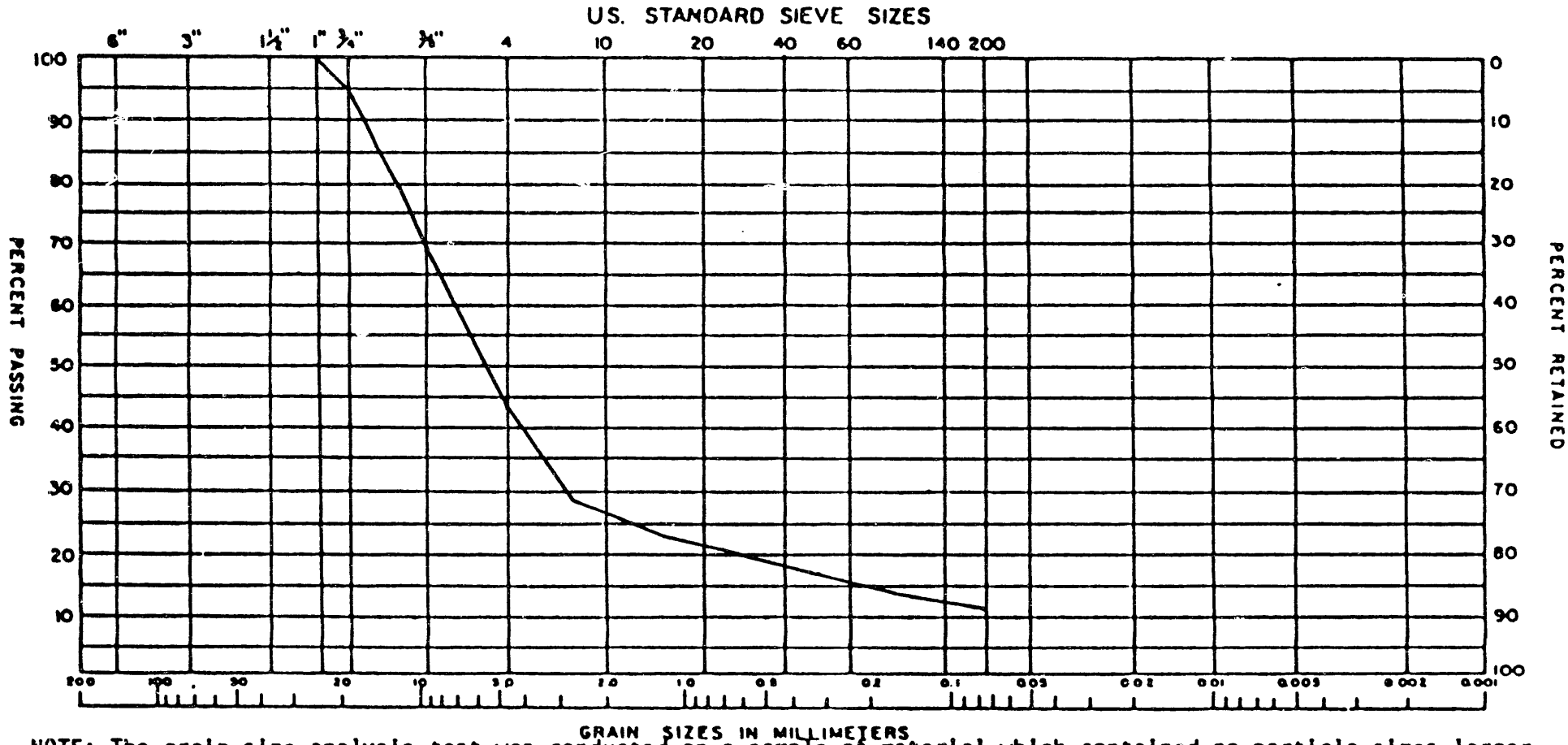
Job Number: M8705-GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-9	5	--	--	--	6.5	2040
CLASSIFICATION	Gravel, sandy (GP-SP)					

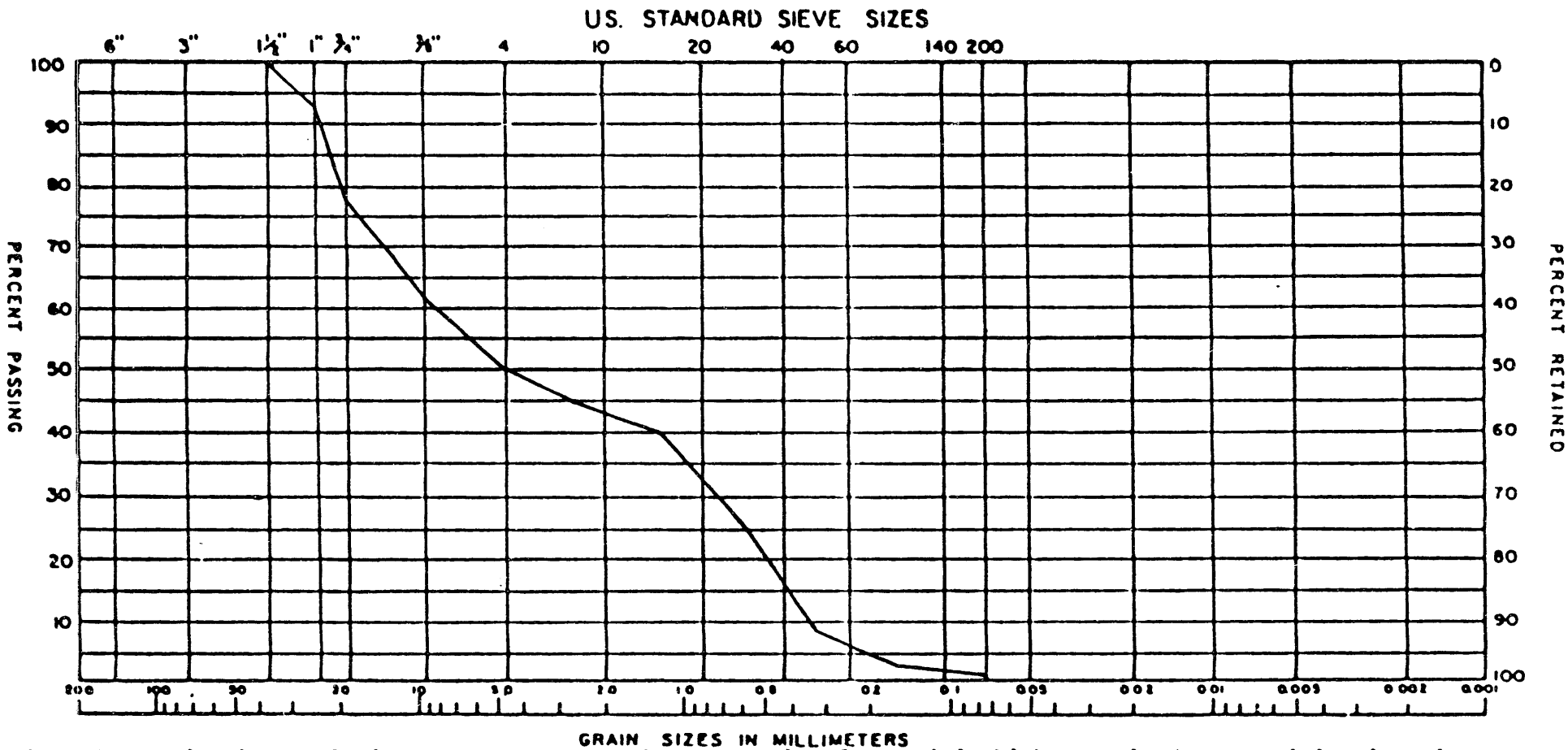
Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

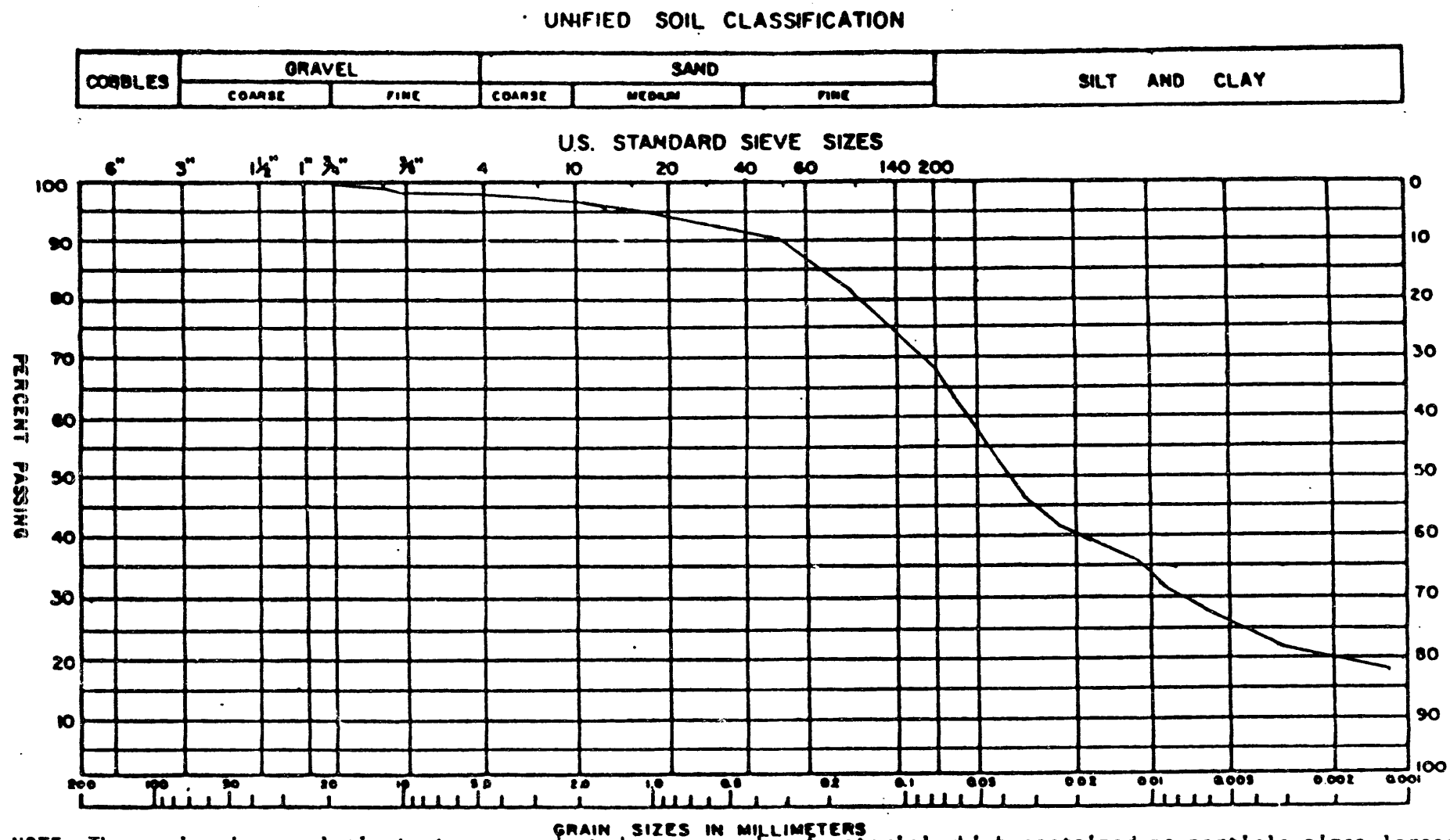
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-9	10	--	--	--	11.4	2041
CLASSIFICATION	Gravel and sand (GP-SP)					

Project: Rifle-RFL-87-01

Job Number: M87054GF

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-10	2½'	29	14	2.75	16.2	2042
CLASSIFICATION						

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MNT-10 at 5 Feet

LABORATORY SAMPLE NUMBER: 2043

SAMPLE DESCRIPTION: Sand,medium to fine grained,slightly clayey,(SC)

INITIAL MOISTURE CONTENT: 24.2 percent

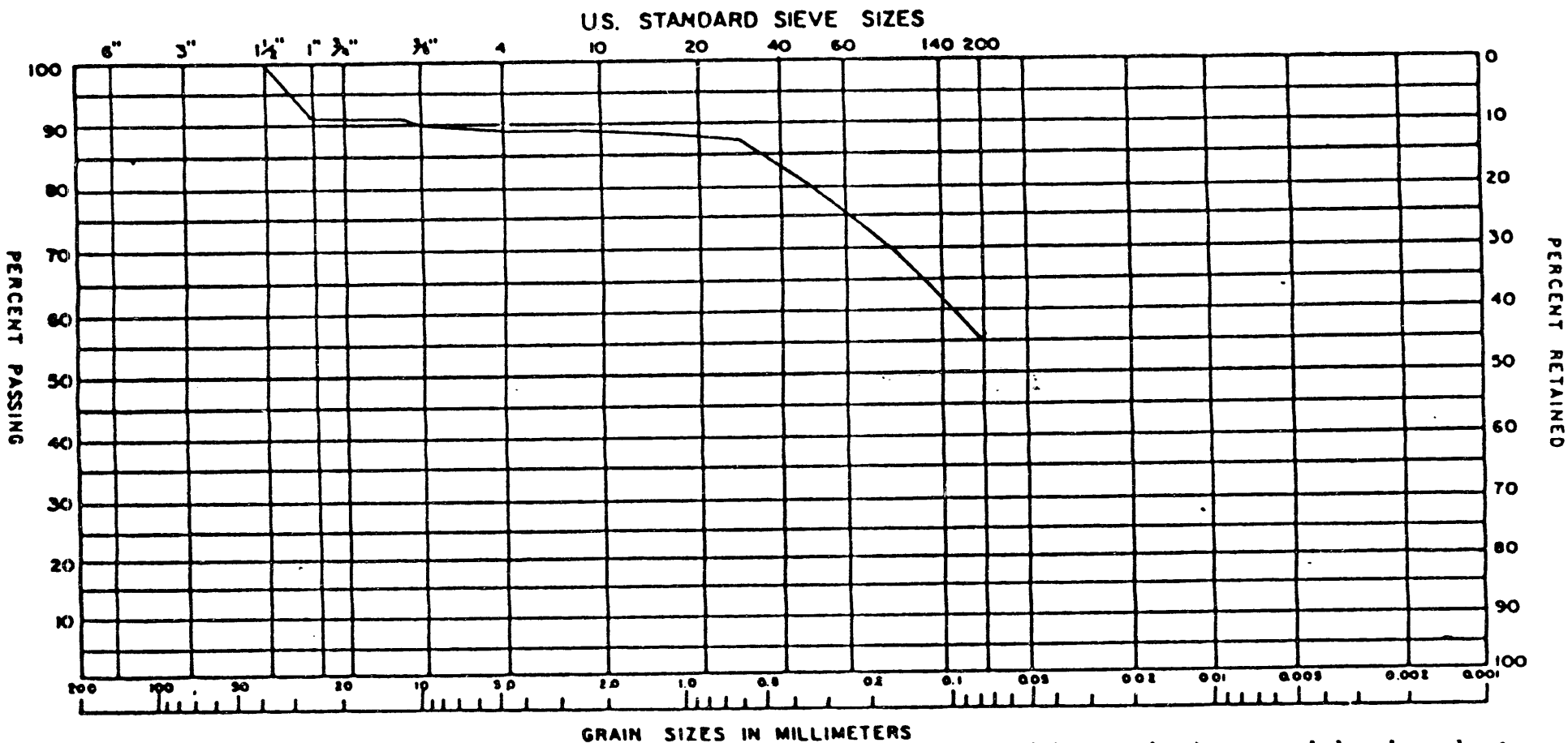
Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

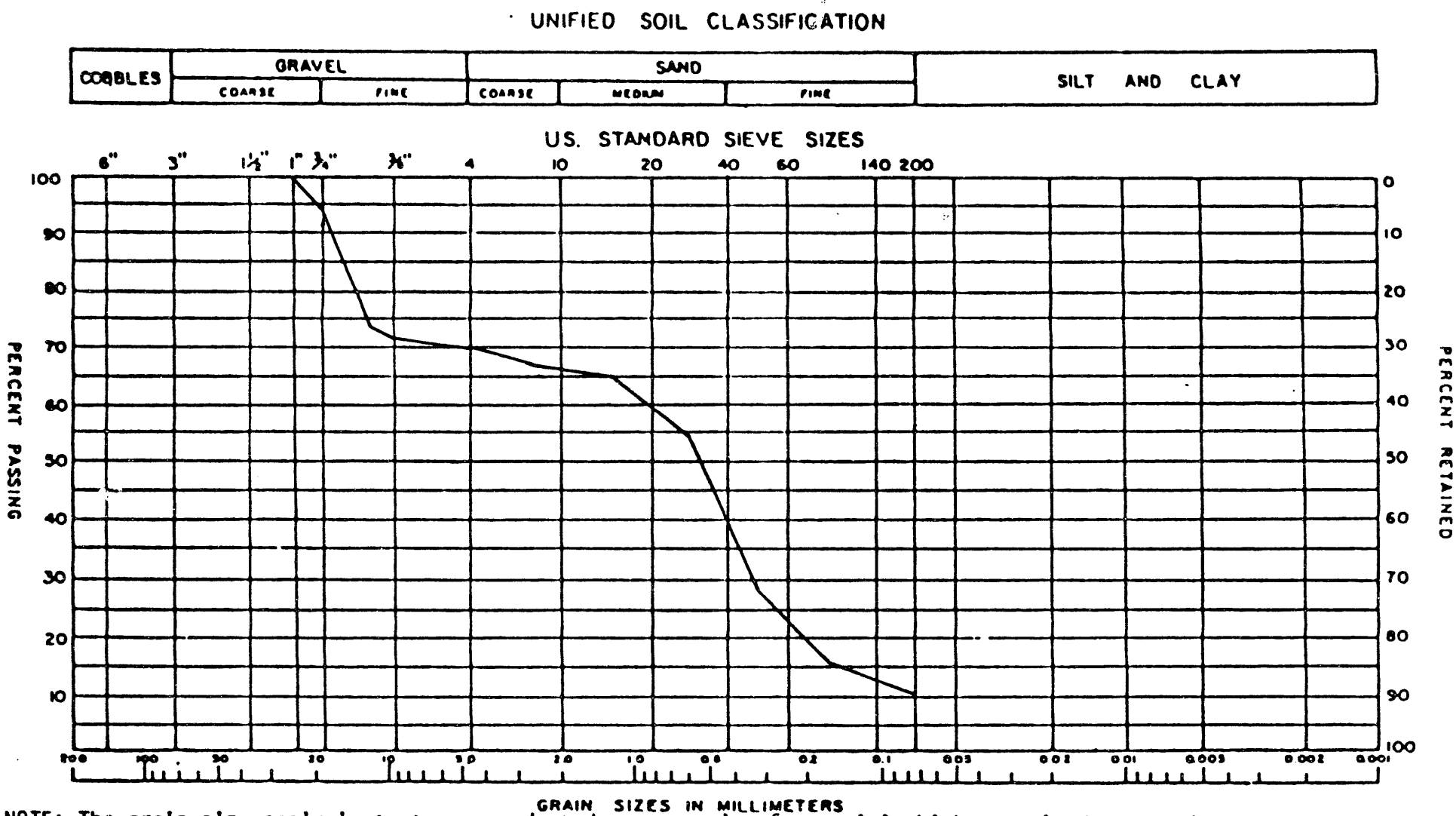
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-12	1/2 to 1½	--	--	2.69	4.9	2044
CLASSIFICATION	Silt, sandy (ML-SM)					

Project: Rifle-RFL-87-01

Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

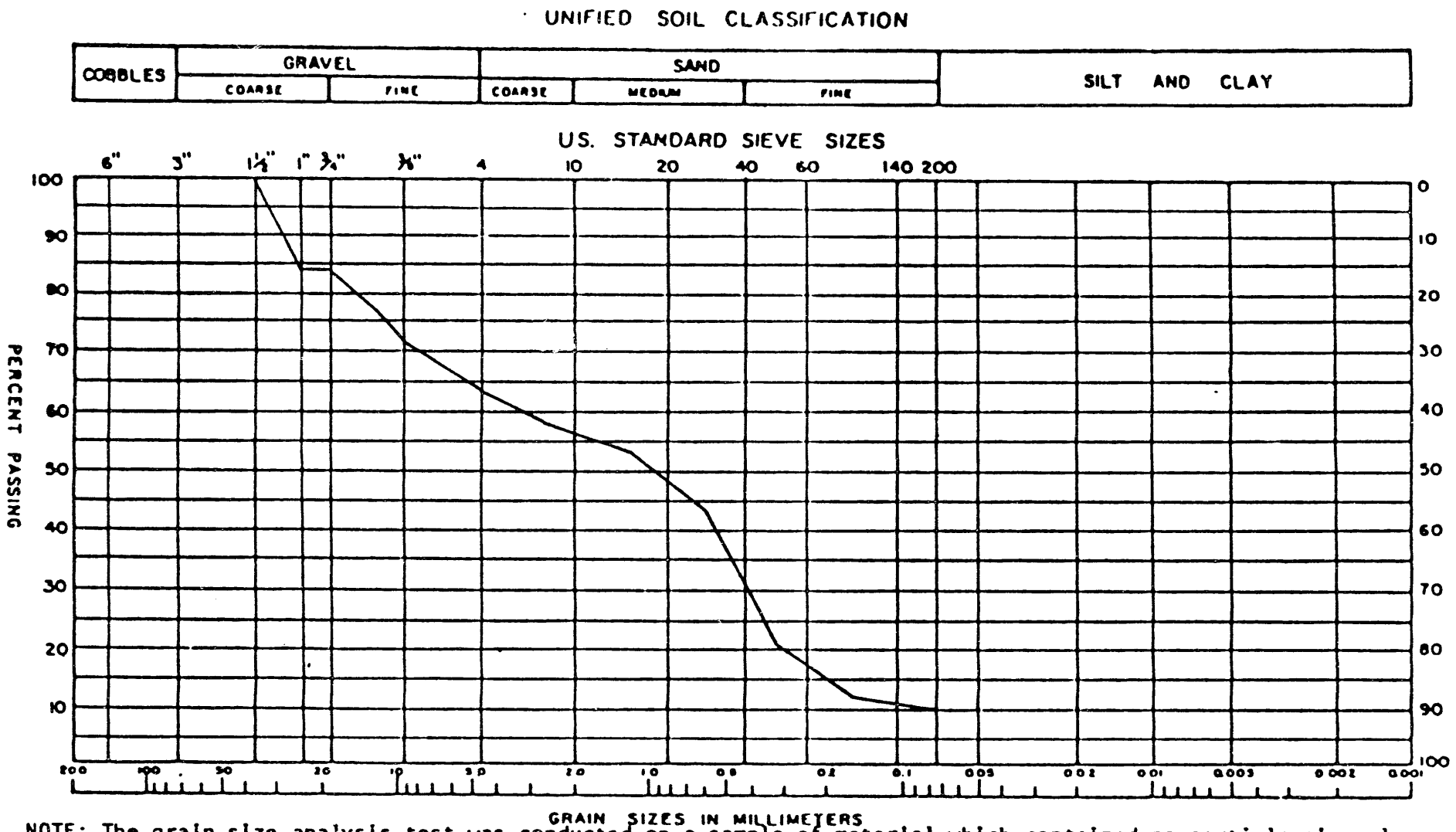


NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL --	PI --	SPECIFIC GRAVITY --	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-12	2 1/2				8.8	2045
CLASSIFICATION	Sand, gravelly, (SP)					

Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-12	6	--	--	--	7.6	2046
CLASSIFICATION	Sand, gravelly, (SP)					

Fig.

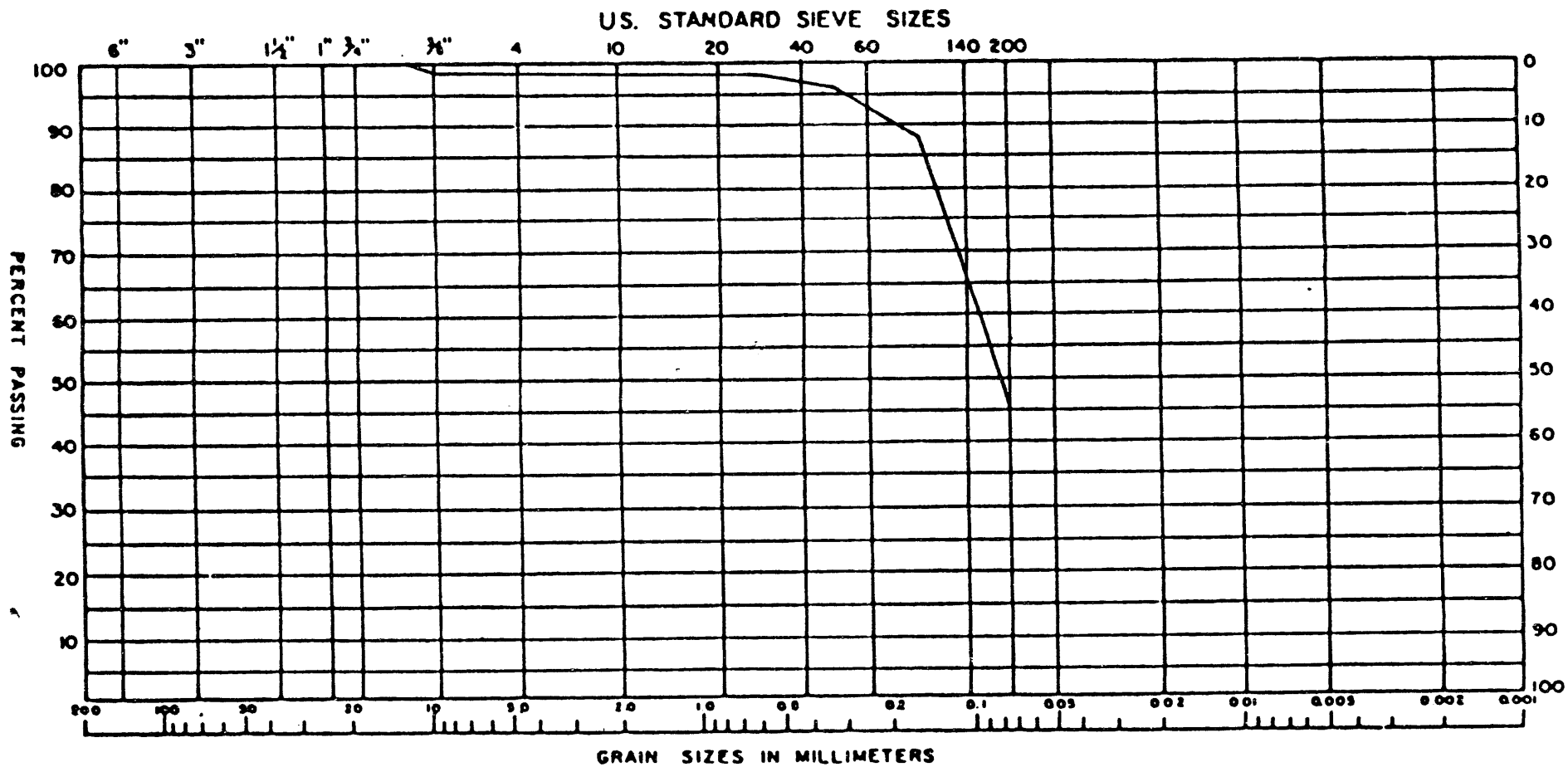
Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-13	2	--	--	--	5.1	2047
CLASSIFICATION	Sand, very clayey, (SC-CL)					

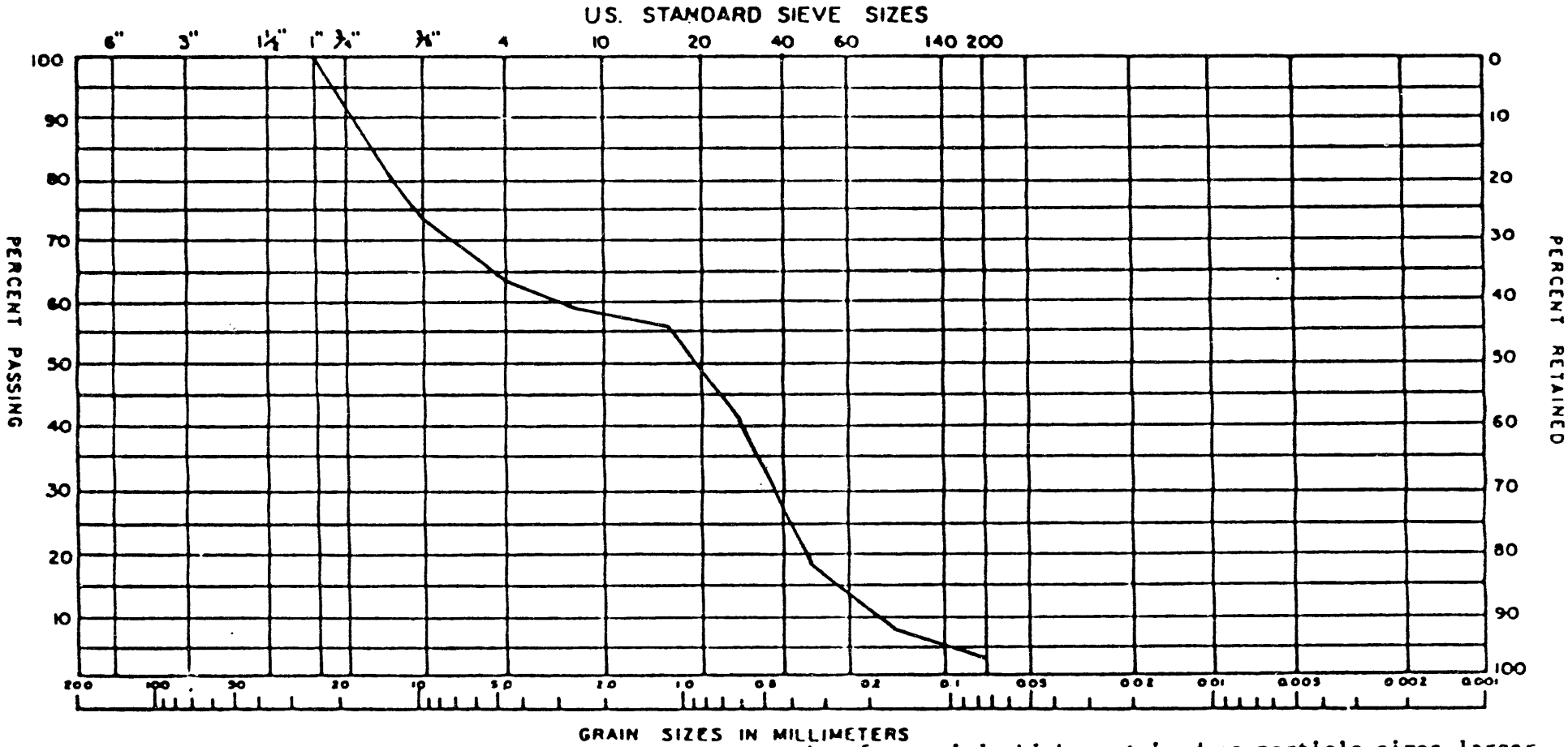
Fig.

Project: Rifle RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-13	10	--	--	--	17.9	2048
CLASSIFICATION	Sand, gravelly (SP)					

Fig

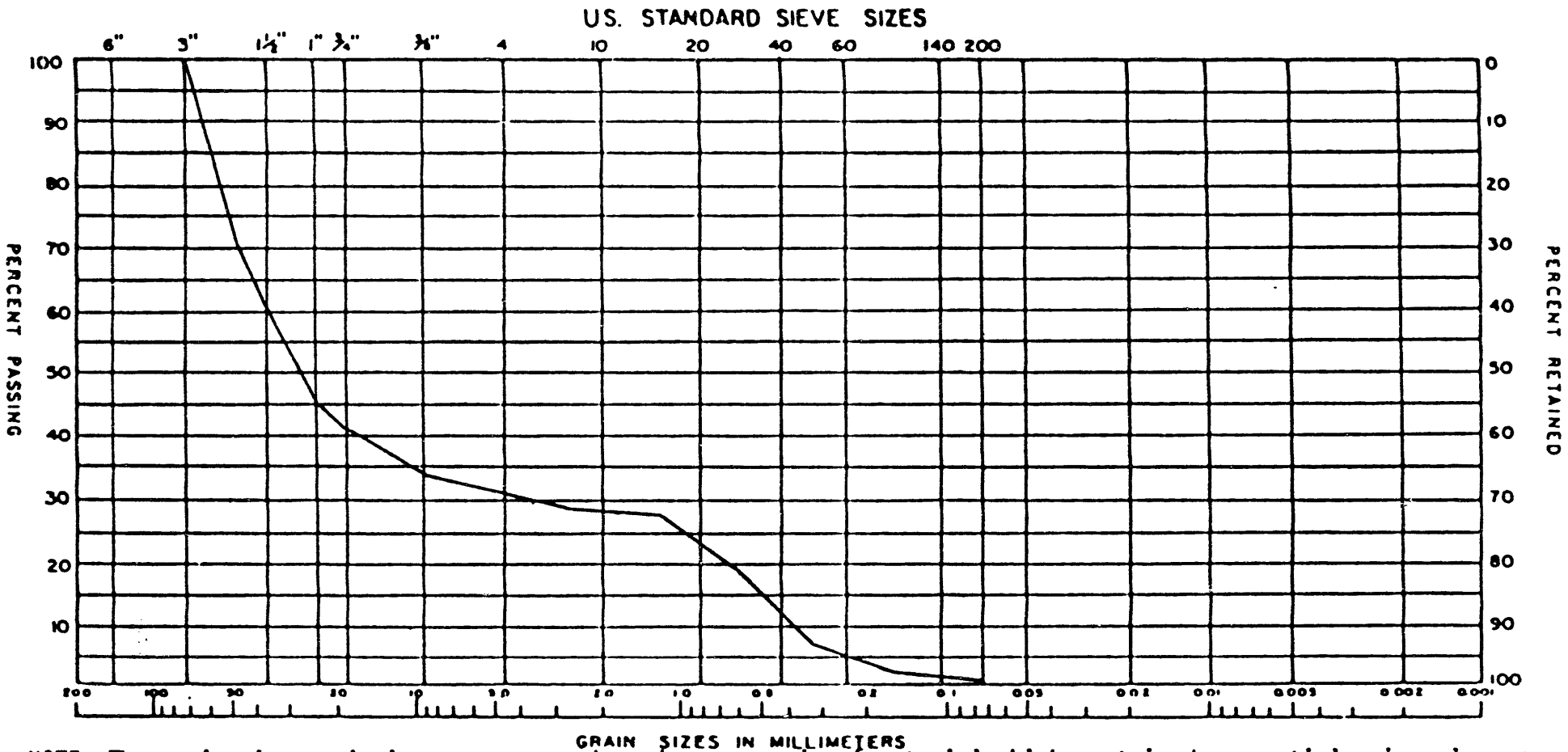
Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 6 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-14	5	--	--	2.68	5.2	2049
CLASSIFICATION Gravel, sandy, (GP)						

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MNT-14 at 7 Feet

LABORATORY SAMPLE NUMBER: 2050

SAMPLE DESCRIPTION: Gravel and cobbles,sand matrix,(GP)

INITIAL MOISTURE CONTENT: 16.8 percent

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MNT-15 at 2 1/2 Feet

LABORATORY SAMPLE NUMBER: 2051

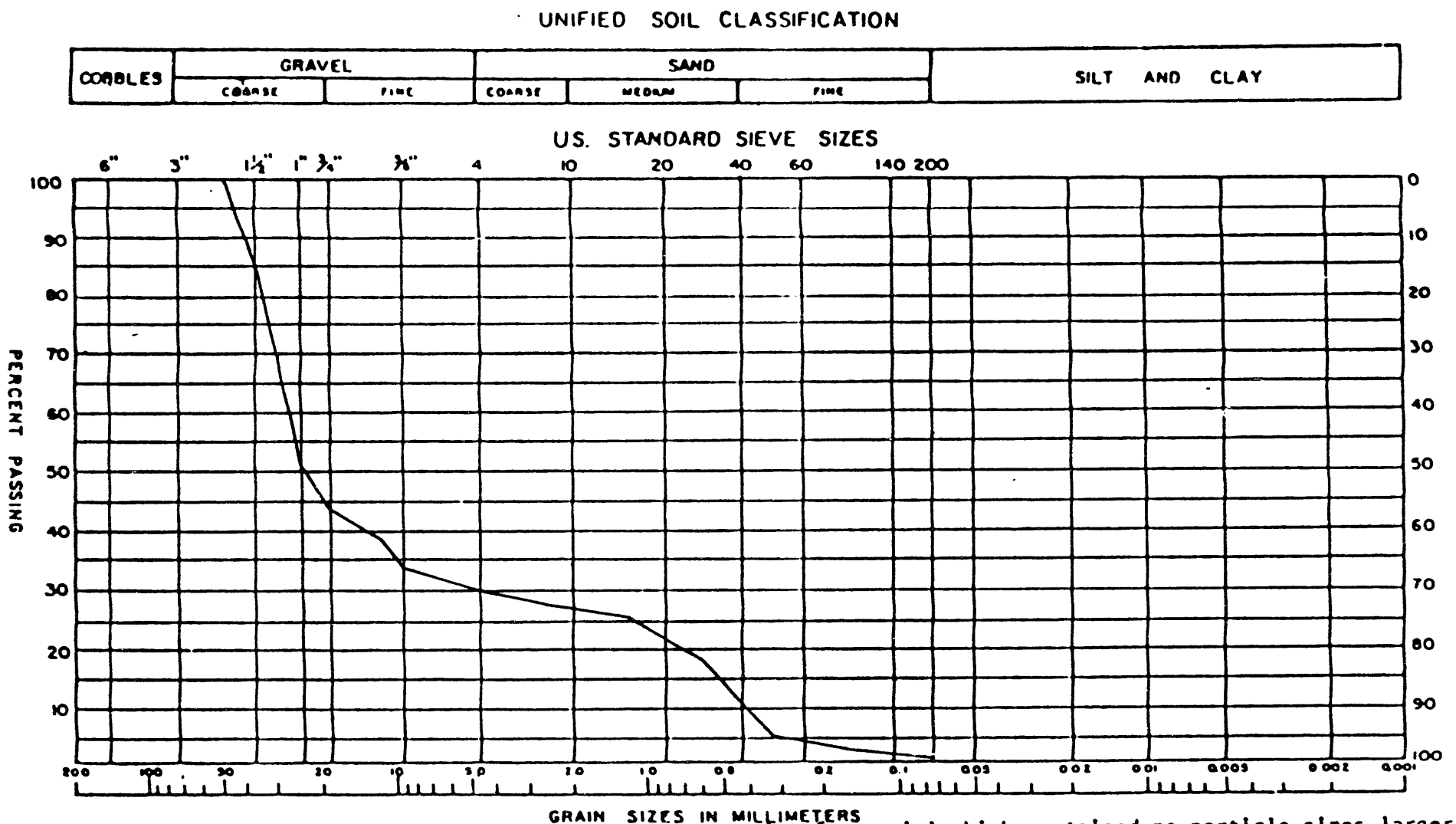
SAMPLE DESCRIPTION: Gravel and cobbles,sand matrix,(GP)

INITIAL MOISTURE CONTENT: 2.4 percent

Project: Rifle-RFL-87-01
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-15	5	--	--	--	6.2	2052
CLASSIFICATION	Gravel, sandy (GP)					

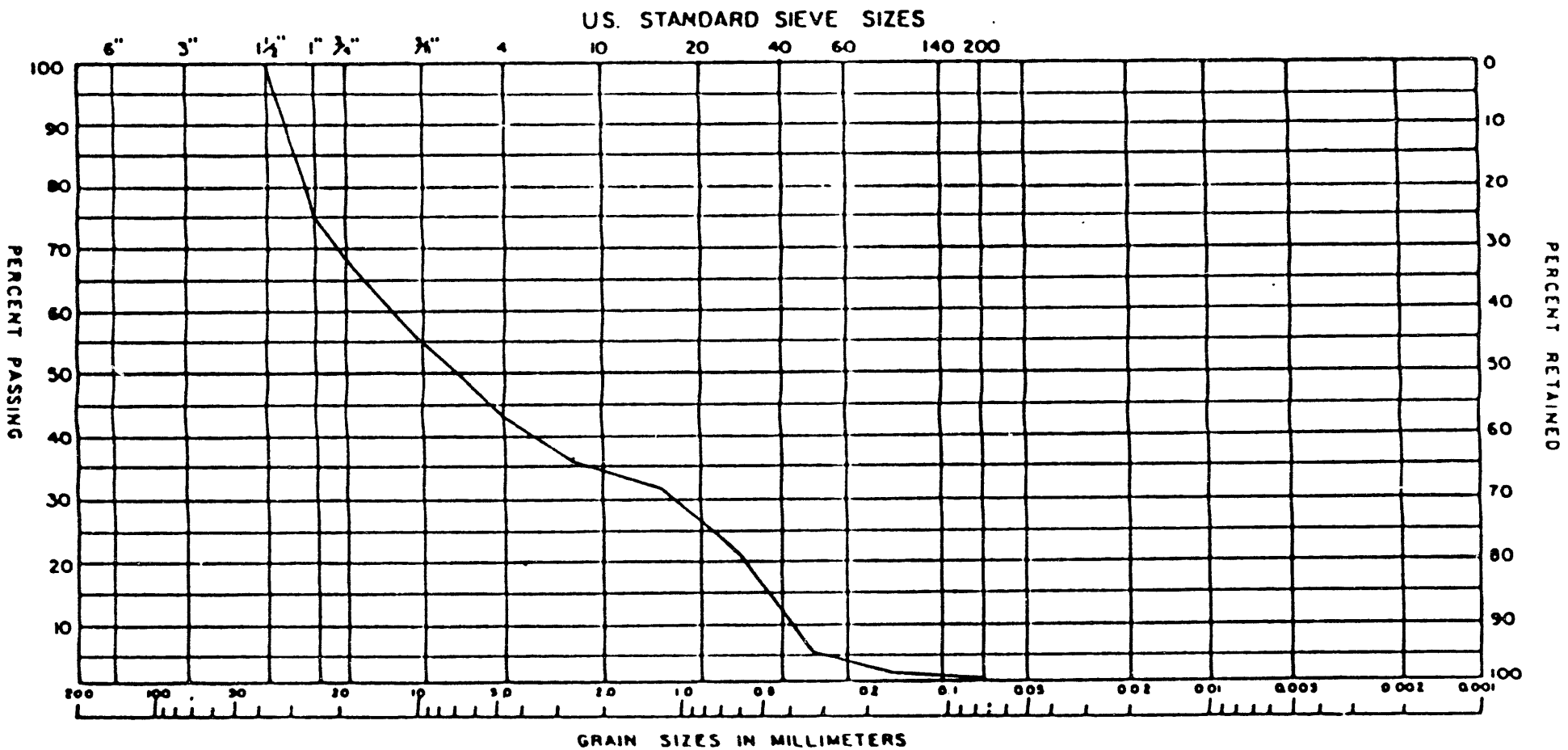
Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



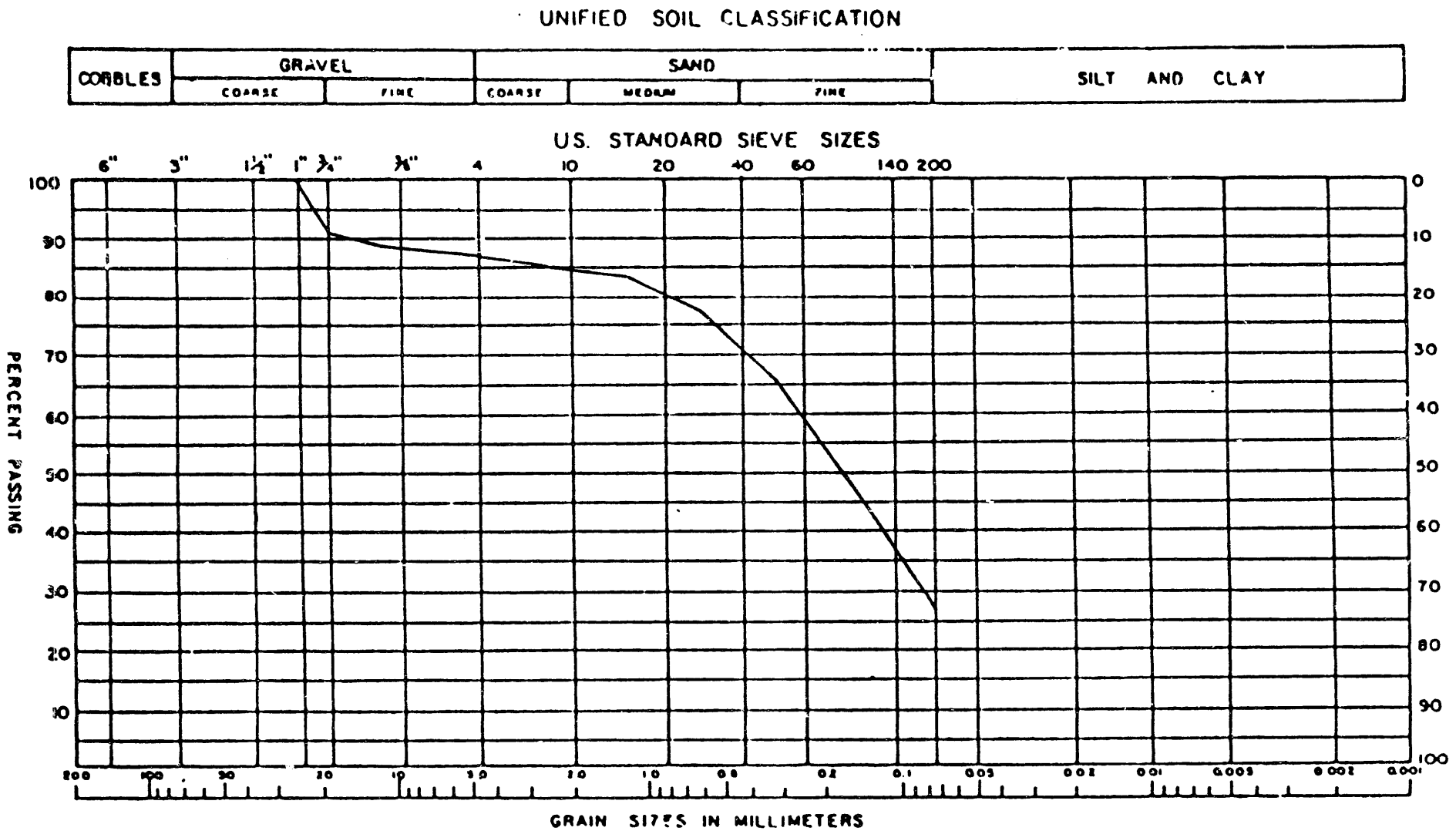
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
		--	--	--		
MNT-15	7 1/2				8.5	2053
CLASSIFICATION	Gravel, very sandy (GP)					

Project: Rifle-RFL-87-01

Job Number 187054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-16C	2 1/2	--	--	--	--	2054
CLASSIFICATION Sand, gravelly, silty (SM)						

Fig

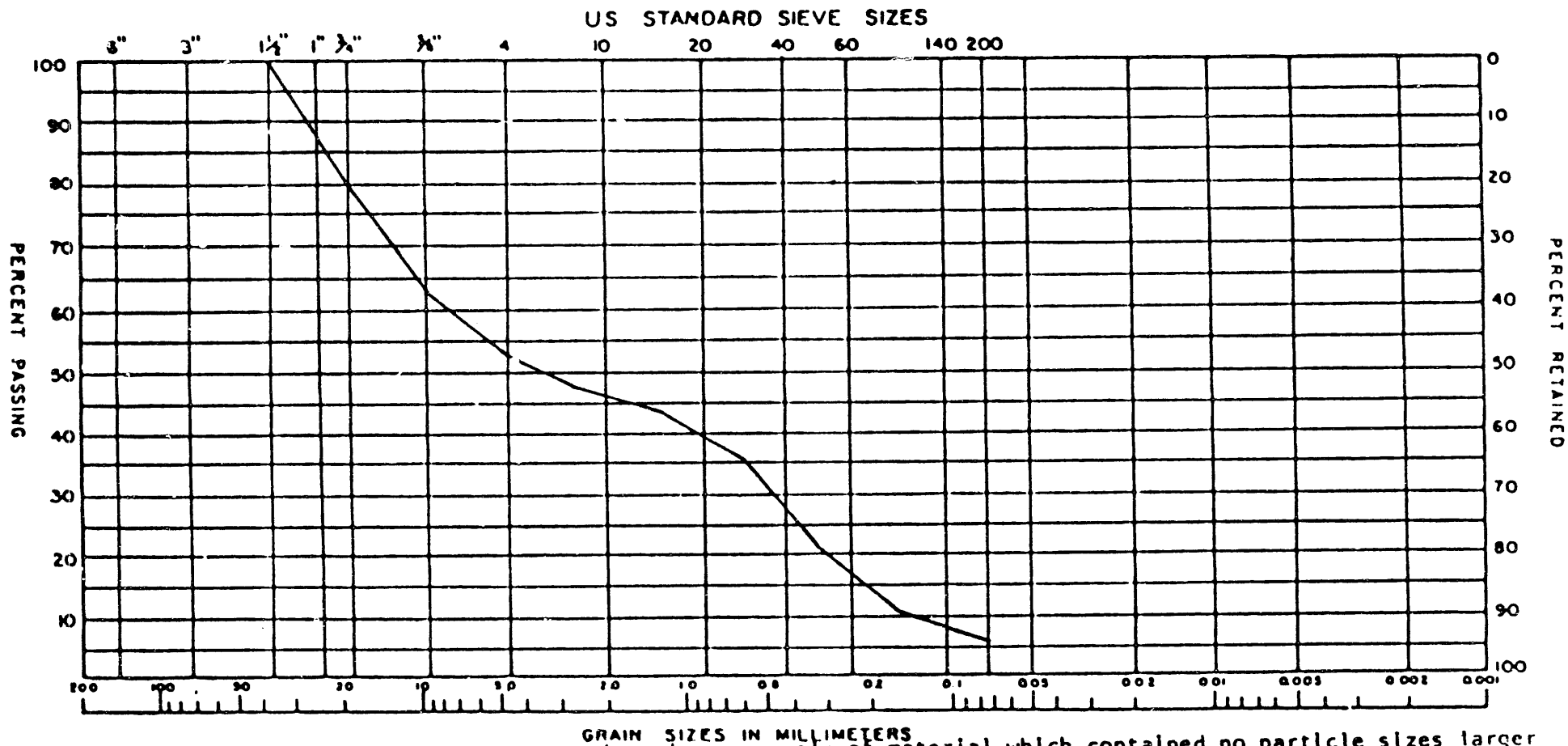
Project: Rifle-RFL-87-01

Job Number M8705-GE

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-16	5	--	--	--	4.1	2055
CLASSIFICATION	Gravel and sand, (GP-SP)					

Fig.

Project: RFL-87-01, Rifle, Colorado

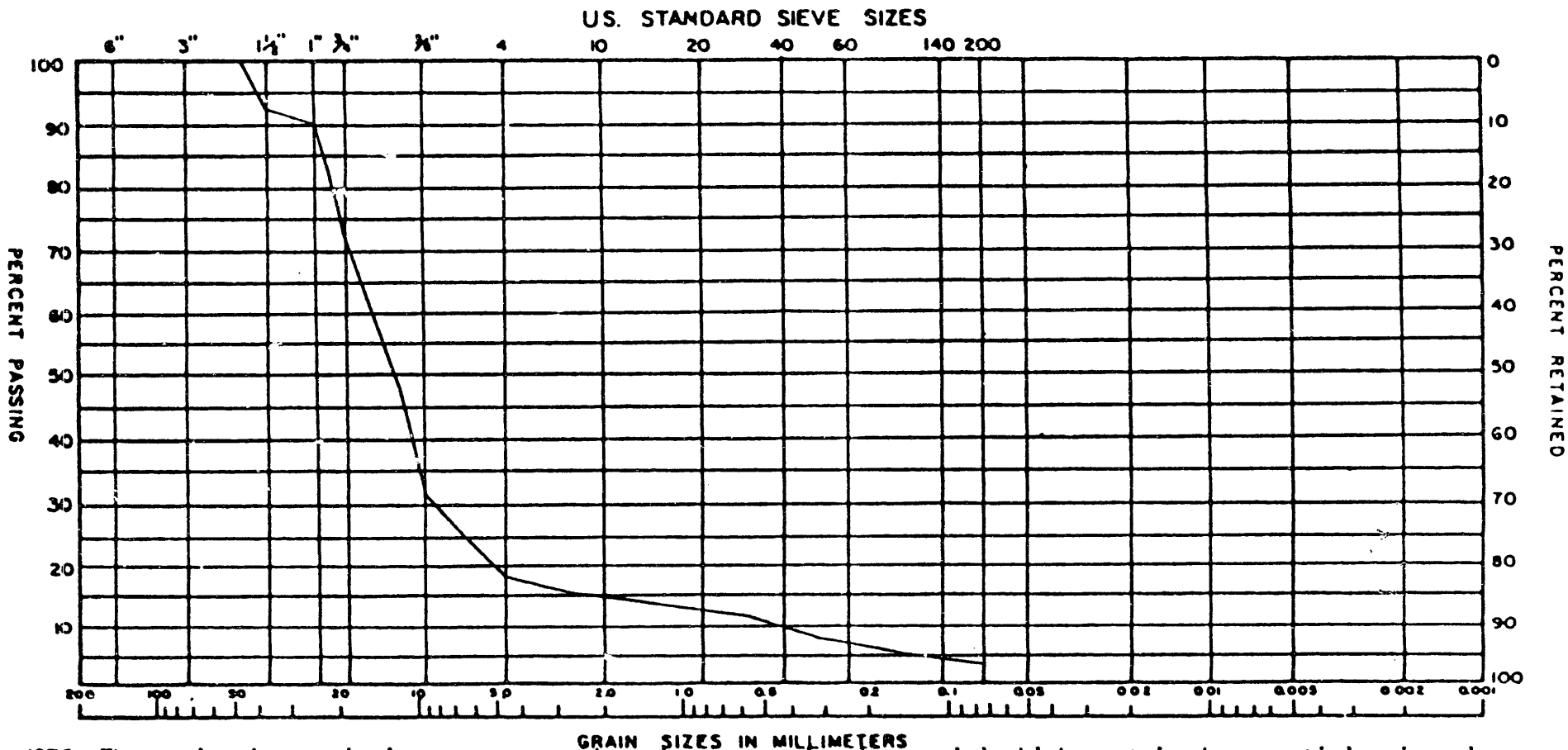
Job Number N27254GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

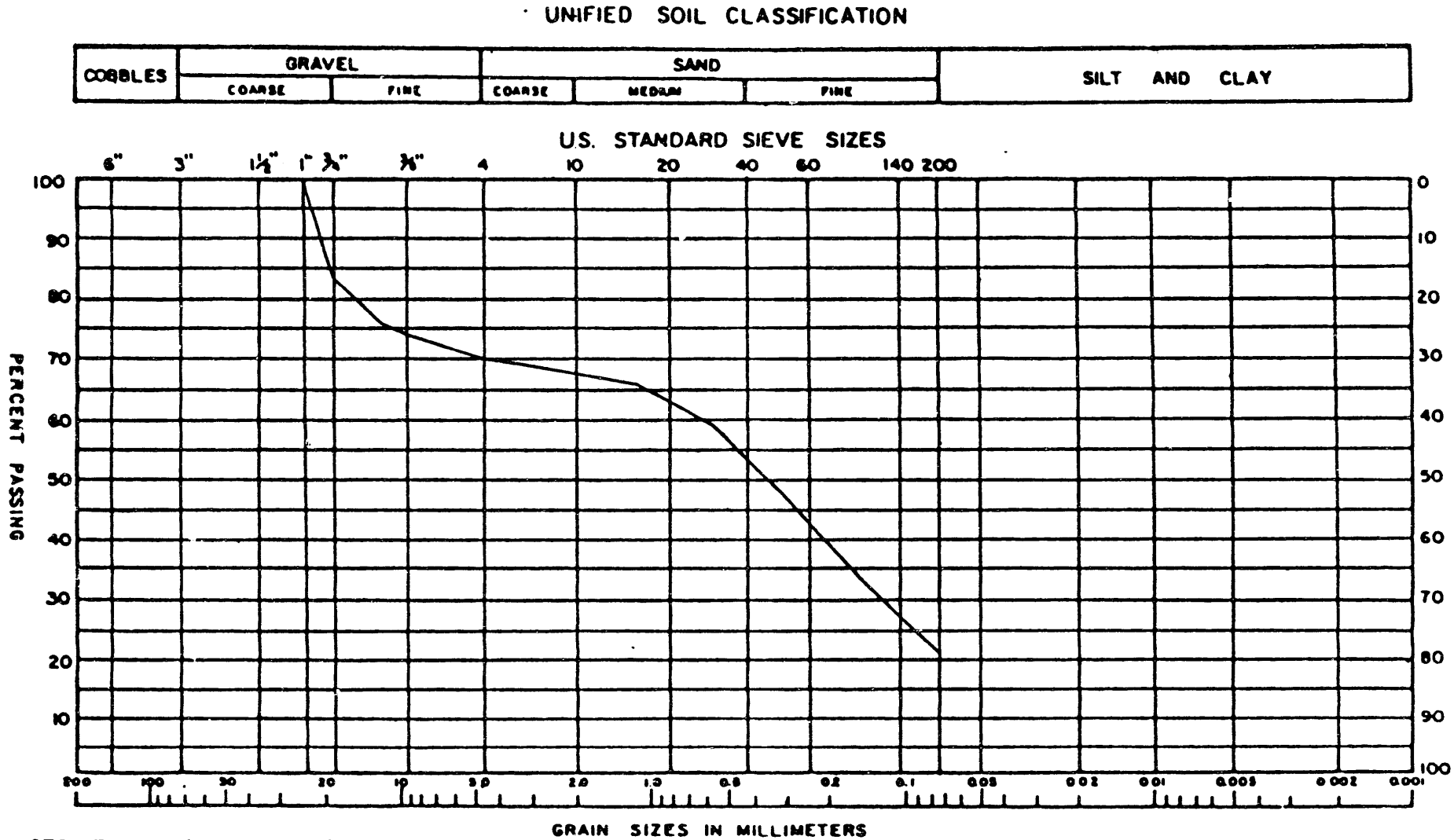
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
M NT 17	12	--	--	----	9.3	2183
CLASSIFICATION	Gravel, sandy, (GP)					

Project: RFL-87-01, Rifle, Colorado

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig



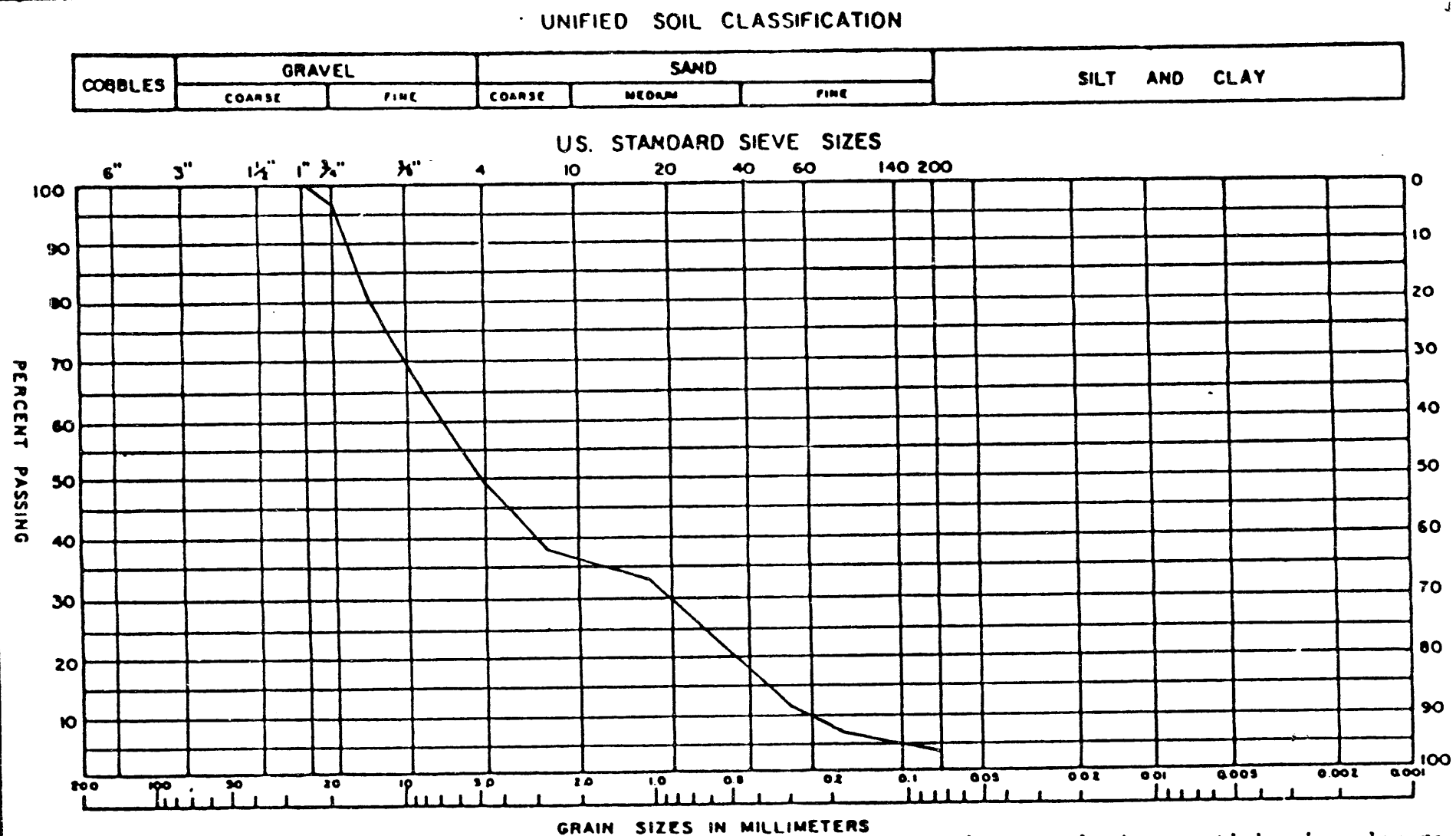
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT 18	2 1/2	--	--	----	10.0	2184
CLASSIFICATION	Sand, gravelly, silty, (SM)					

Project: RFL-87-01
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.



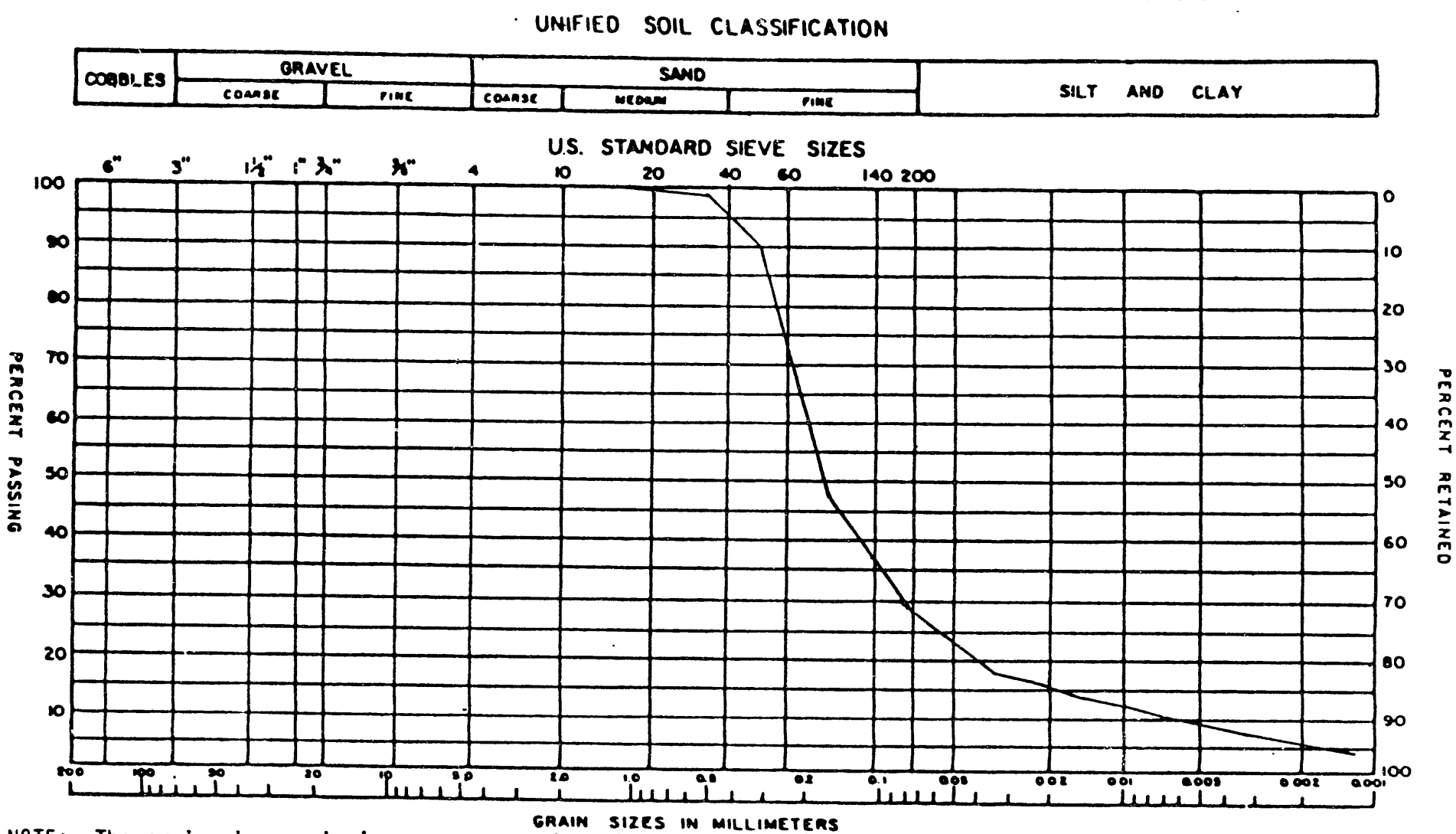
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-18	15	--	--	---	9.8	2140
CLASSIFICATION	Gravel, very sandy, (GP-SP)					

Project: RFL-87-01
Job Number: M37054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig 9



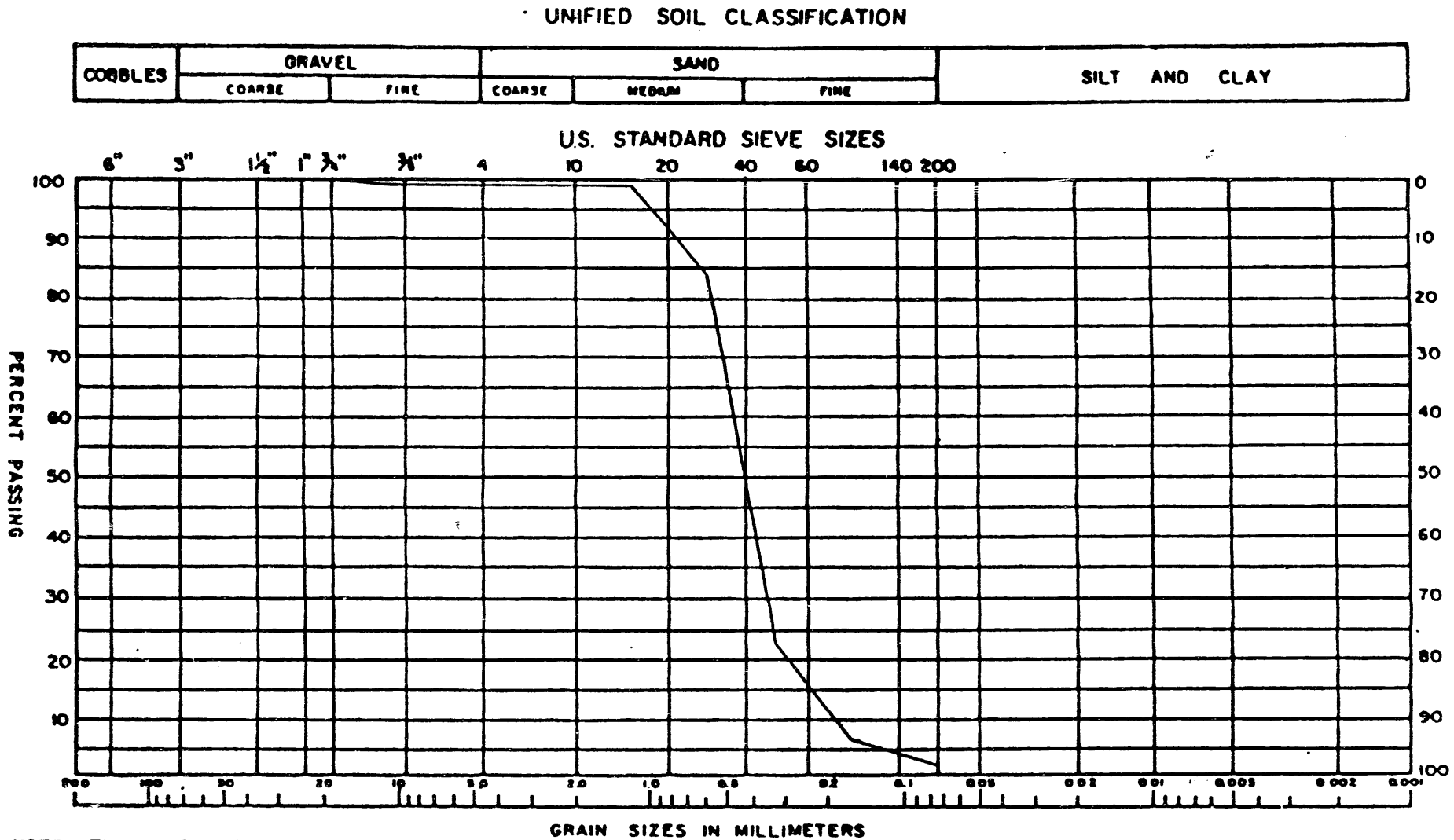
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT 19B	2	NP	NP	---	---	2185
CLASSIFICATION						

Project: RFL-87-01
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.



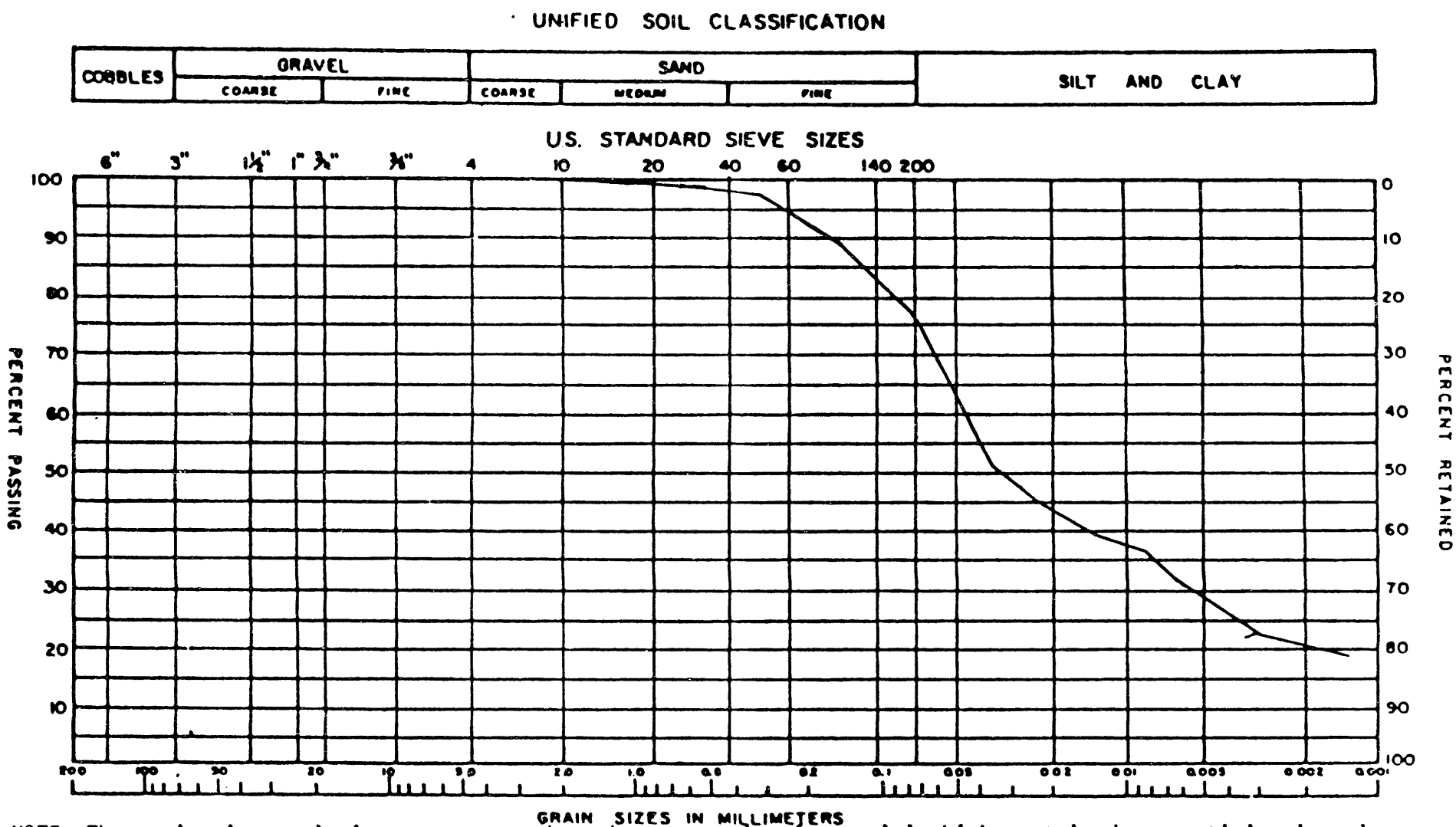
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT 19B	10	--	--	----	27.1	2186
CLASSIFICATION						

Project: RFL-87-01, Rifle, Colorado

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT 20	4	26	11	2.70	20.1	2187
CLASSIFICATION						

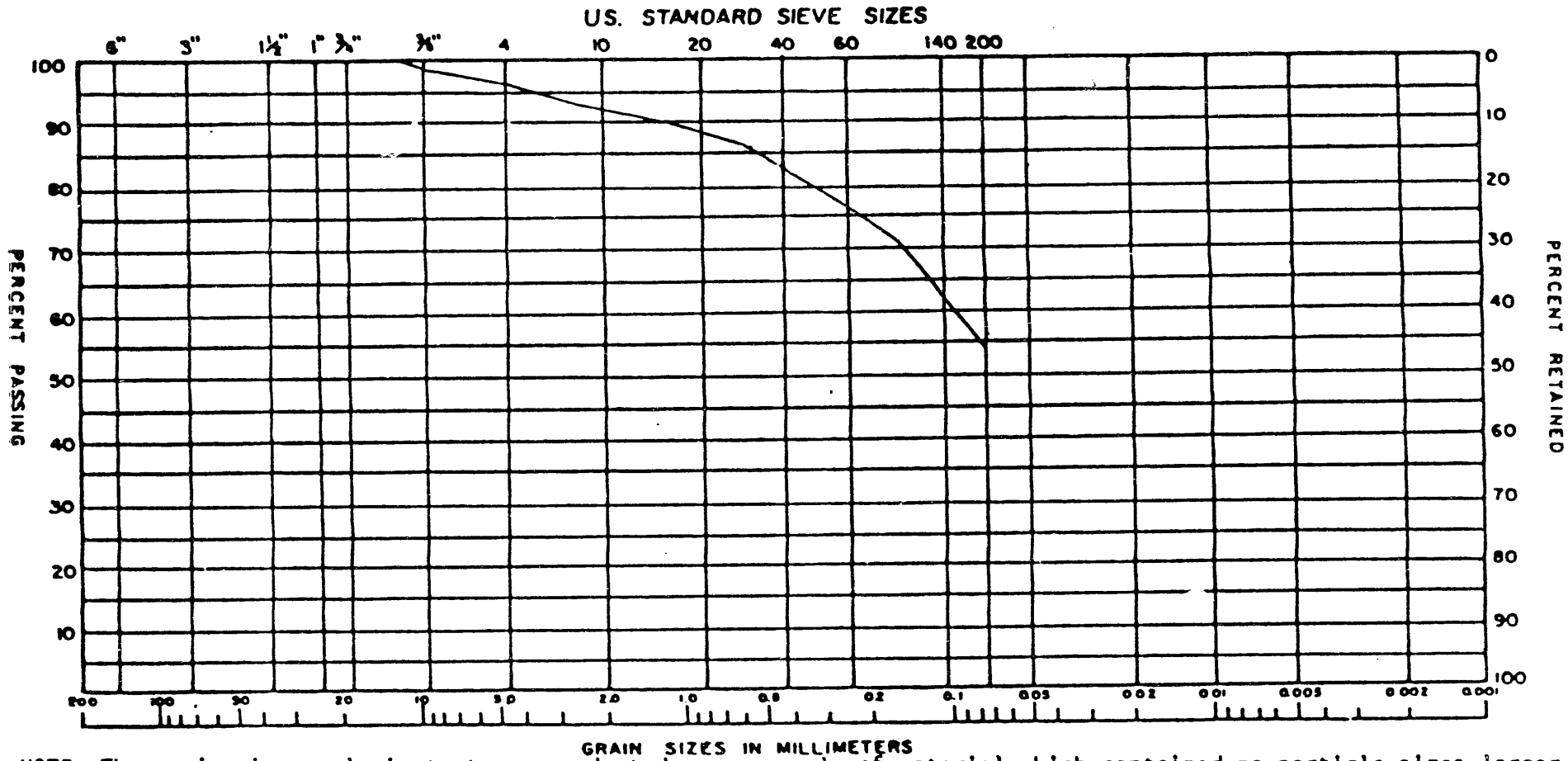
Fig

Project: TFL-87-01
Job Number: M870504GE

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT 20	6	--	--	----	26.0	2188
CLASSIFICATION						

Fig

Project: RFL-87-01

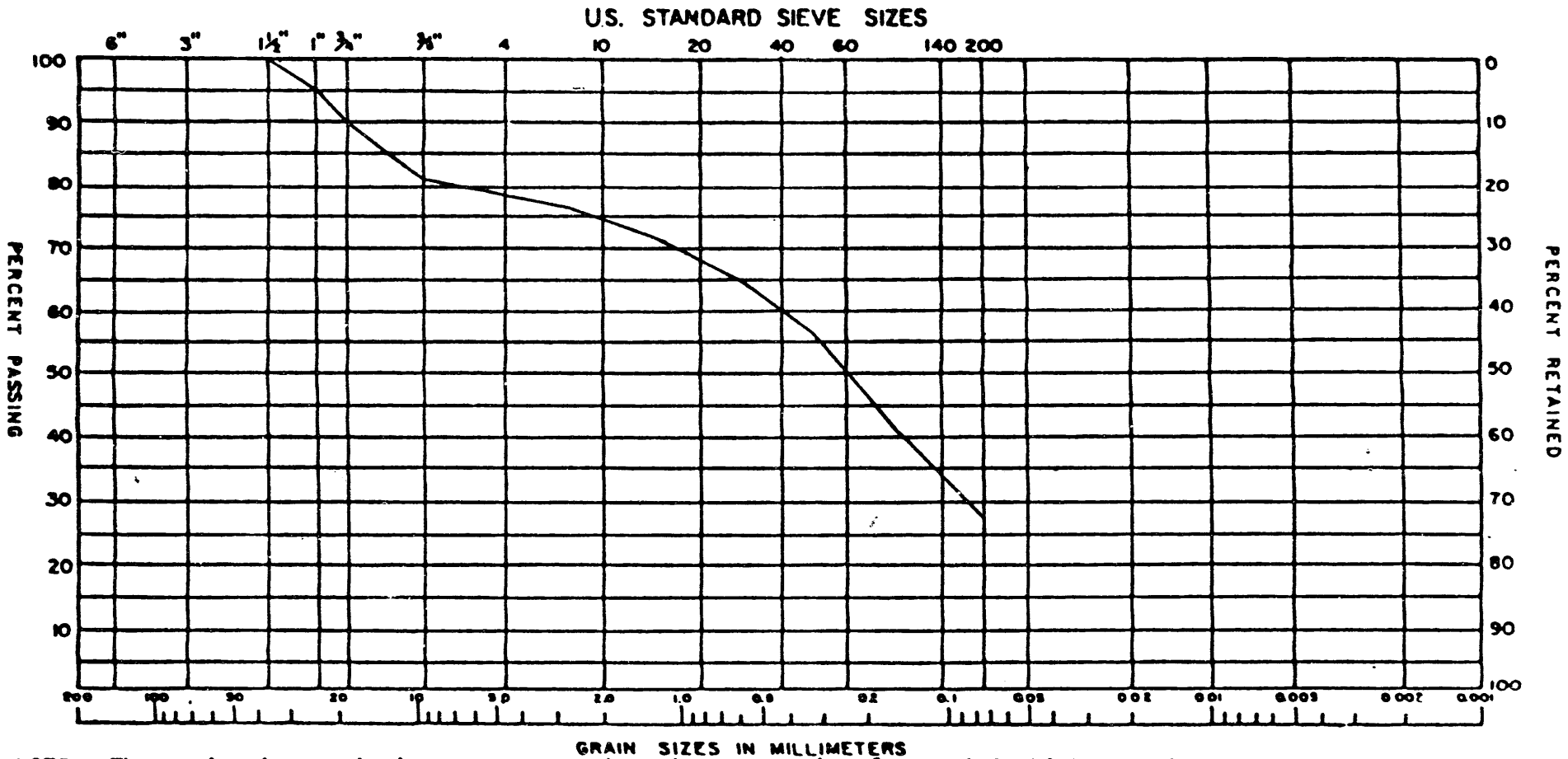
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT 20	16	--	--	----	18.7	2189
CLASSIFICATION						

Project: RFL-87-01

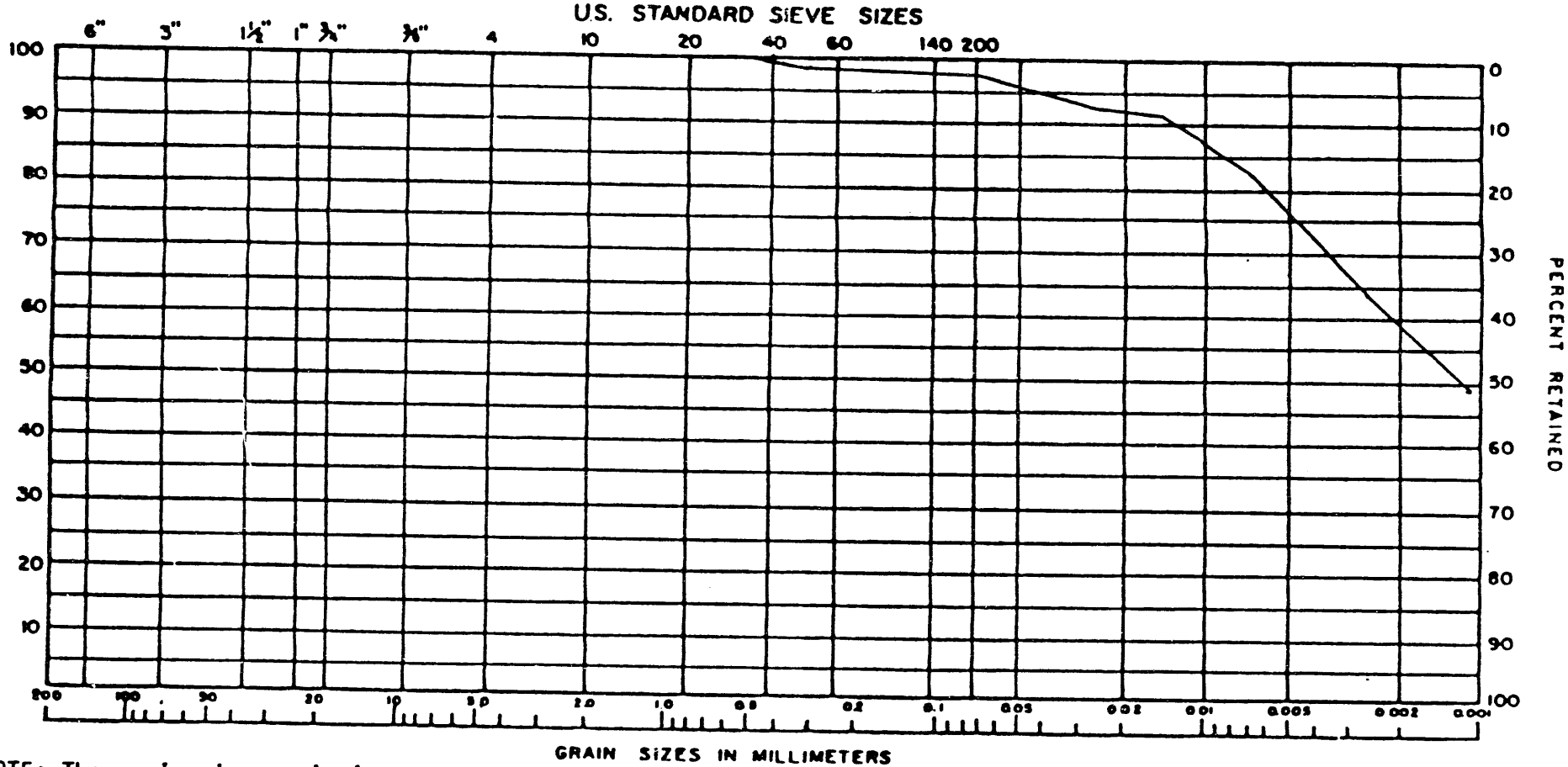
Job Number: M67054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



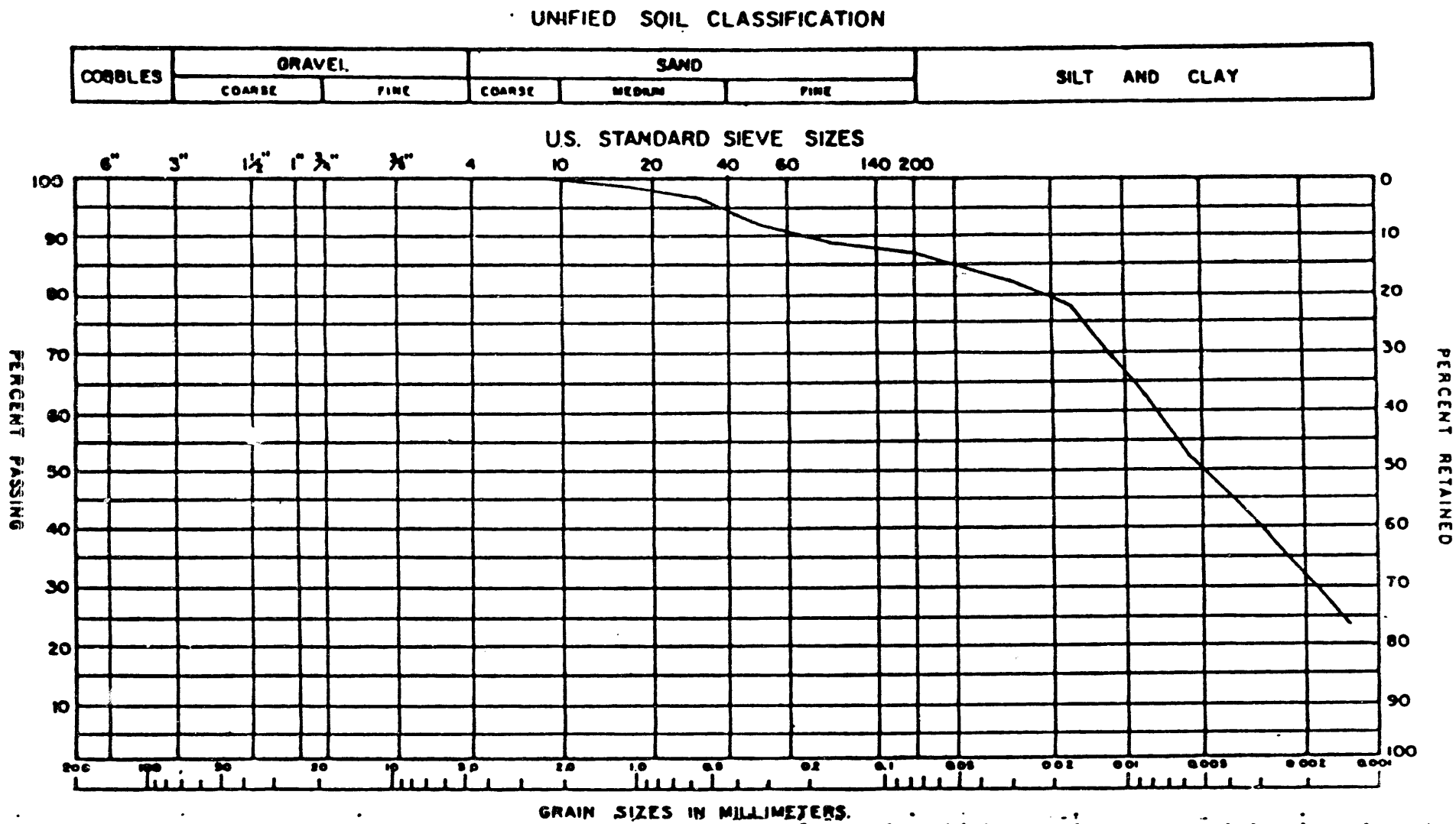
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT 21	13	66	39	----	30.5	2190
CLASSIFICATION						

Project: RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT 22	2 1/2	39	13	----	----	2191
CLASSIFICATION						

Fig

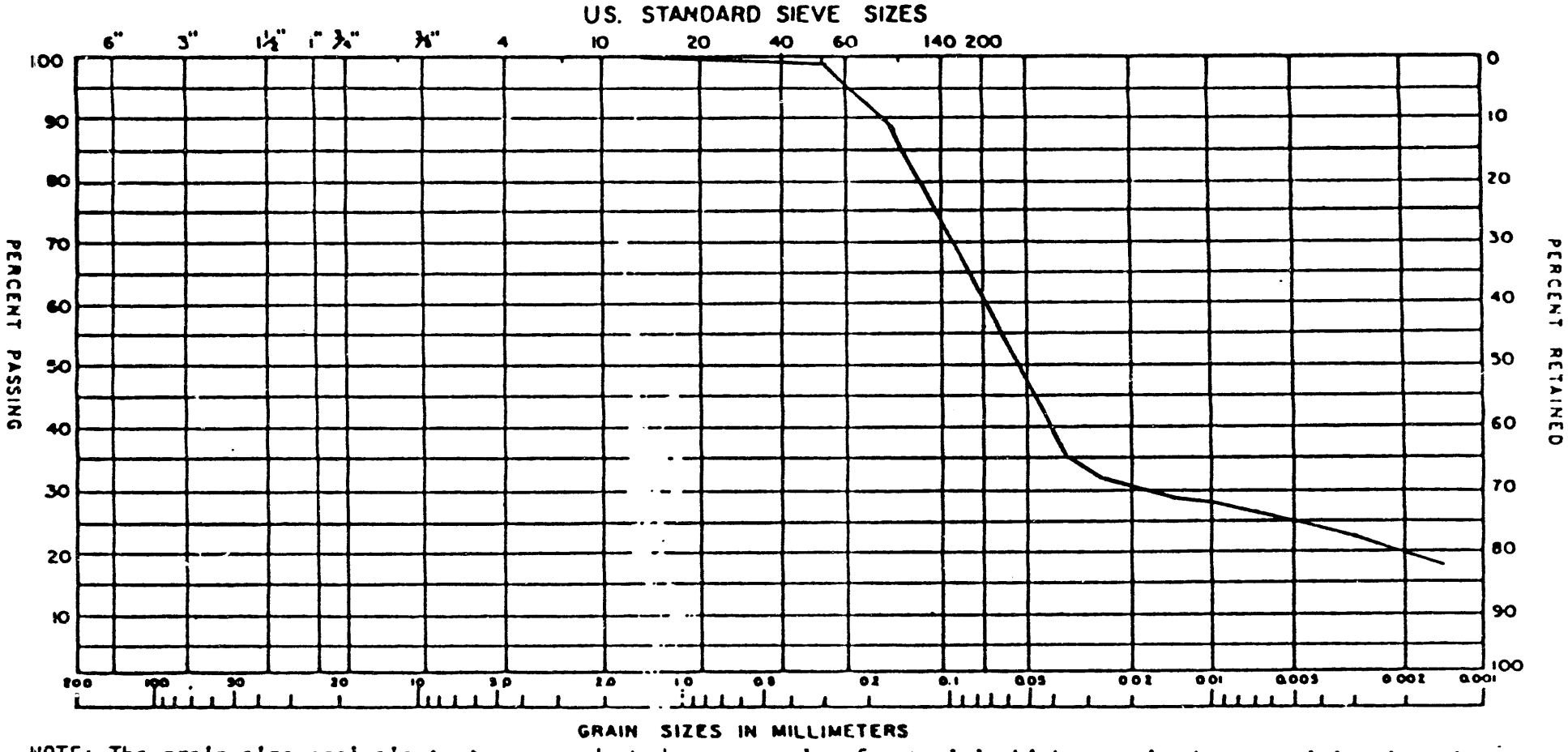
Project: RFL-87-01
MATACHICE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-22	7 1/2	--	--	----	19.6	2192
CLASSIFICATION						

Project: RFL-87-01

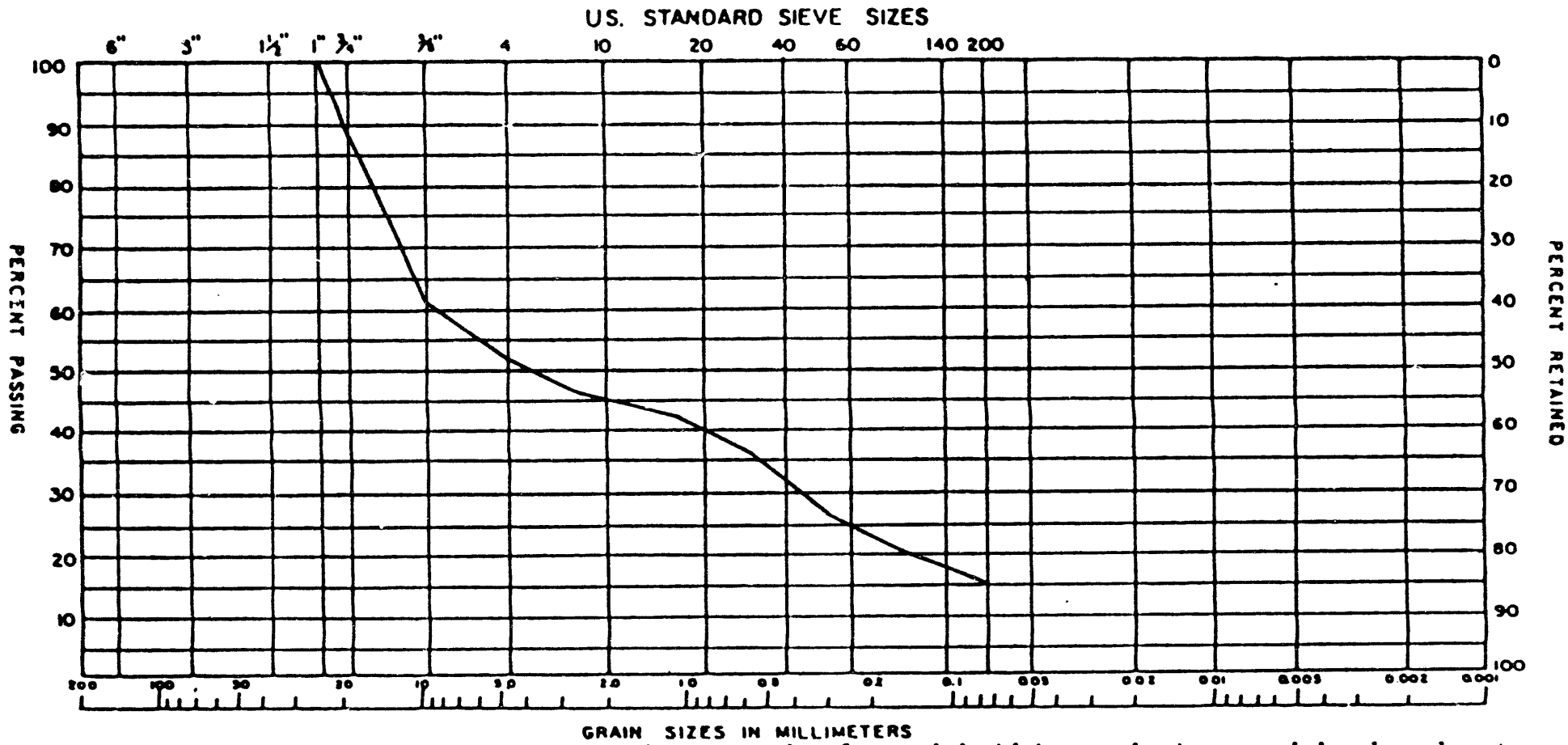
Job Number M8705463E

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNT-22	15	--	--	---	14.0	2141
CLASSIFICATION	Sand, very gravelly, silty, (SM-GM)					

Project: Rifle-RFL-87-01

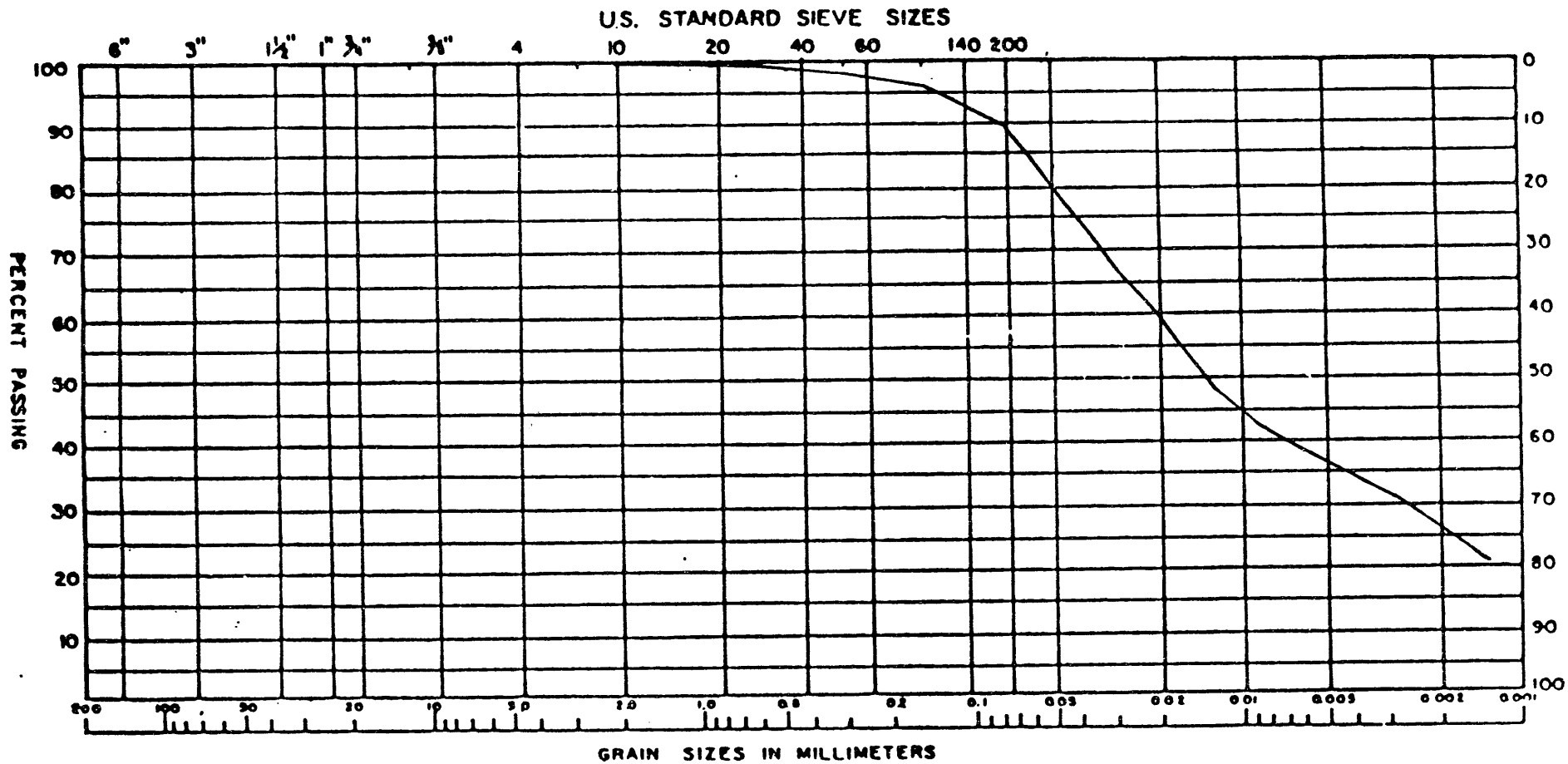
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

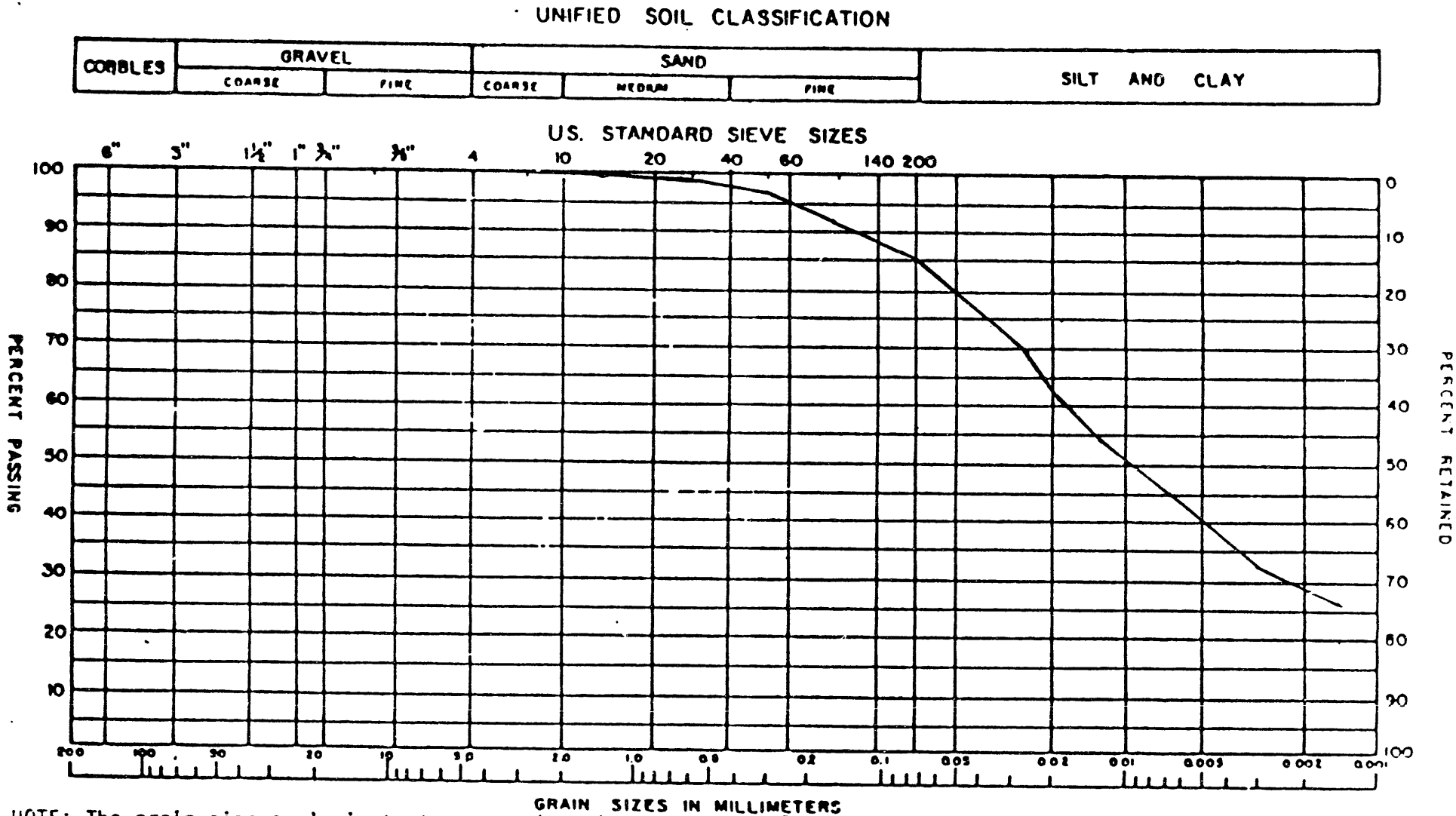


NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNS-2	1/2' to 1'	26	10	--	--	2056
CLASSIFICATION						

Project: Rifle-RFL-87-01
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNS-3	1/2' to 1'	34	16	--	7.5	2057
CLASSIFICATION						

Fig:

Project: Rifle-RFL-87-01

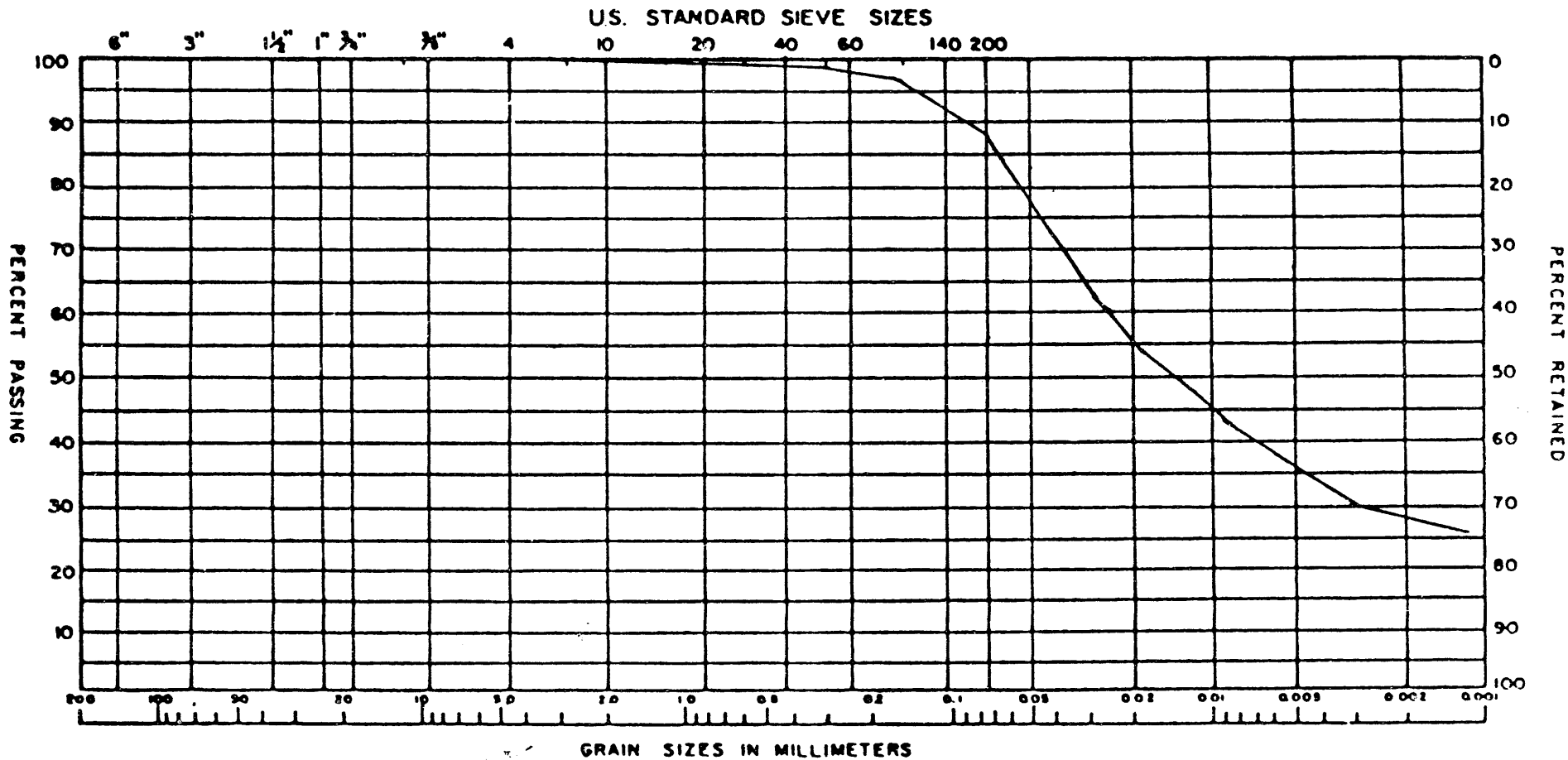
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNS-4	1/2' to 1'	30	15	2.73	14.7	2058
CLASSIFICATION						

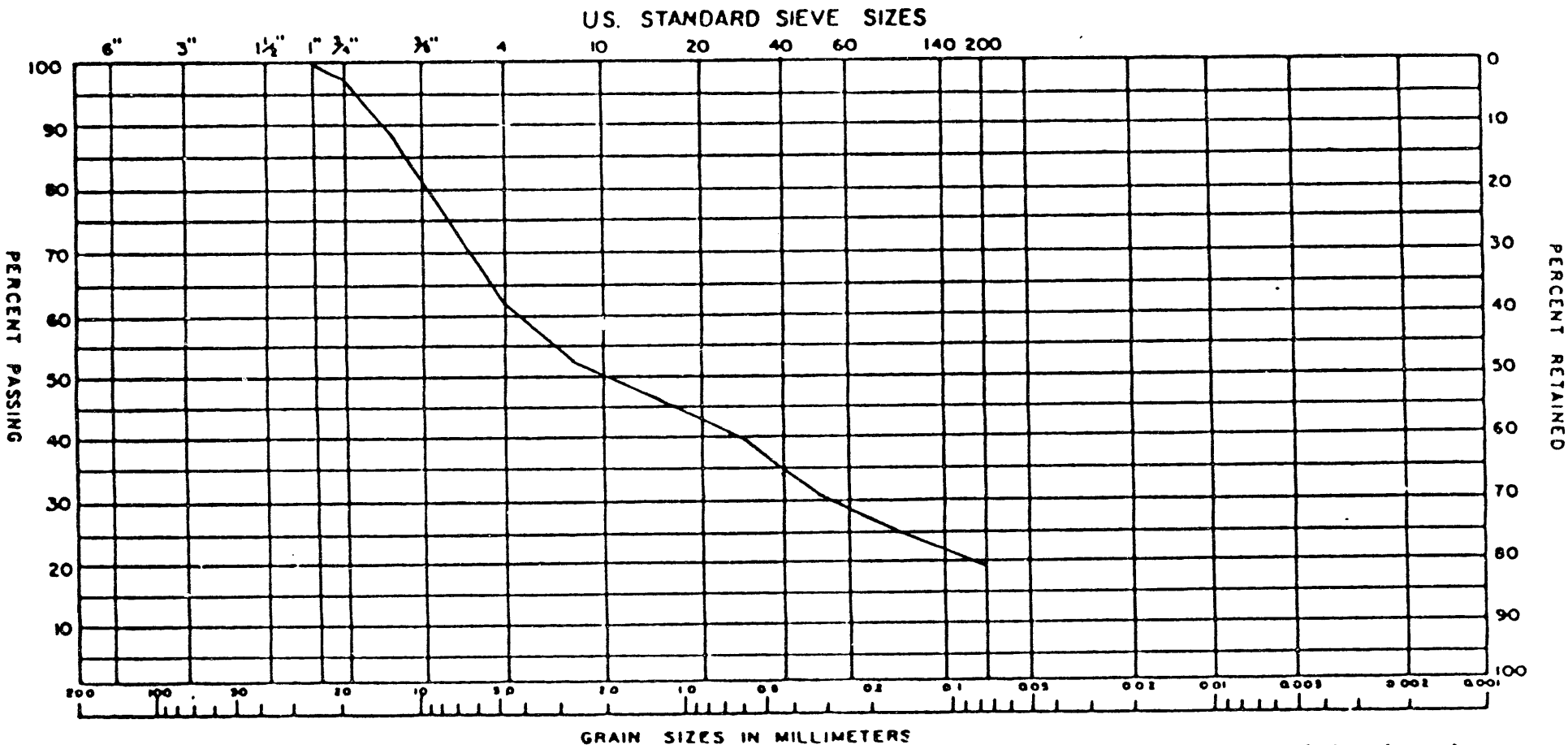
Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



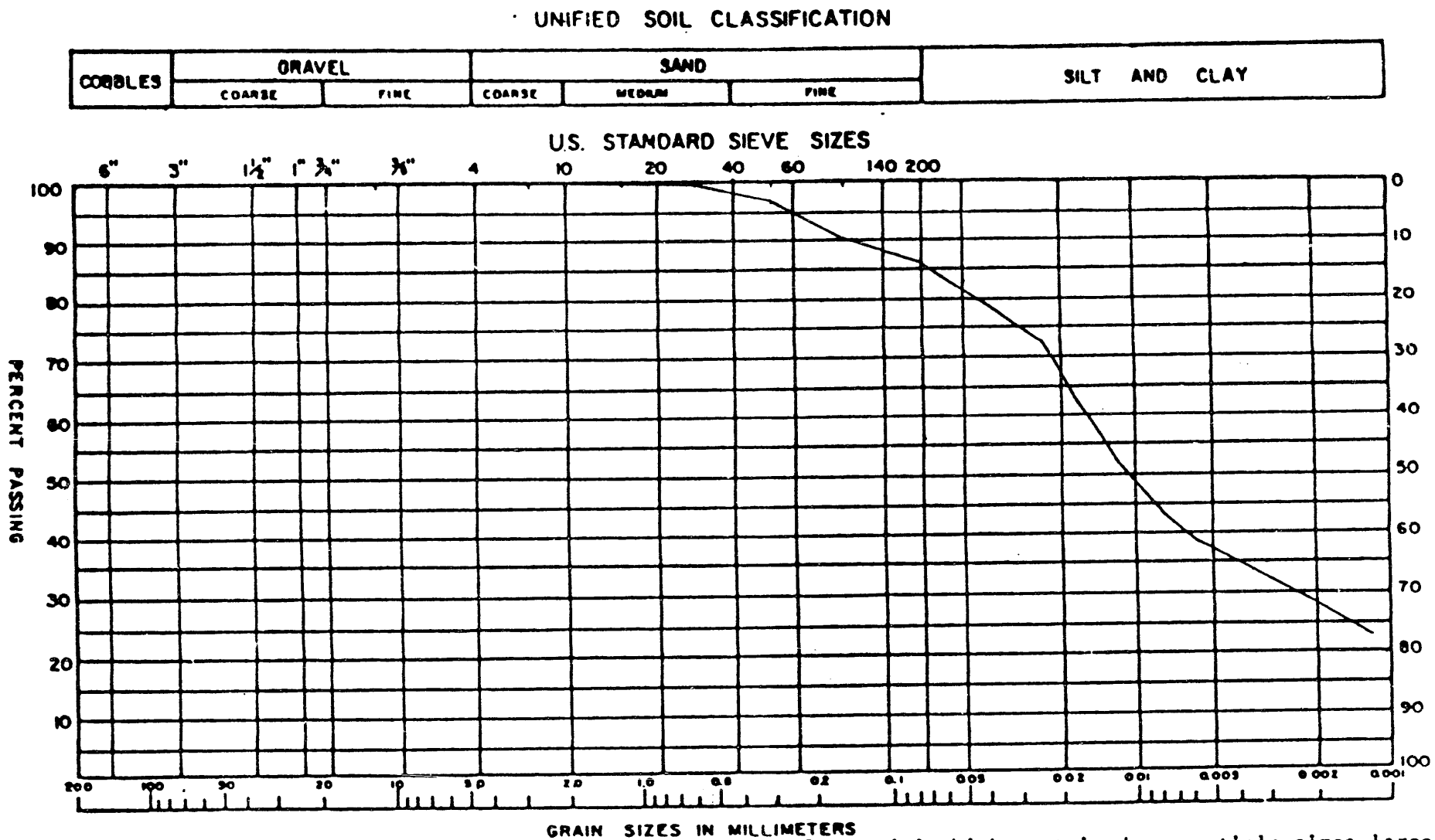
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNS-5	1/2	--	--	--	3.0	2059
CLASSIFICATION	Sand, very gravelly, silty, (SM)					

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNS-8	1/2' to 1'	40	21	2.76	--	2060
CLASSIFICATION						

Fig.

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MNS-8 at 1/2 Foot to 1 Foot

LABORATORY SAMPLE NUMBER: 2060

SAMPLE DESCRIPTION:

TRIAXIAL PERMEABILITY: 6.2×10^{-8} cm/sec

CONFINING PRESSURE: 2 psi

INITIAL DRY DENSITY: 95.9 pcf

INITIAL MOISTURE CONTENT: 19.5 percent

Project: Rifle-RFL-87-01

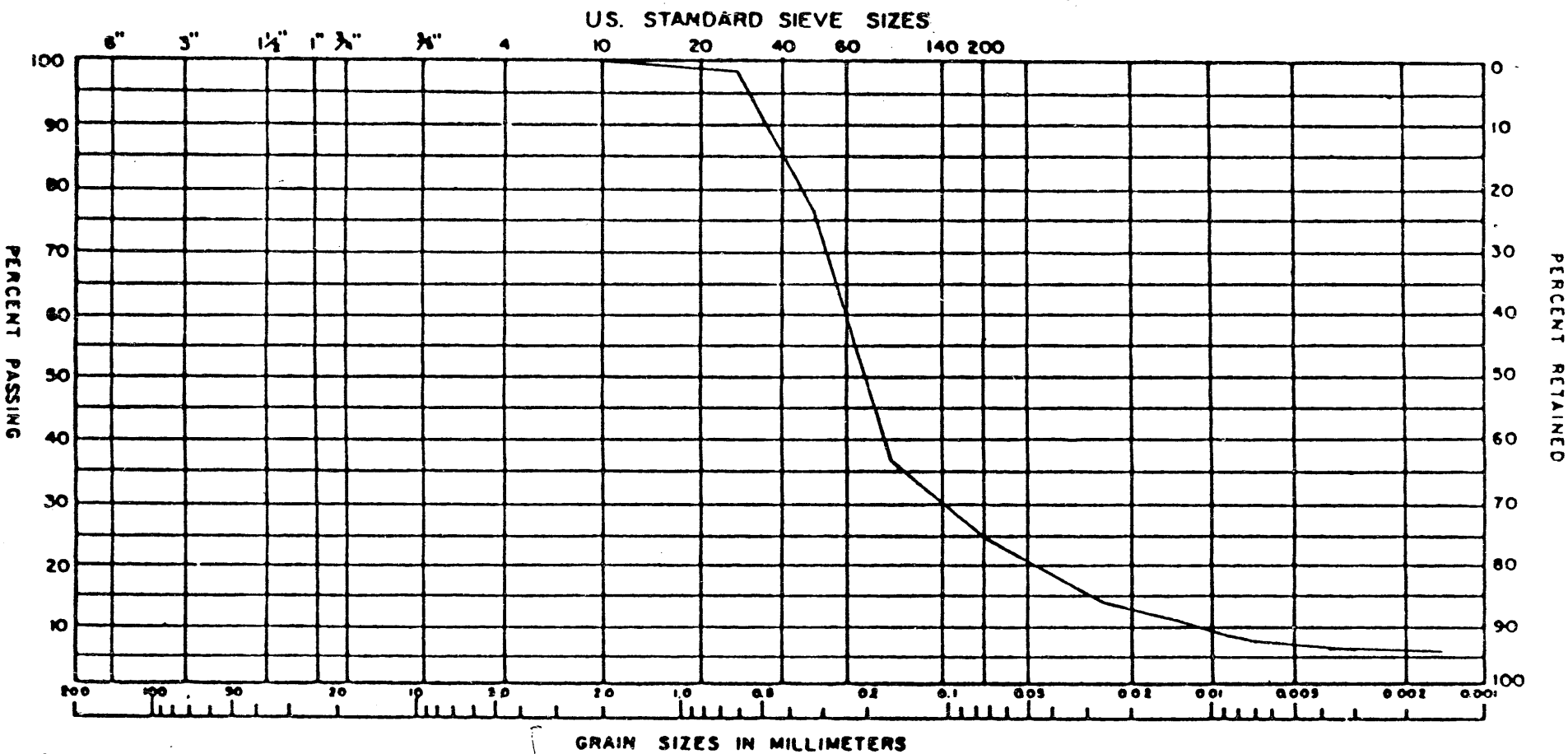
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



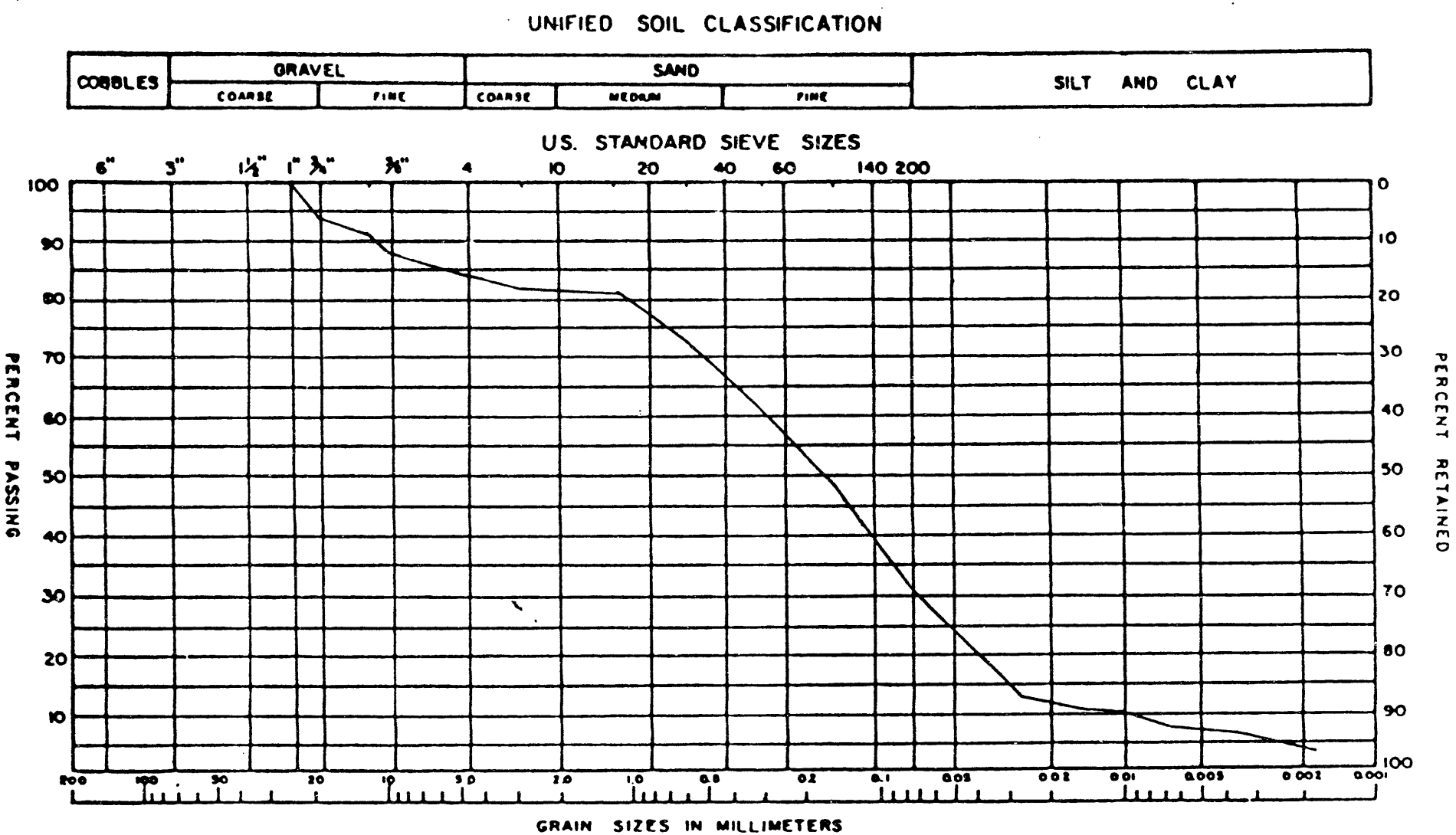
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNS-10	1/2' to 1'	24	NP	2.70	--	2061
CLASSIFICATION						

Project: Rifle-RFL-87-01

Job Number: M87054CE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MNS-11	1/2'	--	--	--	6.2	2062
CLASSIFICATION						

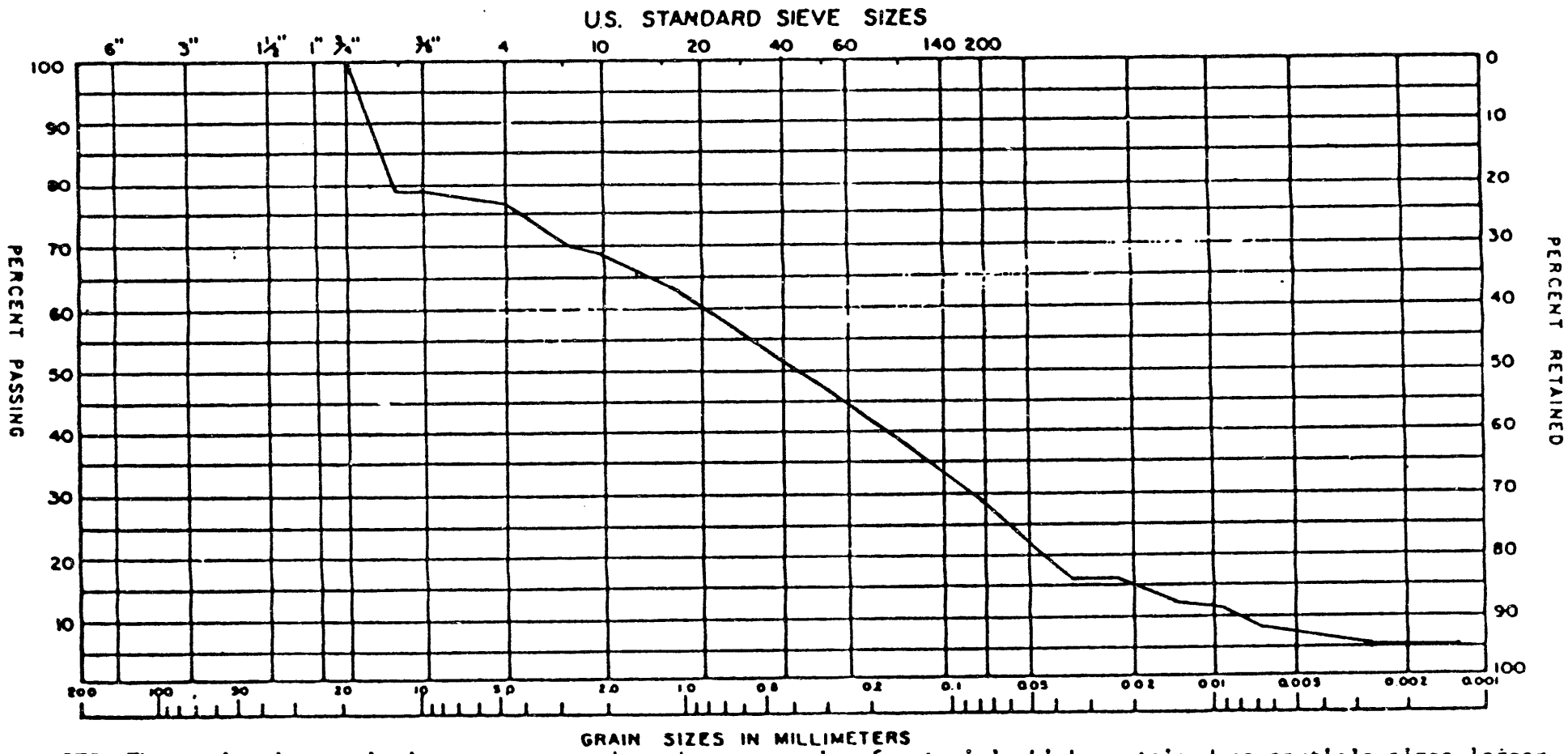
Fig

Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB-6B	2 1/2'			--	--	2161
CLASSIFICATION						

Fig

Project: RFL-87-01, Rifle, Colorado

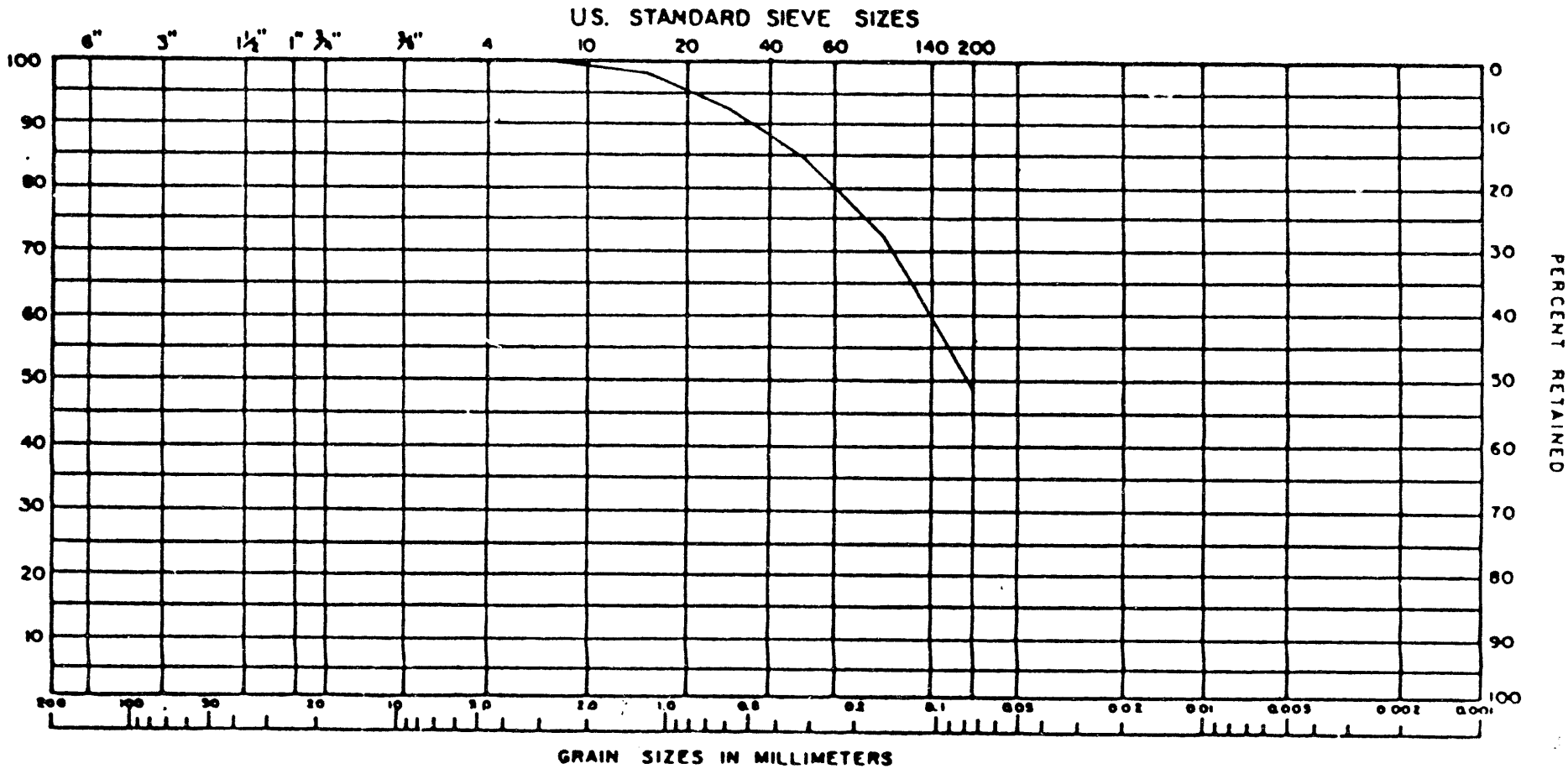
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



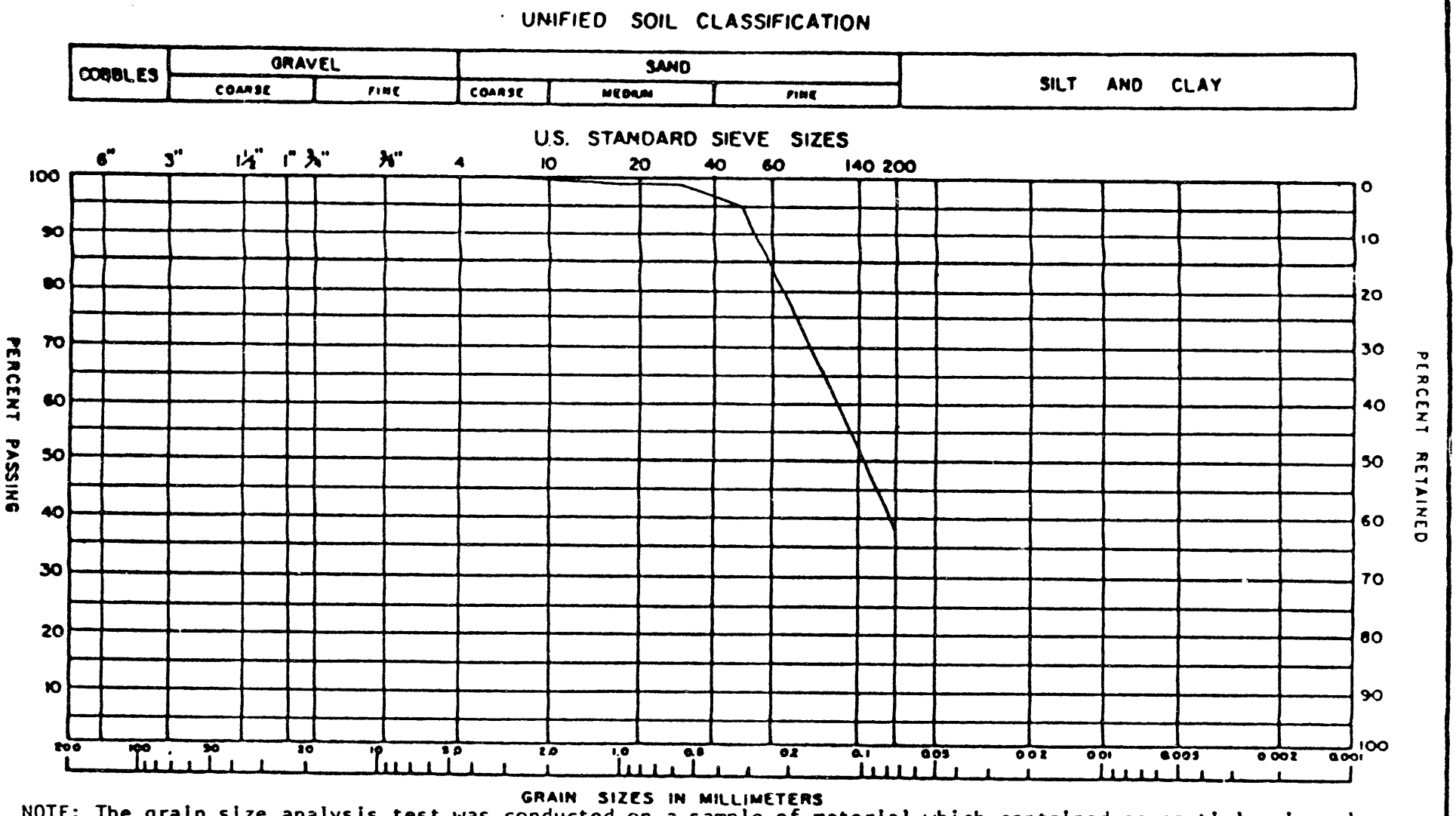
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB 6B	4	--	--	----	16.6	2162
CLASSIFICATION	Sand, very silty, (SM-ML)					

Project: RFL-87-01, Rifle, Colorado

Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB 6B	6 1/2	--	--	----	9.9	2163
CLASSIFICATION	Sand, silty, (SM)					

Fig.

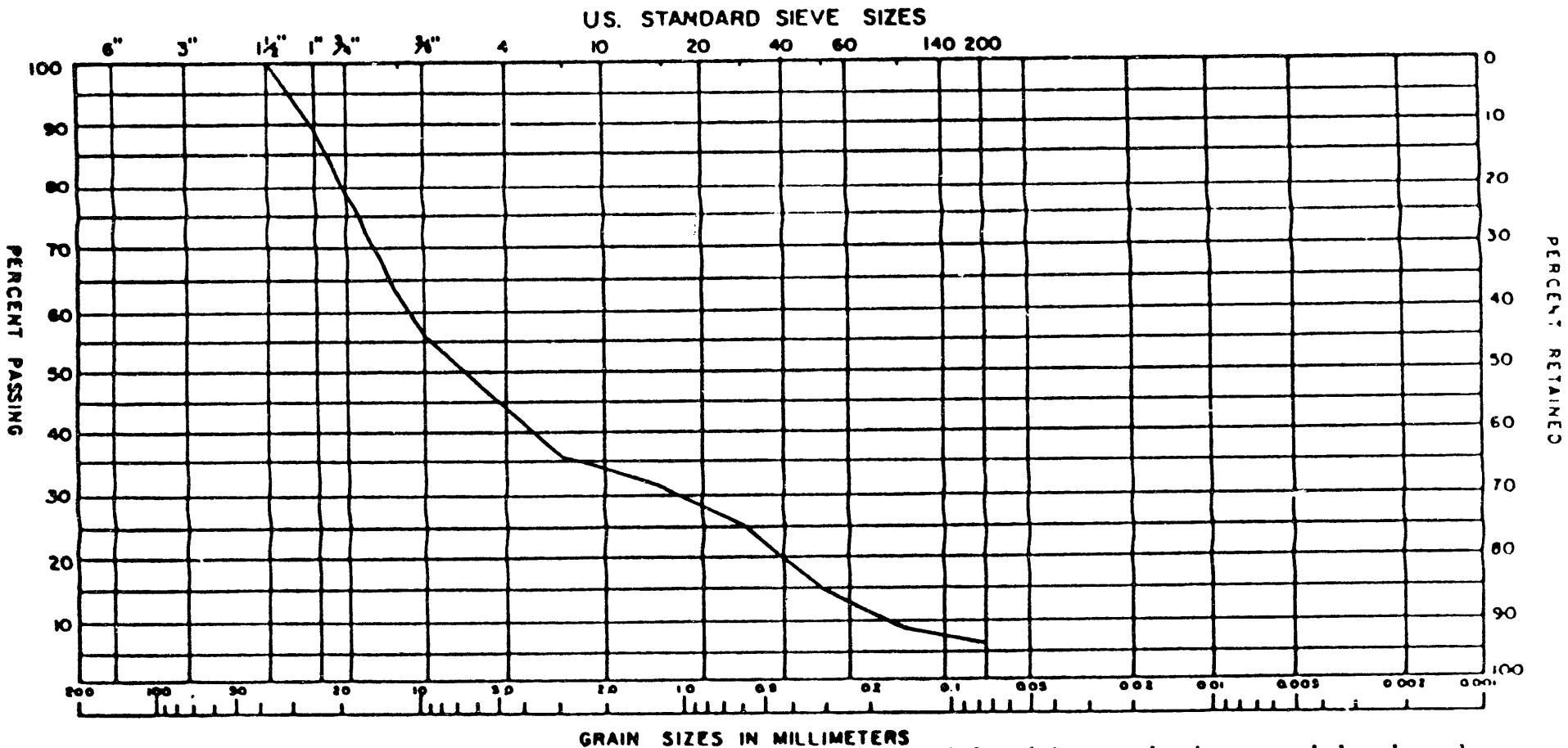
Project: RFL-87-01

Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB-6B	14	--	--	----	5.9	2164
CLASSIFICATION						

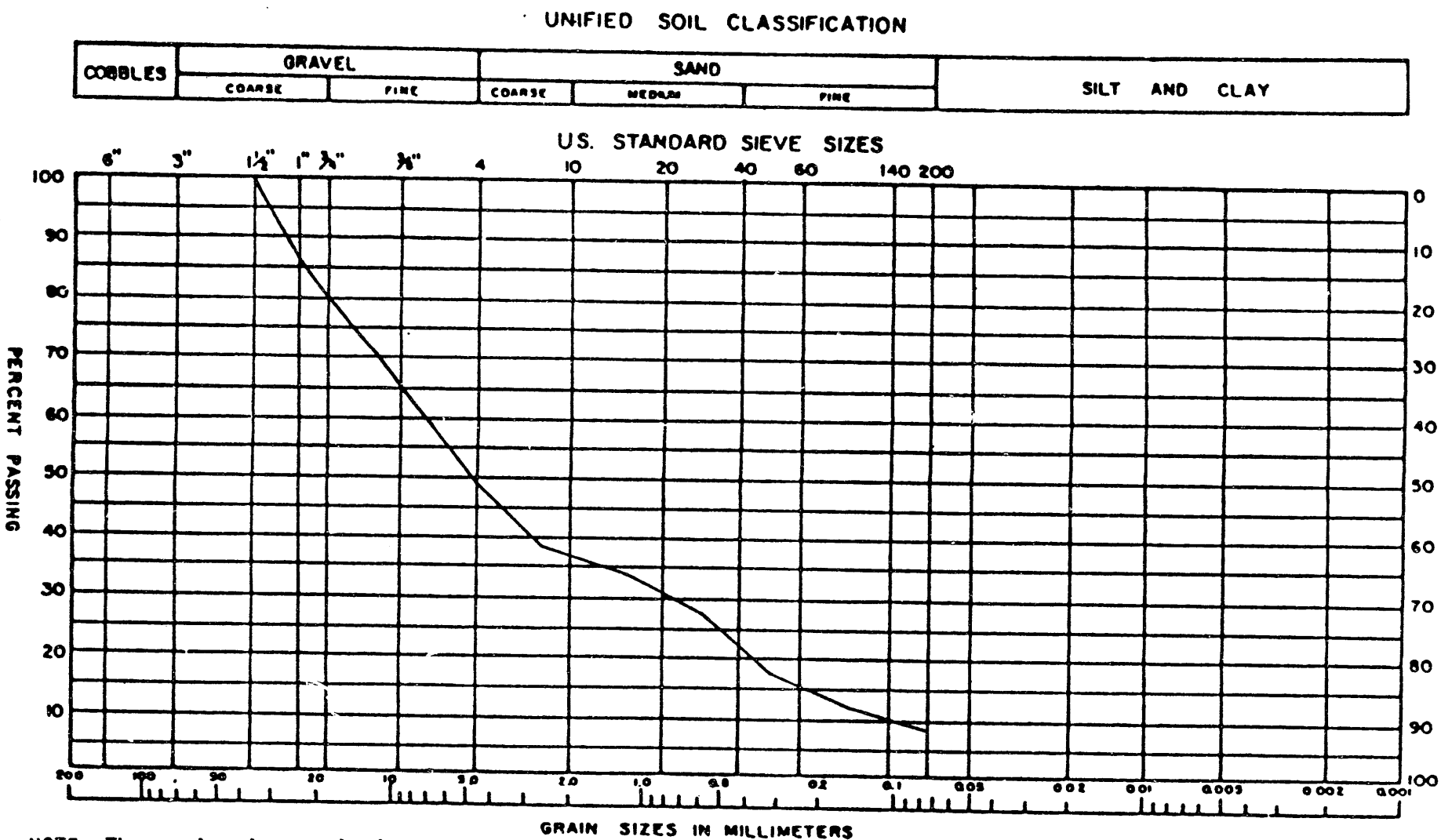
Fig.

Project: RFL-87-01, Rifle, Colorado

Job Number: M8705 4GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.



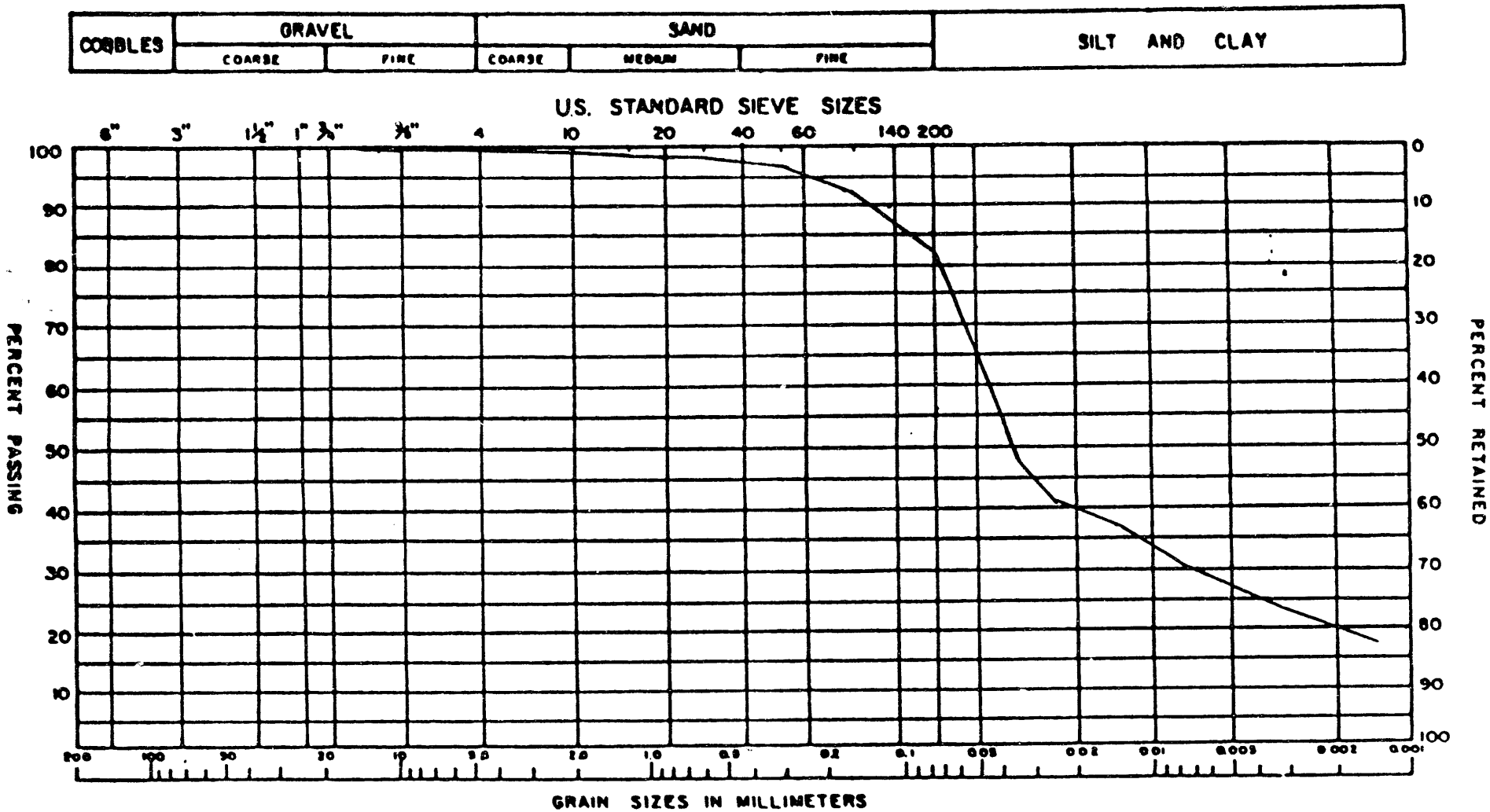
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOB 6B	18 1/2	--	--	----	7.6	2165
CLASSIFICATION	Gravel and sand, (GP-SP)					

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

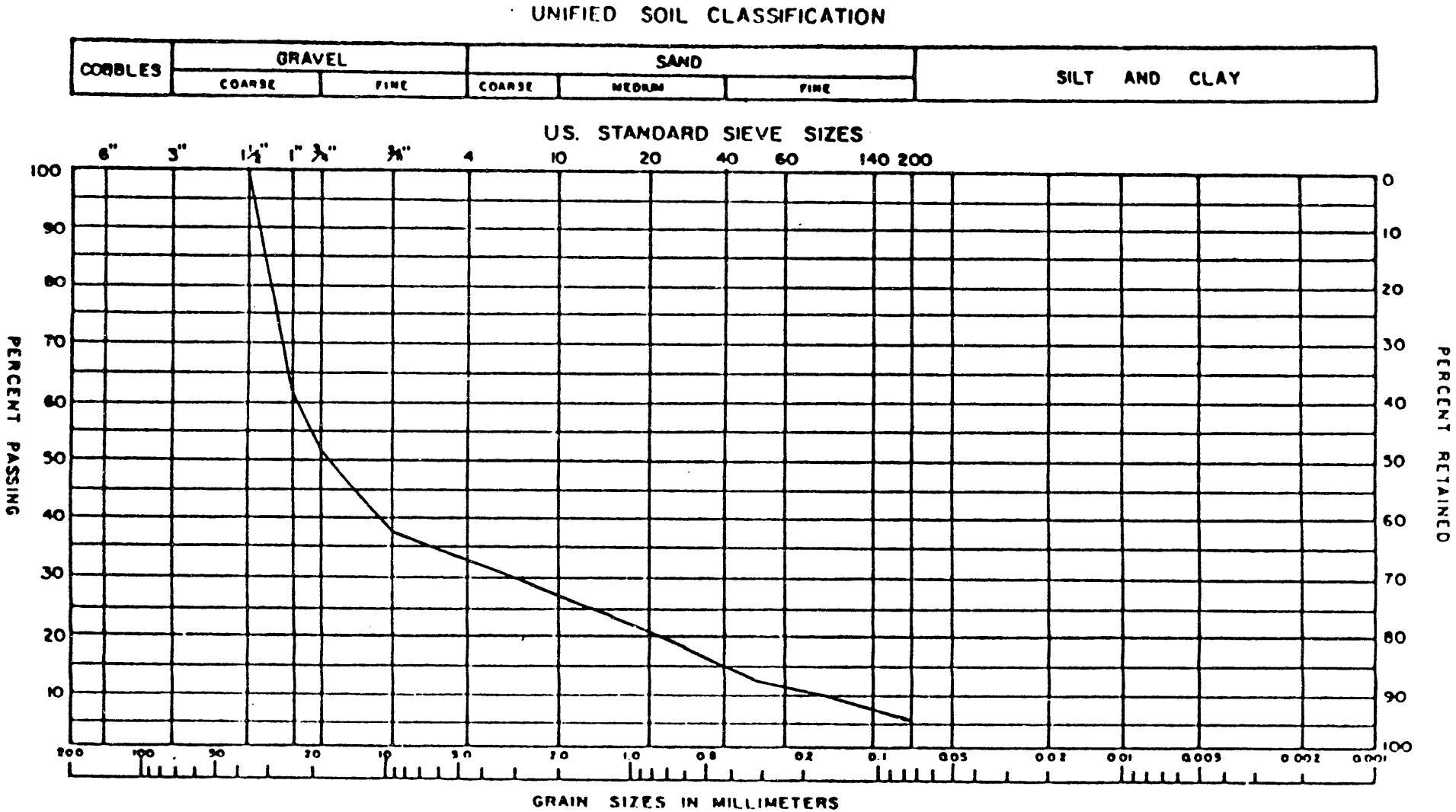
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-5	0' to 1'	38	16	2.63	7.4	2063
CLASSIFICATION						

Fig.

Project: Rifle-RFL-87-01

Job number M8705456

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-9	1/2				5.6	2064
CLASSIFICATION	Gravel, sandy (GP)					

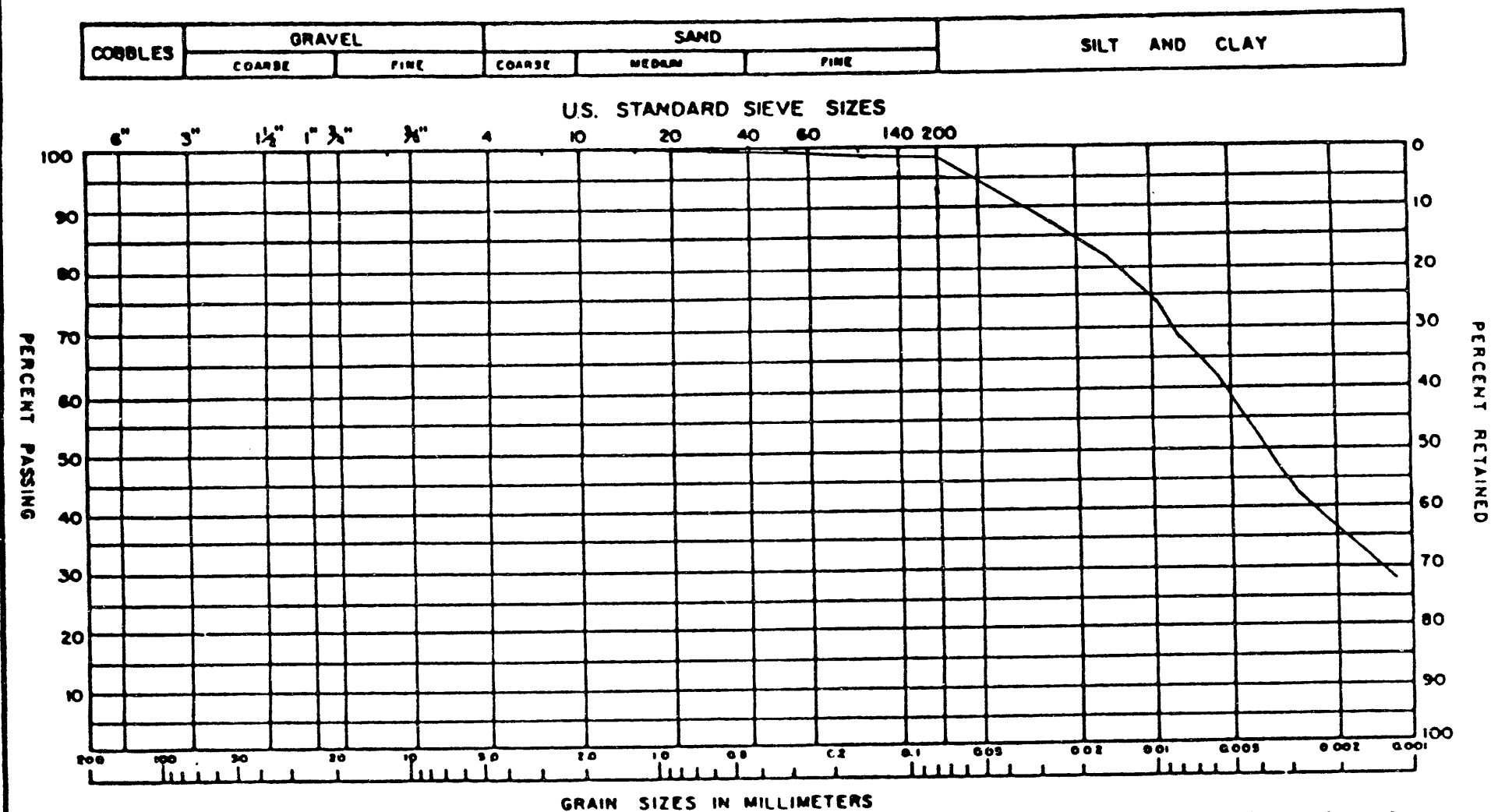
Fig

Project: Rifle-RFL-87-01

Job Number: M8705AGE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-14C	1/2'	36	18	2.79	4.8	2065
CLASSIFICATION						

Project: RFL-87-01

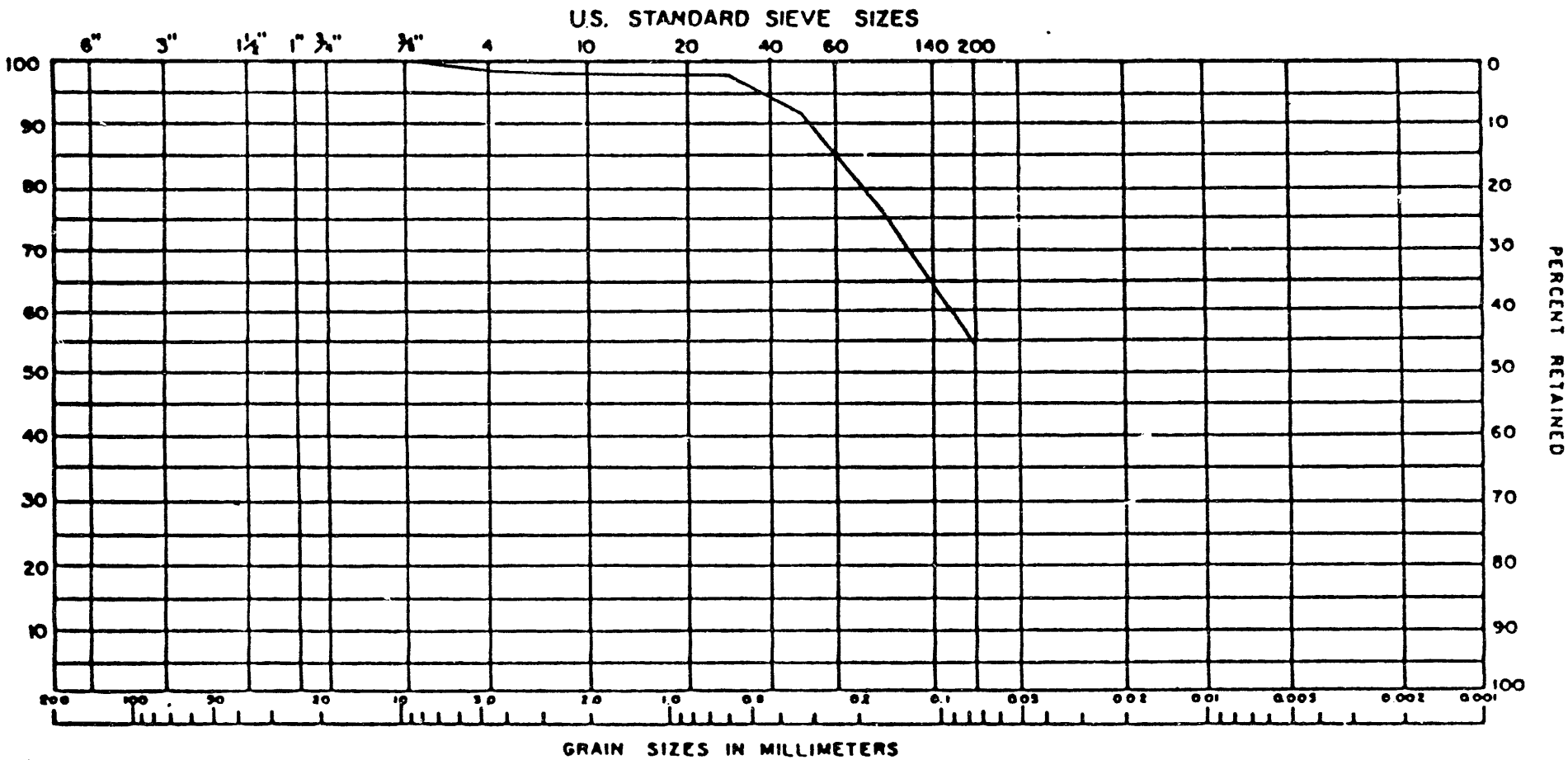
Job Number: M37054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

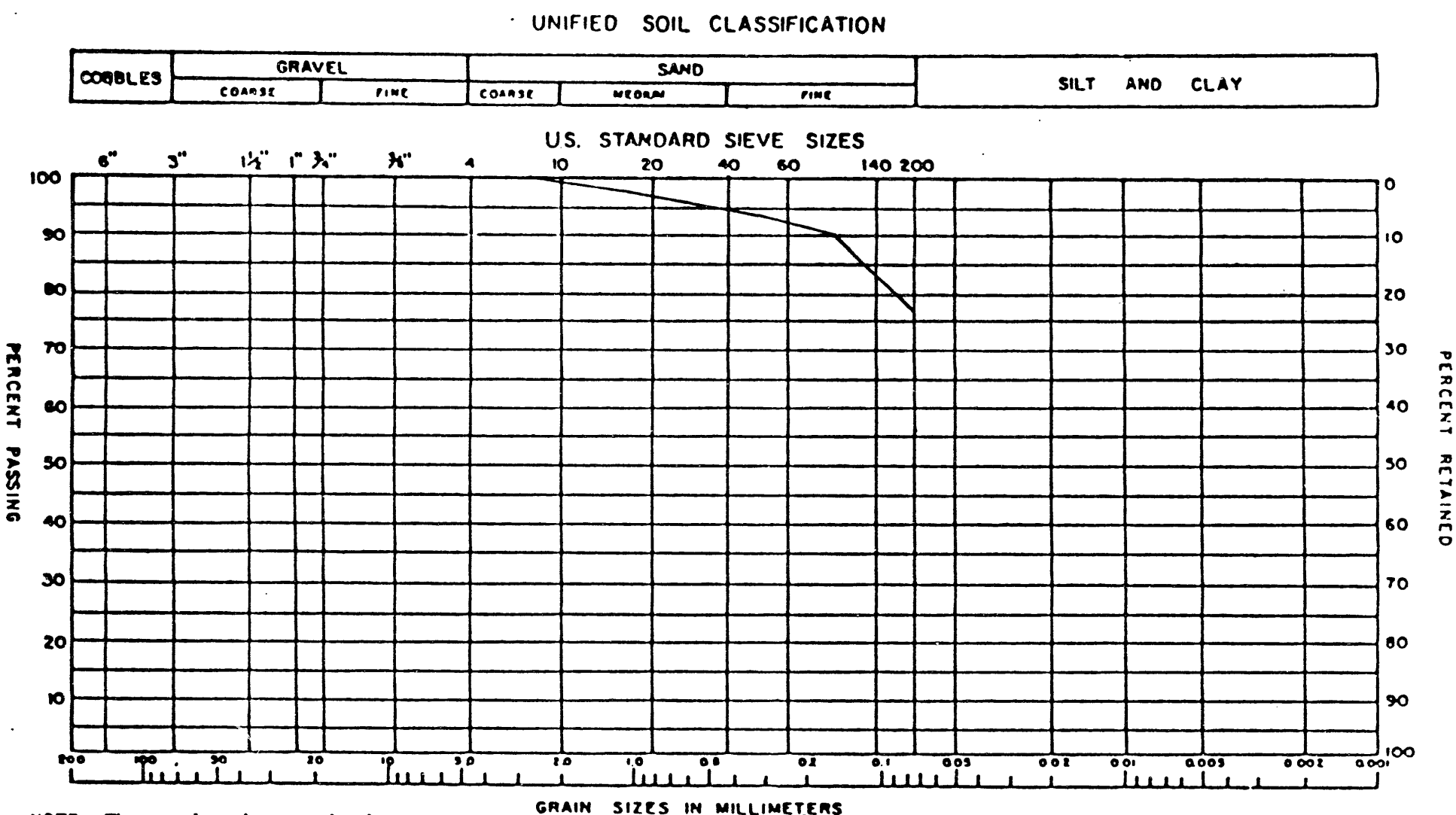
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT 14C	2 1/2	--	--	----	6.5	2066
CLASSIFICATION	Silt, sandy, (ML-SM)					

Project: RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-15	0 to 1	--	--	2.62	6.7	2067
CLASSIFICATION	Clay, sandy, (CL)					

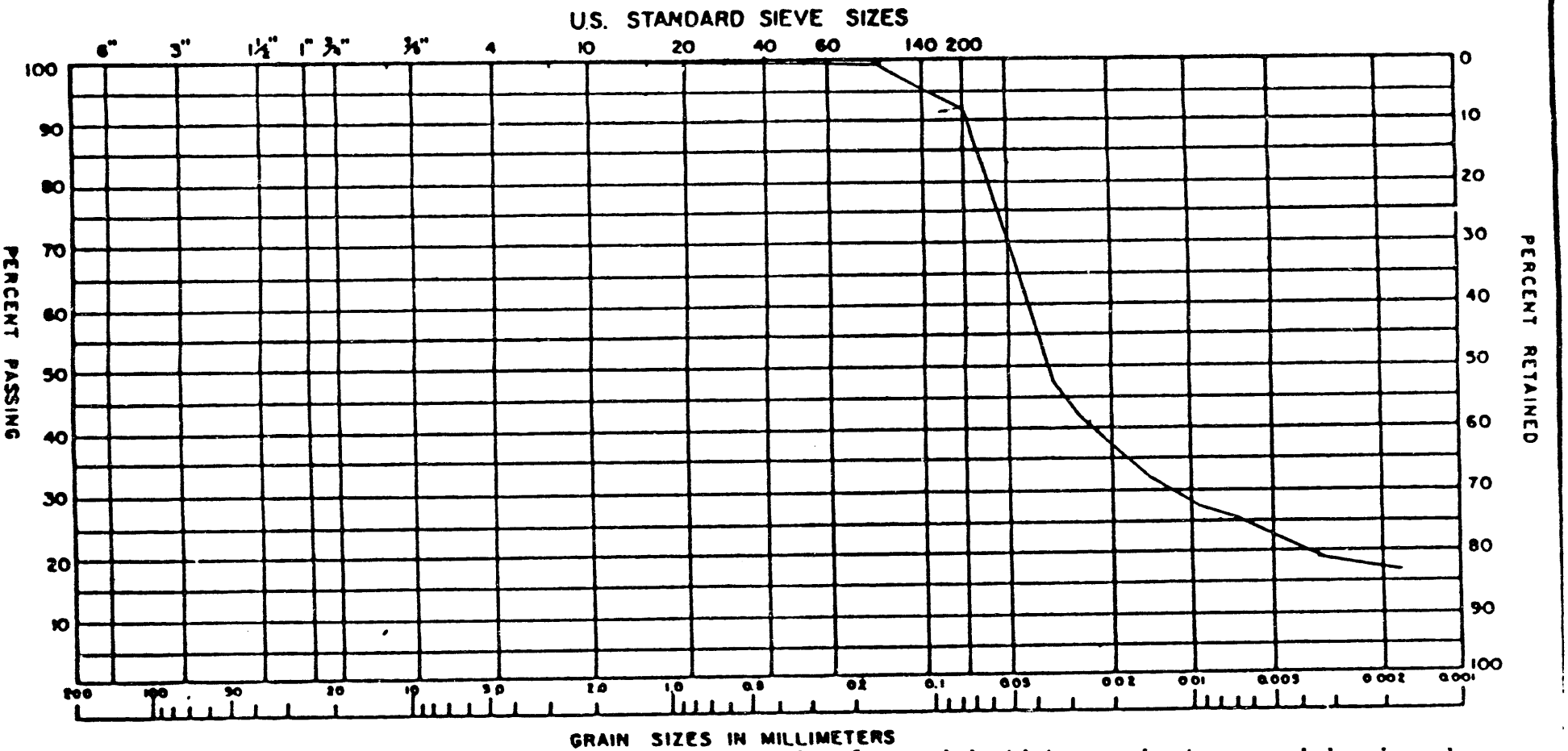
Project: Rifle-RFL-87-01
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-16	2 1/2'	28	7	--	8.0	2068
CLASSIFICATION						

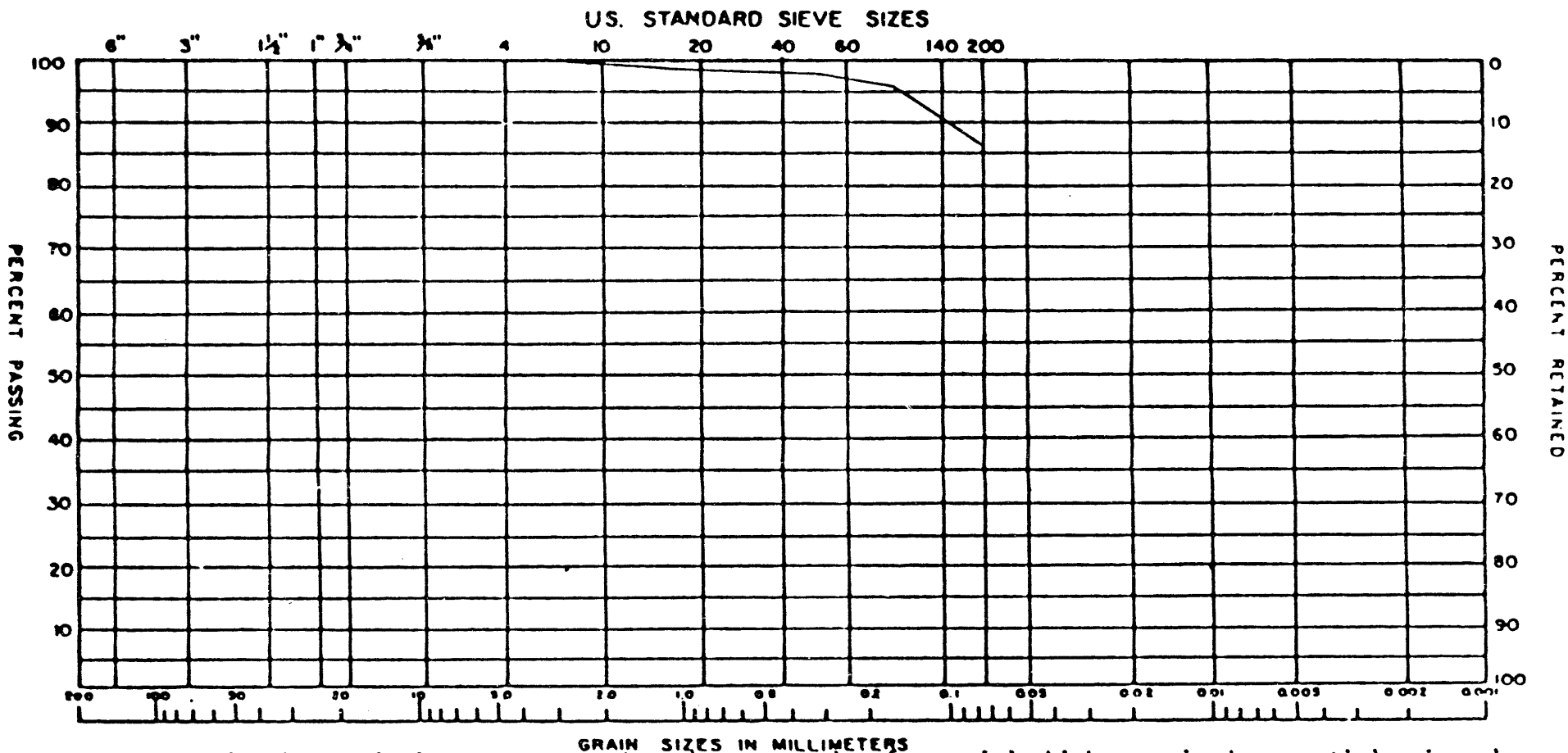
Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-17	2 1/2	--	--	--	10.3	2069
CLASSIFICATION	Silt, clayey, slightly sandy (ML)					

Fig

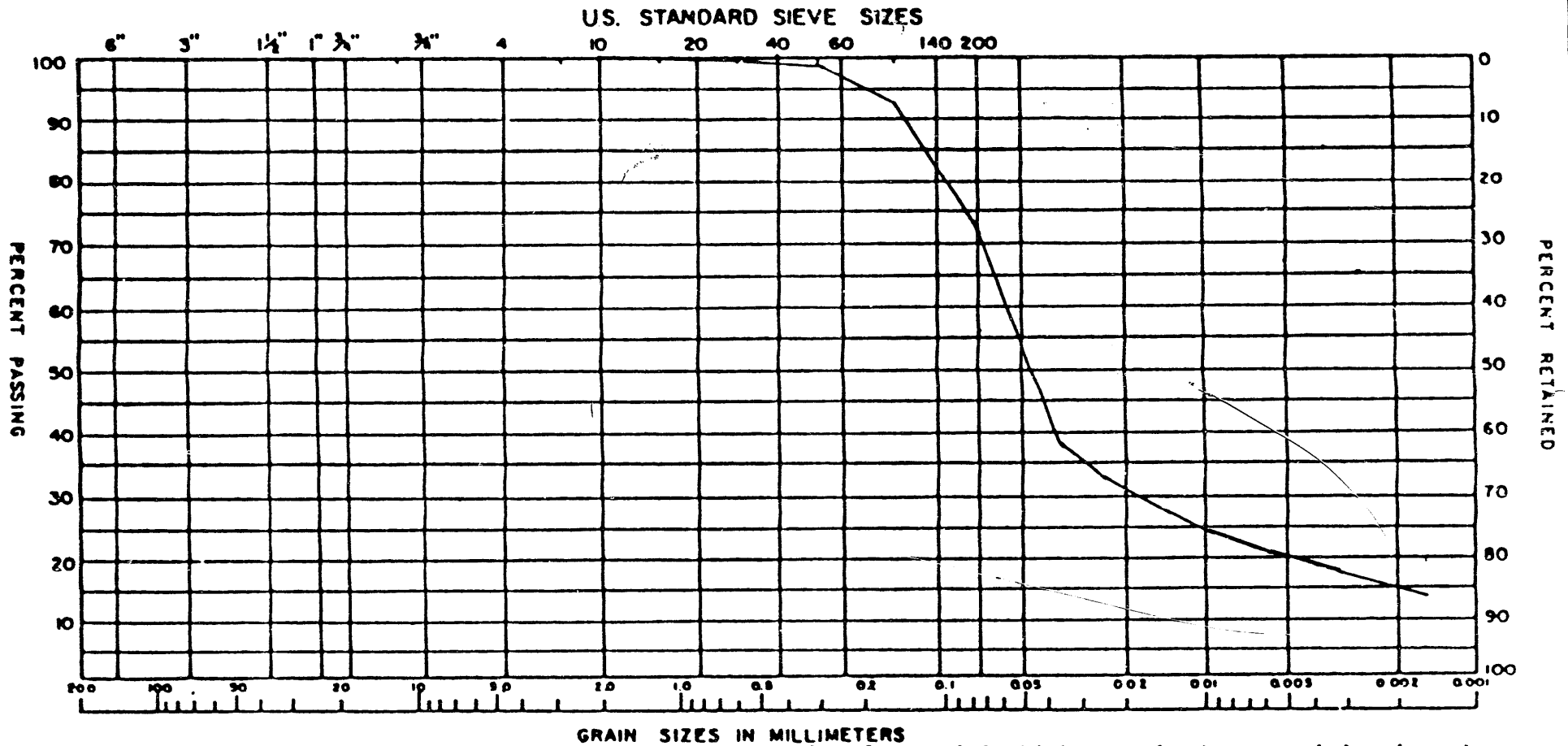
Project: Rifle-RFL-87-01
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-18	1/2'	26	7	2.60	---	2070
CLASSIFICATION						

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MOT-18 at 1/2 Foot

LABORATORY SAMPLE NUMBER: 2070

TRIAXIAL PERMEABILITY: 1.6×10^{-7} cm/sec

CONFINING PRESSURE: 2 psi

INITIAL DRY DENSITY: 99 pcf

INITIAL MOISTURE CONTENT: 16.5 percent

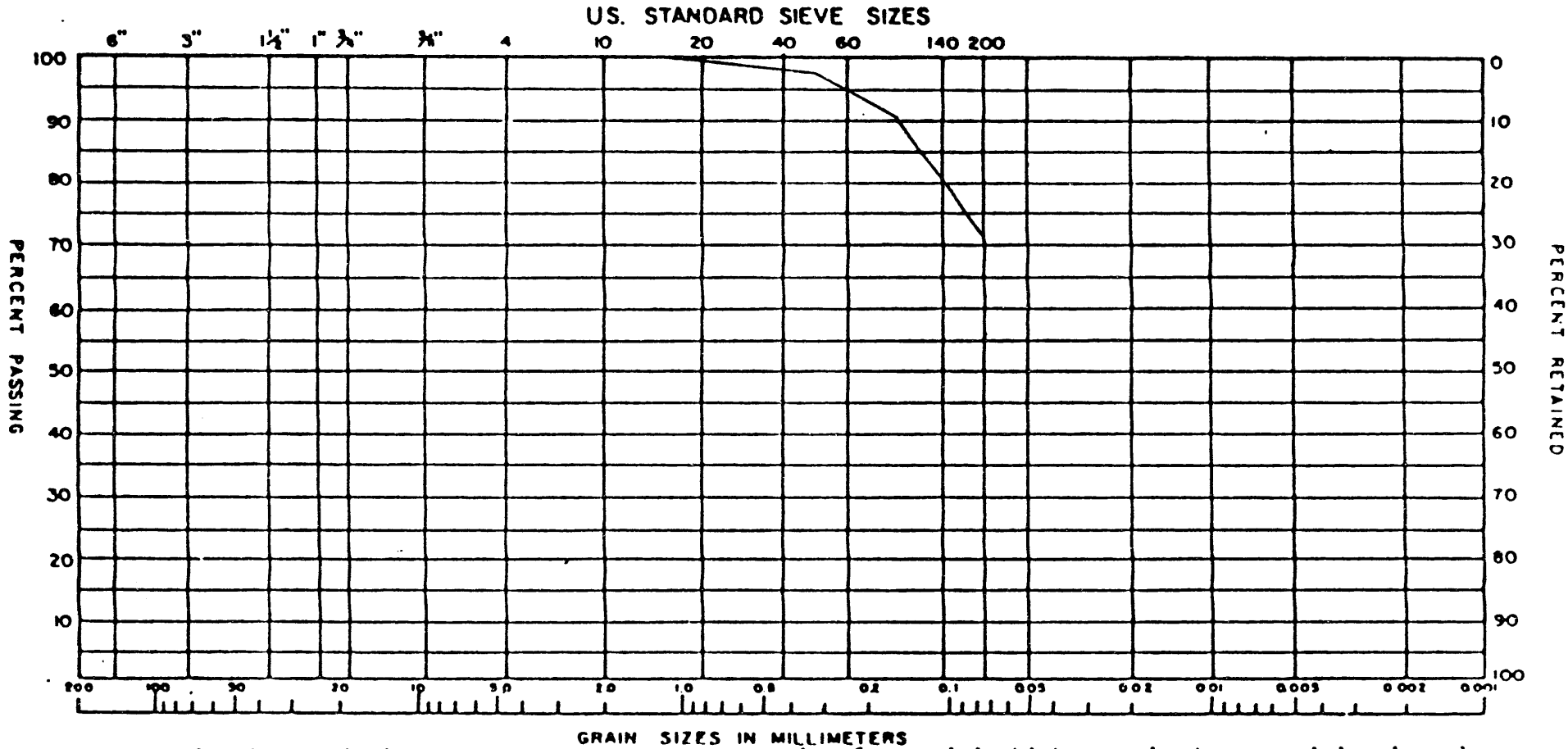
Project: Rifle-RFL-87-01

Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

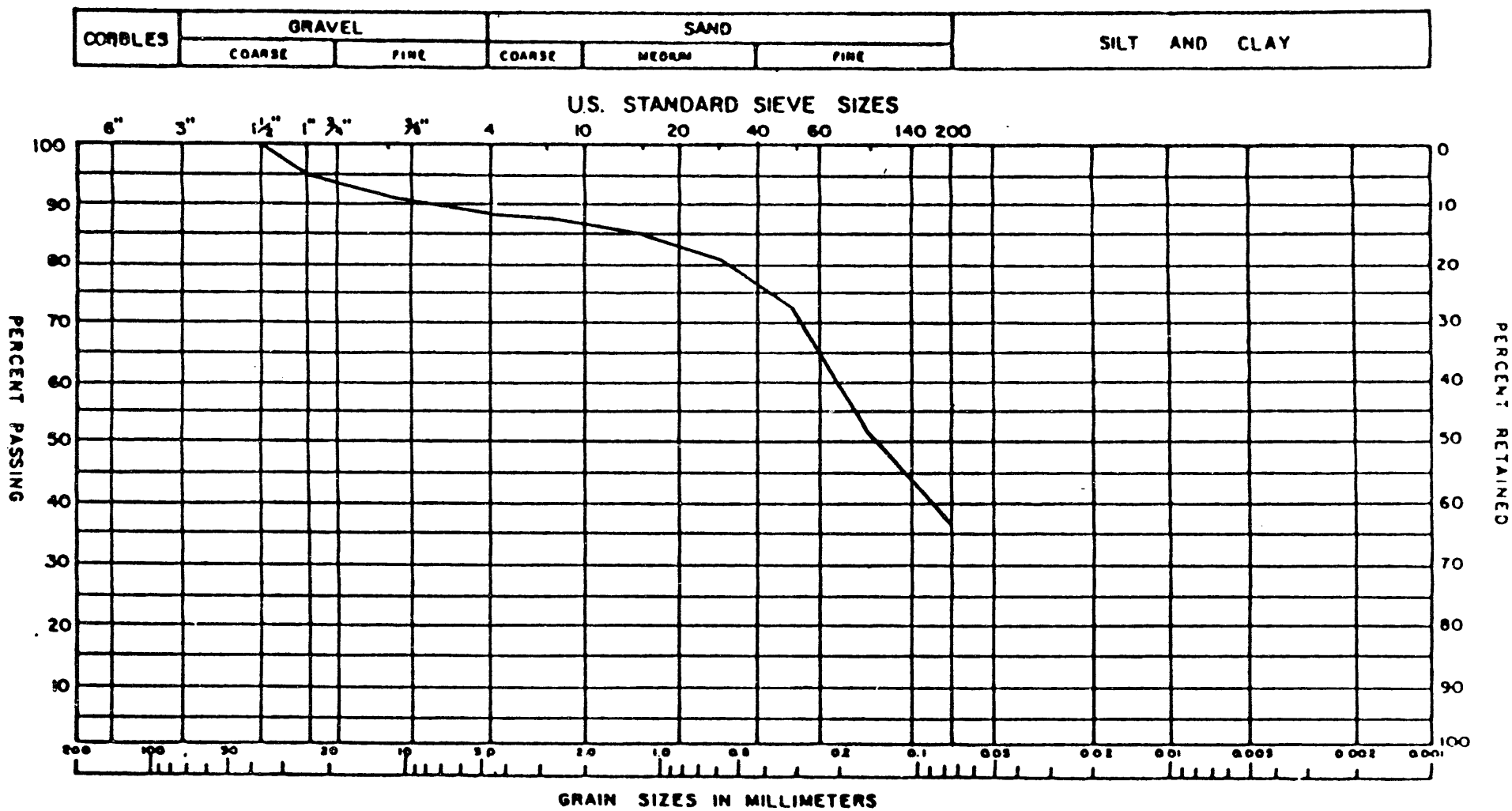
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-18	2 1/2	--	--	-	5.1	20/1
CLASSIFICATION Silt, clayey, sandy (ML)						

Fig

Project: RFL-87-01
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-21	1/2	--	--	2.71	---	2209
CLASSIFICATION						

TEST RESULT SHEET

TEST HOLE: MOT-21 at 1/2 Foot

LABORATORY NUMBER: 2209

TRIAXIAL PERMEABILITY: 1.4×10^{-4} cm/sec

INITIAL DRY DENSITY: 107.6 pcf

INITIAL MOISTURE CONTENT: 11.5 percent

CONFINING PRESSURE: 2 psi

Project: Rifle-RFL-37-01

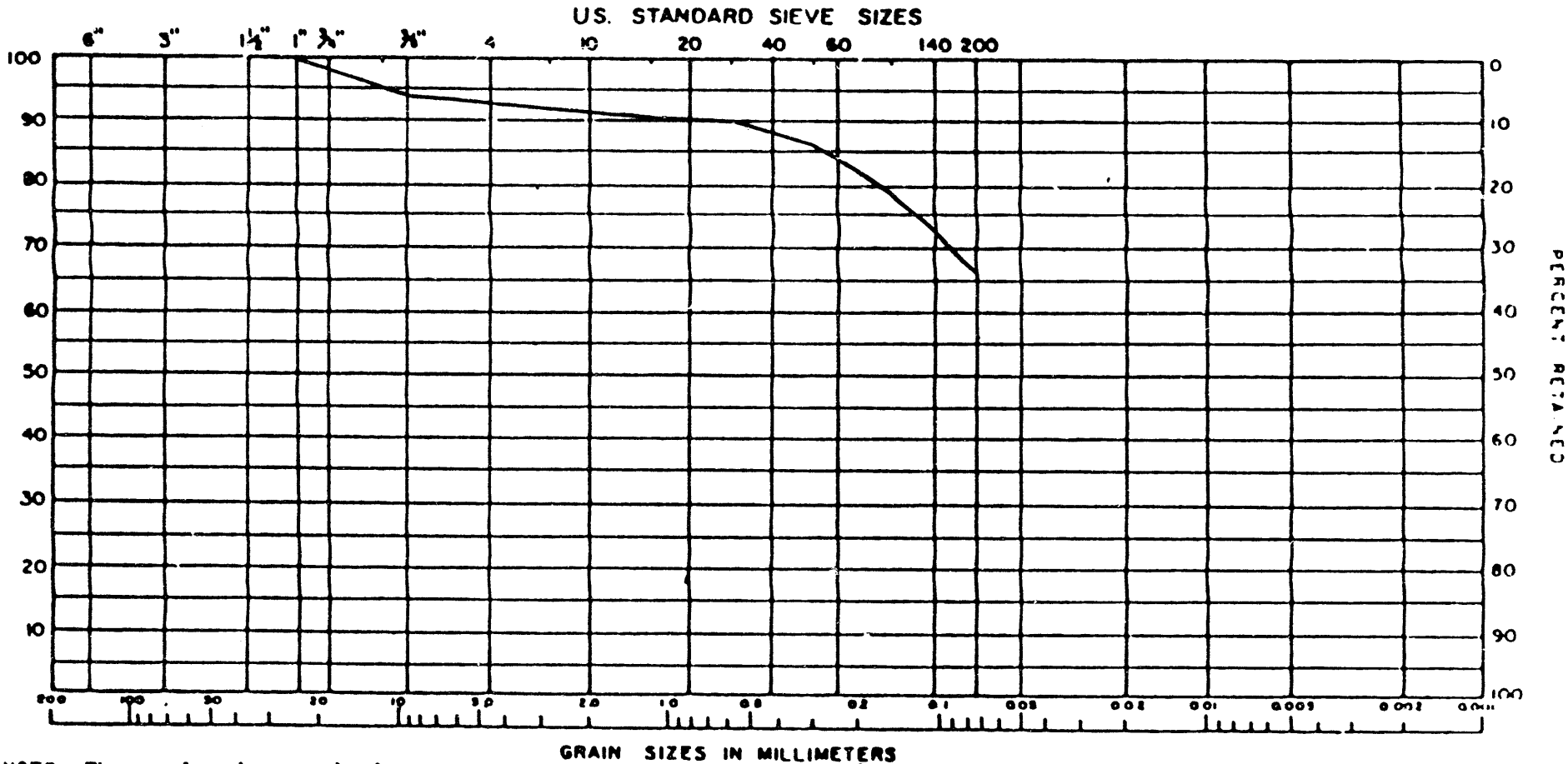
Job Number [illegible]

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
HOT-21	5	--	--	---	16.4	2210
CLASSIFICATION						

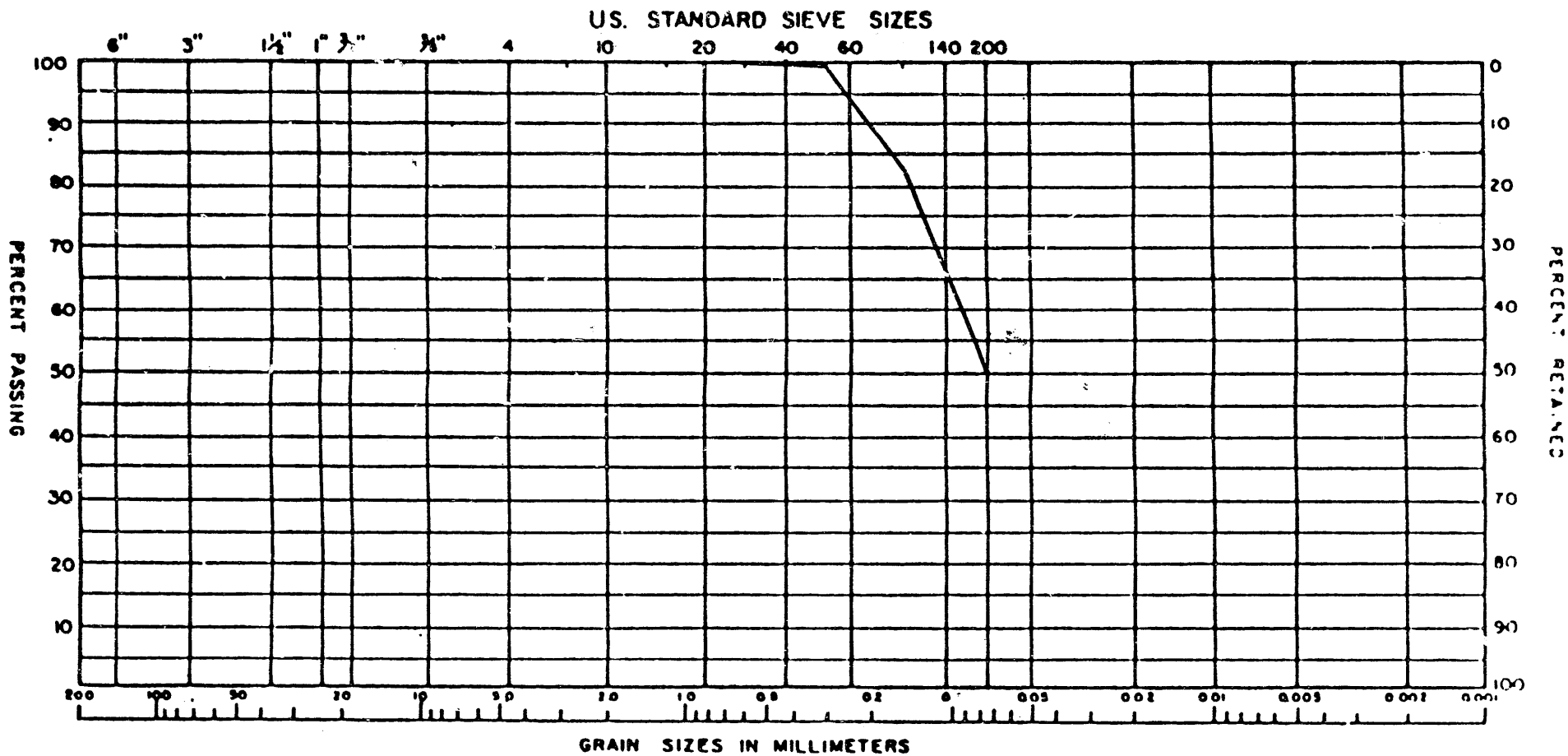
Project: PFL-87-01
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



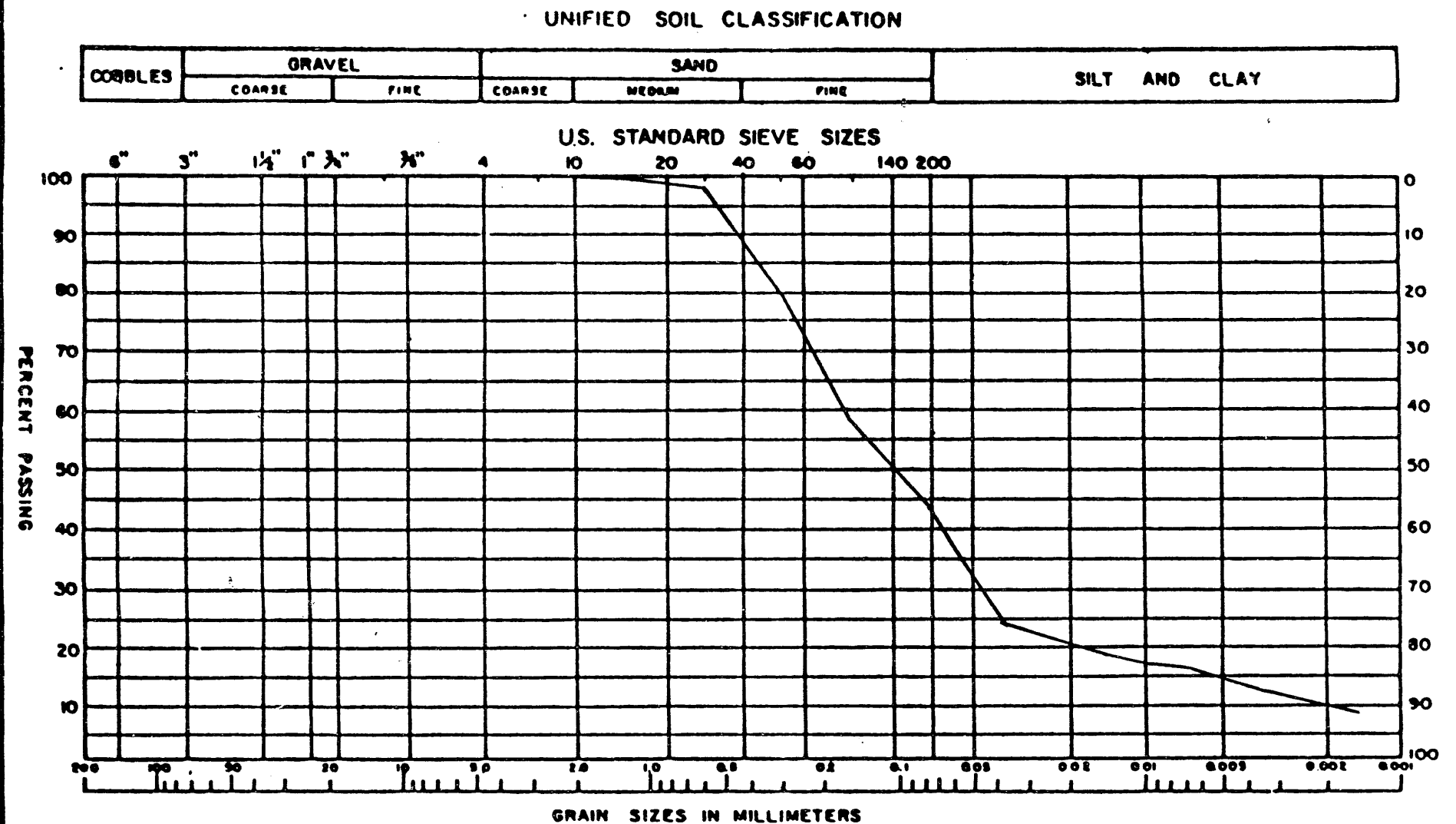
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-21	10	--	--	----	---	2211
CLASSIFICATION						

Project: Rifle-RFL-87-01
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

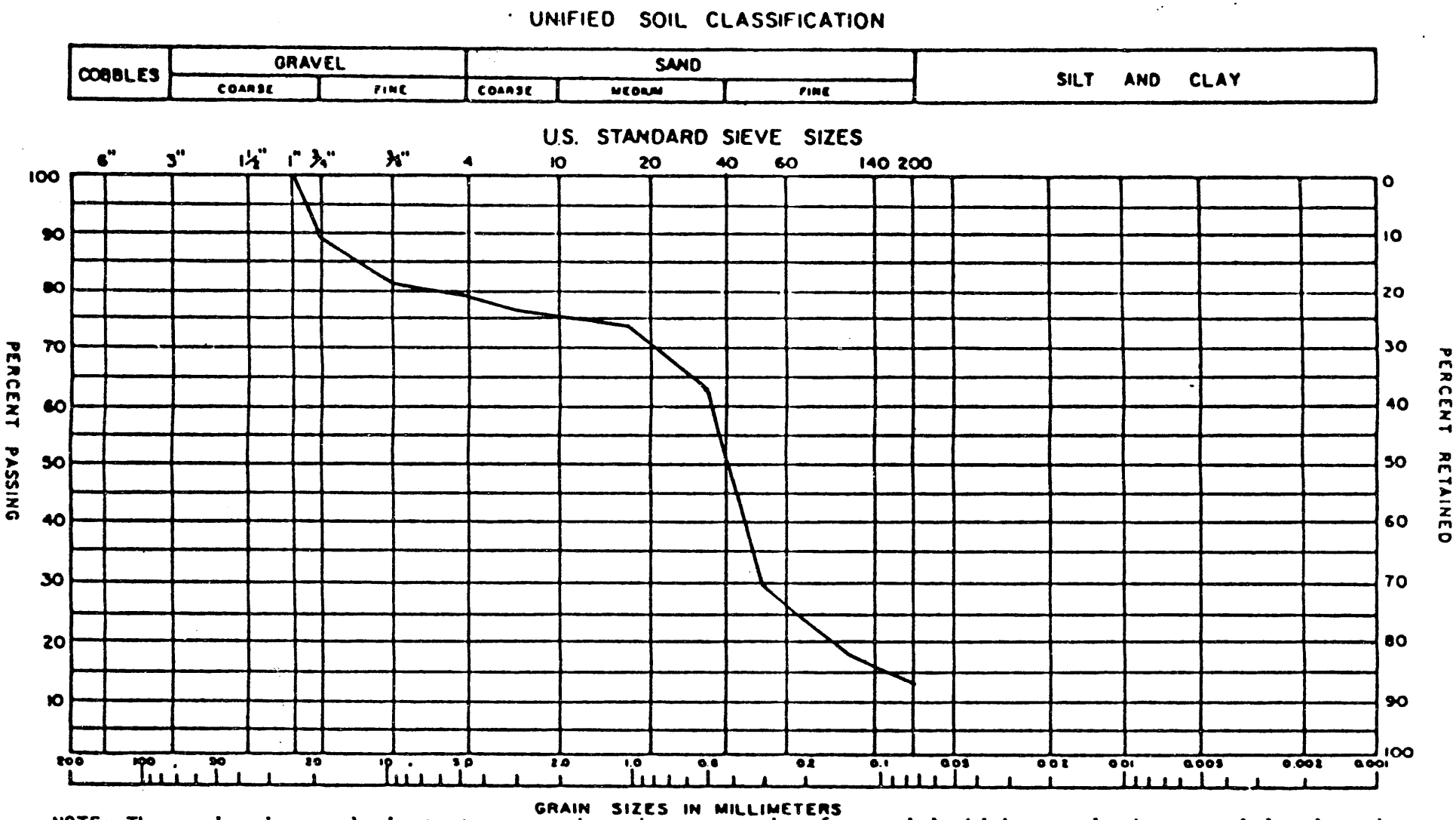
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-22	5'	16	NP	--	15.9	2072
CLASSIFICATION						

Project: Rifle-RFL-87-01

MR70546F

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-24	2 1/2 feet	--	--	--	1.7	2073
CLASSIFICATION	Sand, gravelly (SP)					

Project: Rifle-RFL-87-01

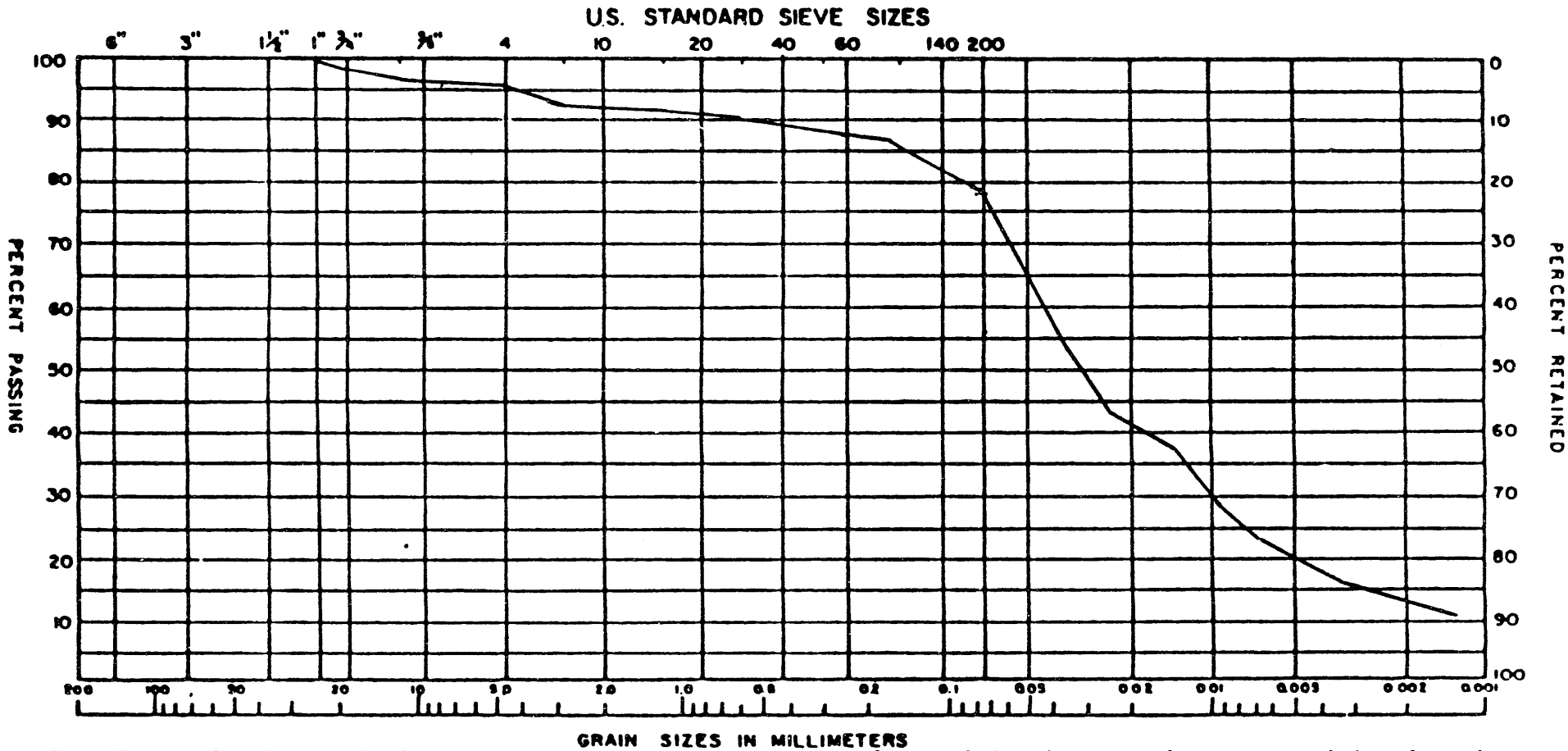
Job Number H8705 4GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT 26	1/2'	24	8	--	--	2074
CLASSIFICATION						

Project: Rifle-RFL-87-01

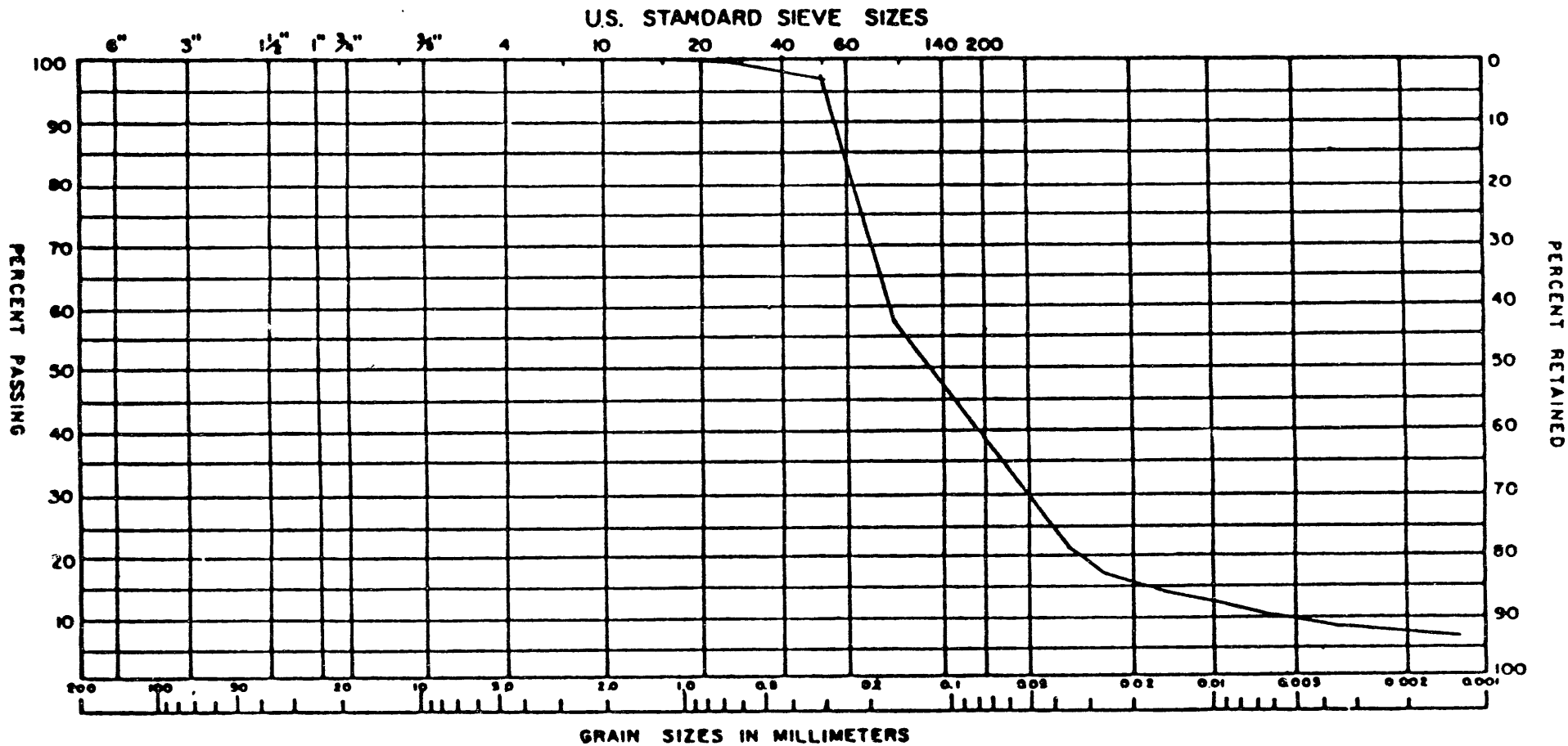
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-27	2 1/2'	--	--	--	10.2	2075
CLASSIFICATION						

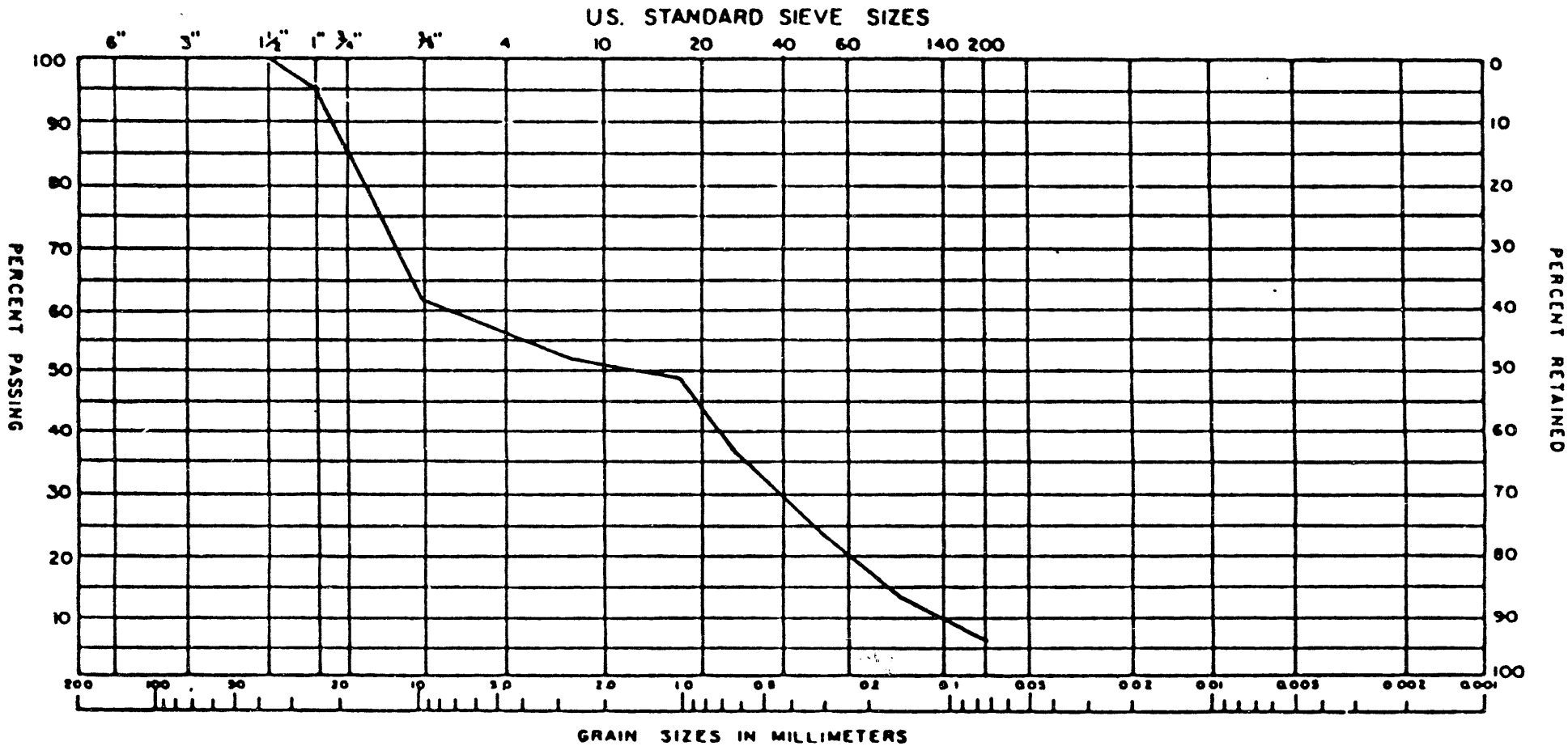
Project: RFL-37-0
Job Number: 8E705GE

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-27	9	--	--	---	12.7	2142
CLASSIFICATION	Sand, very gravelly, (SP-GP)					

Project Rifle-RFL-87-01

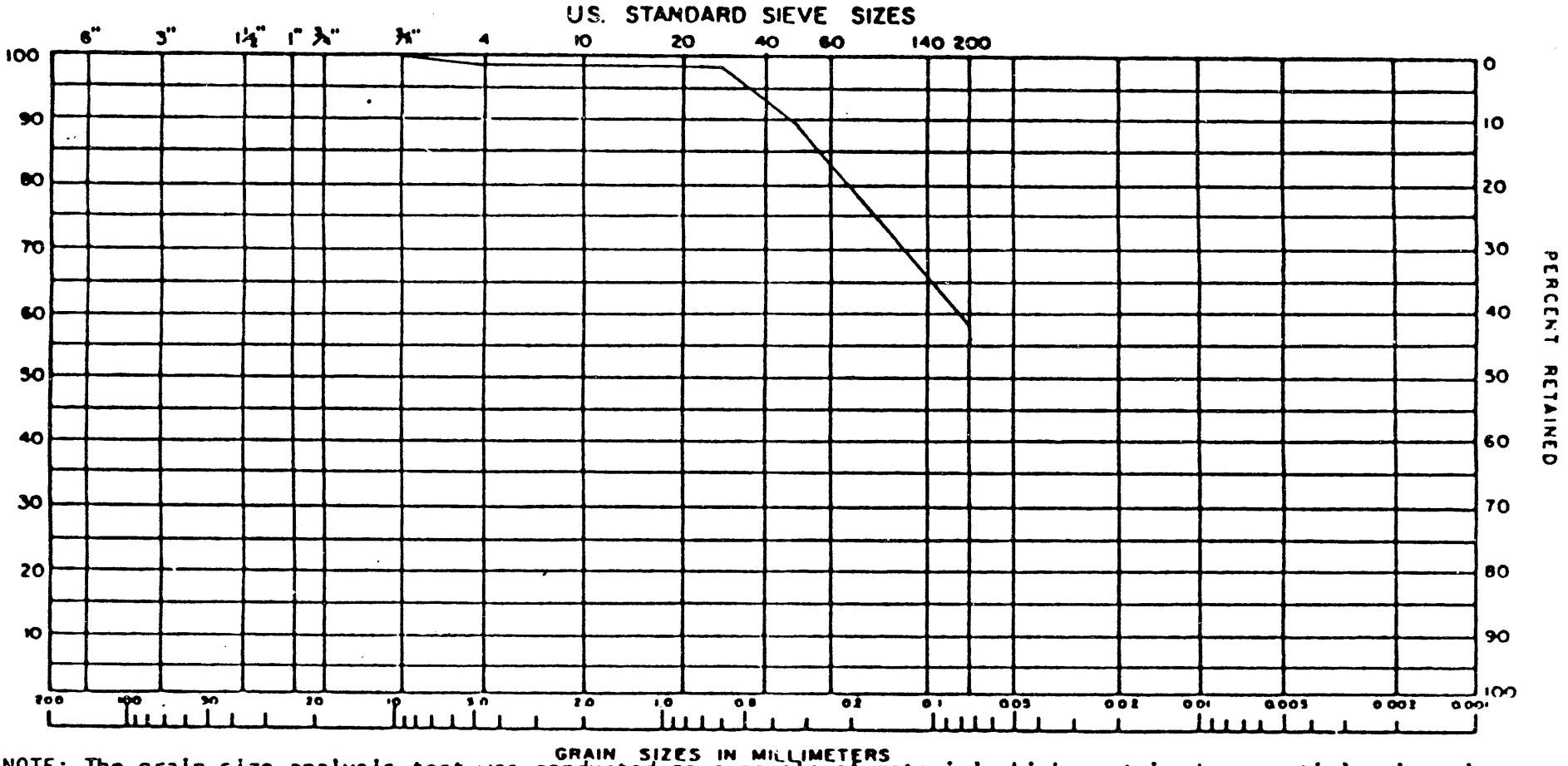
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-28	3	--	--	2.68	18.4	2076
CLASSIFICATION	Silt, sandy, clayey, (ML)					

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MOT-28 at 3 Feet

LABORATORY SAMPLE NUMBER: 2076

SAMPLE DESCRIPTION:

TRIAXIAL PERMEABILITY: 1.3×10^{-6} cm/sec

CONFINING PRESSURE: 2 psi

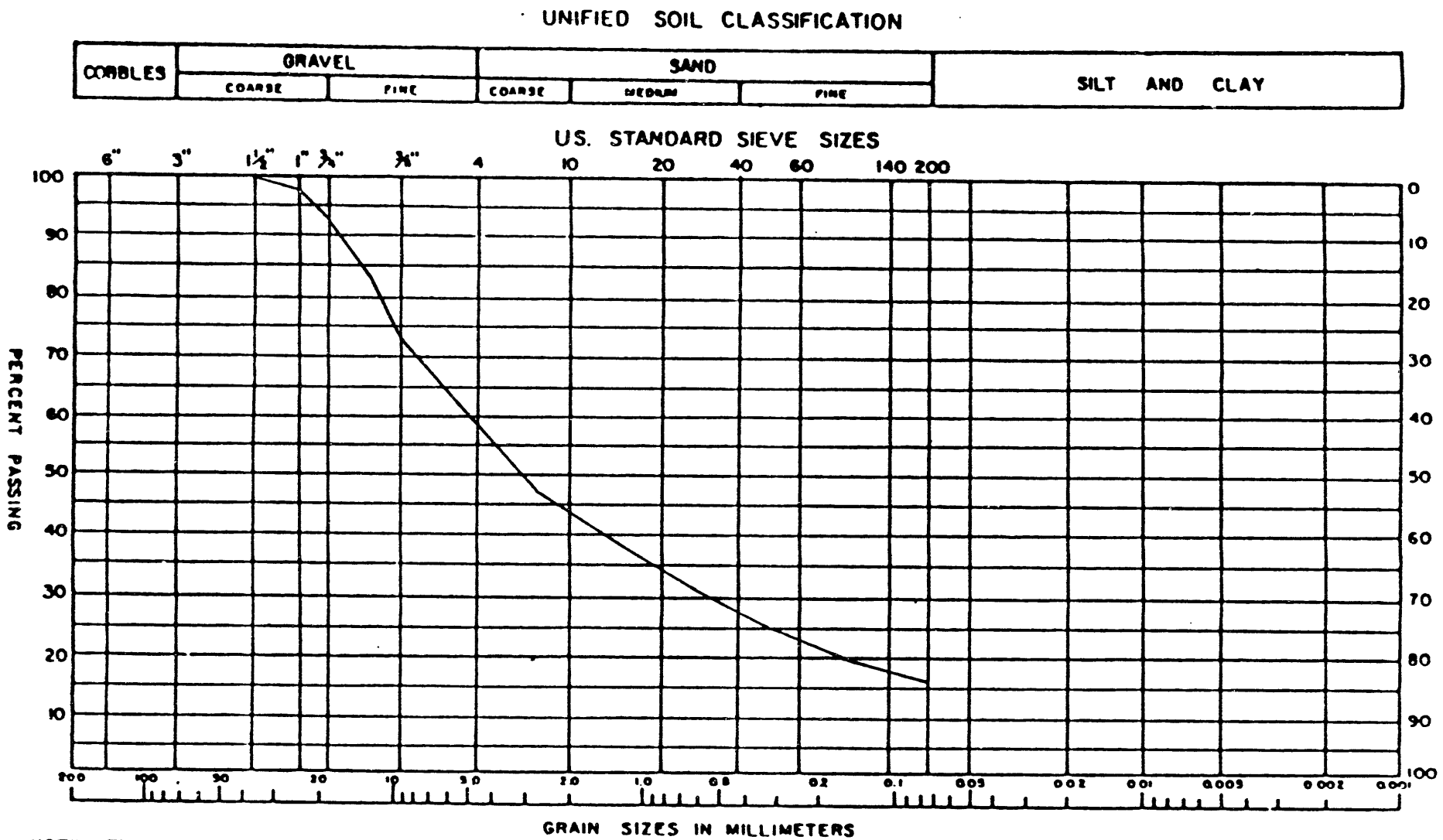
INITIAL DRY DENSITY: 102.1 pcf

INITIAL MOISTURE CONTENT: 14.5 percent

Project: Rifle-RFL-87-01

Job Number H87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE; The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-29	5	--	--	--	18.6	2077
CLASSIFICATION Sand, gravelly, silty (SM)						

Fig

Project: RFL-87-01

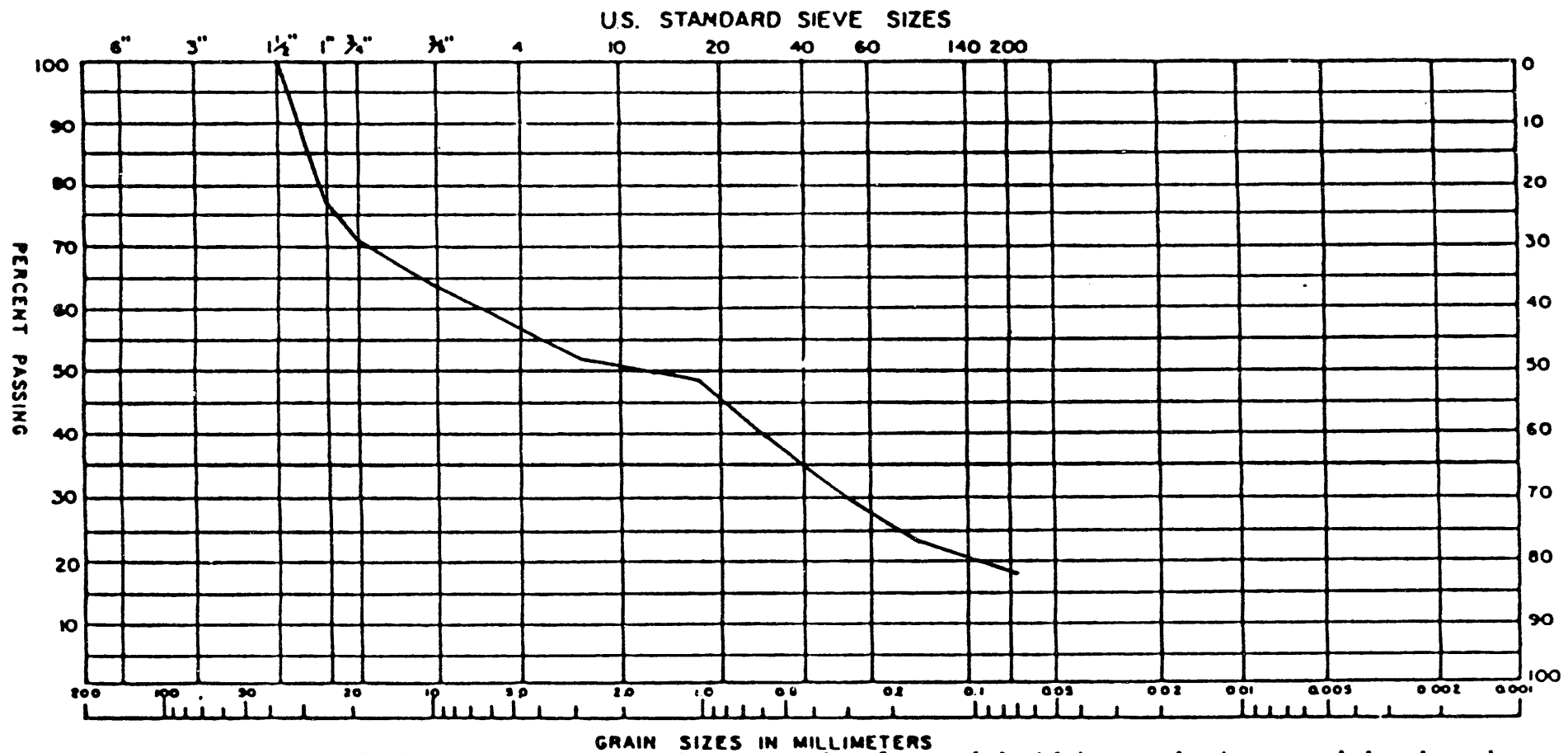
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by th grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-29	10	--	--	---	8.4	2143
CLASSIFICATION	Sand, very gravelly, silty, (SM-GM)					

Project: Rifle-RFL-87-01

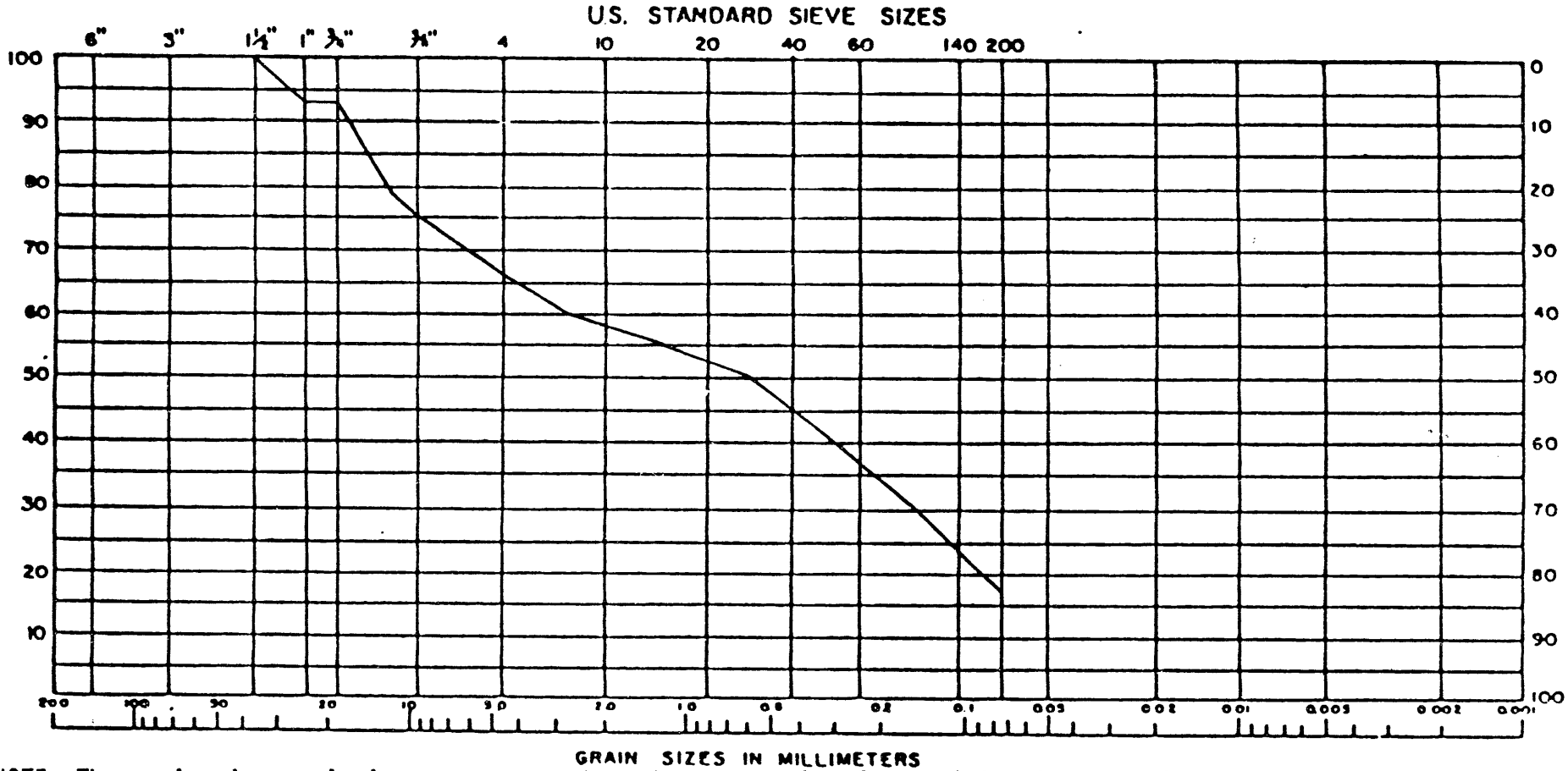
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	
MOT-32	2½ feet	--	--	--	13.8	2166
CLASSIFICATION	Sand, gravelly, silty, (SM)					

Project: RFL-87-01, Rifle, Colorado

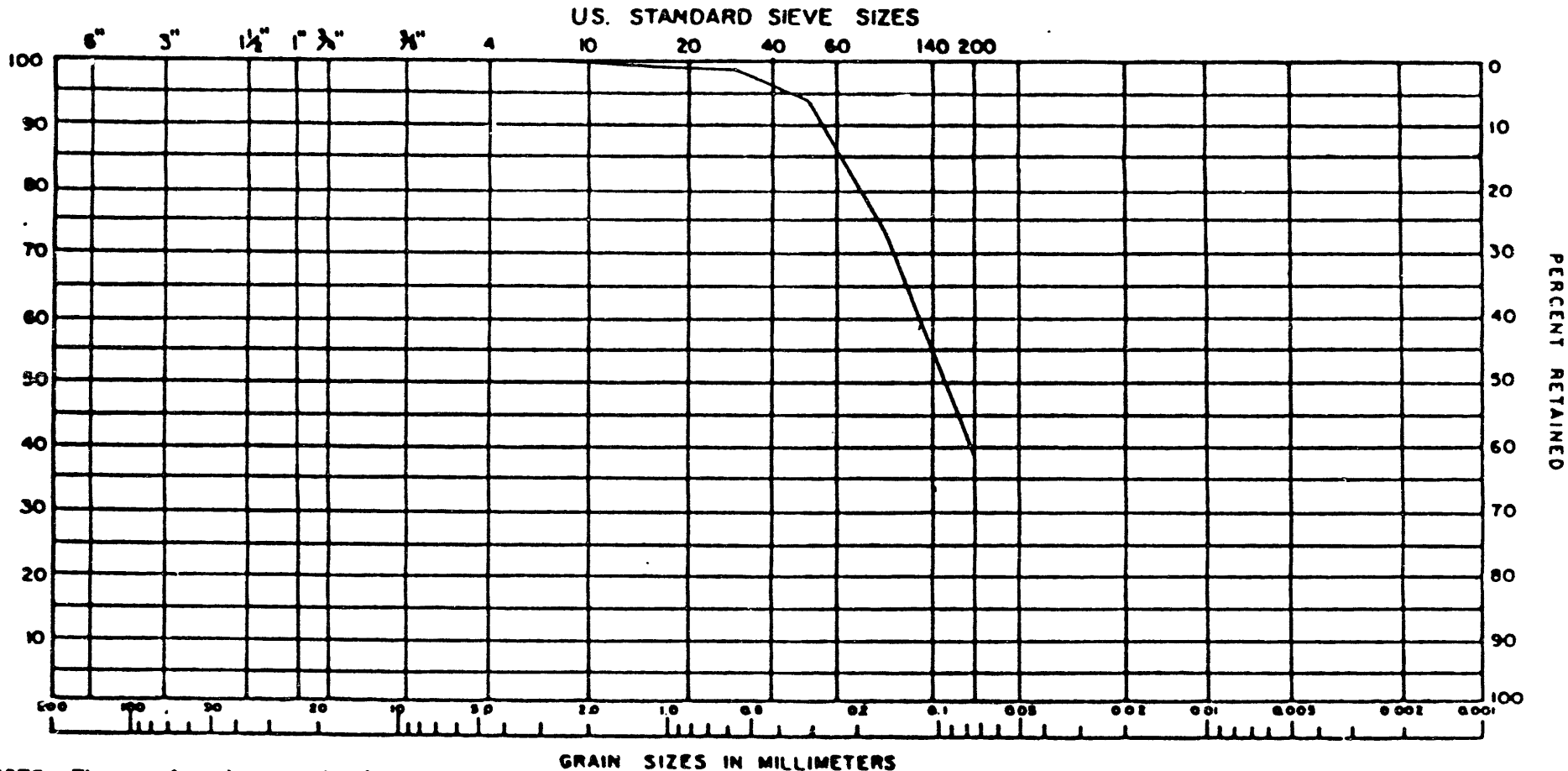
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



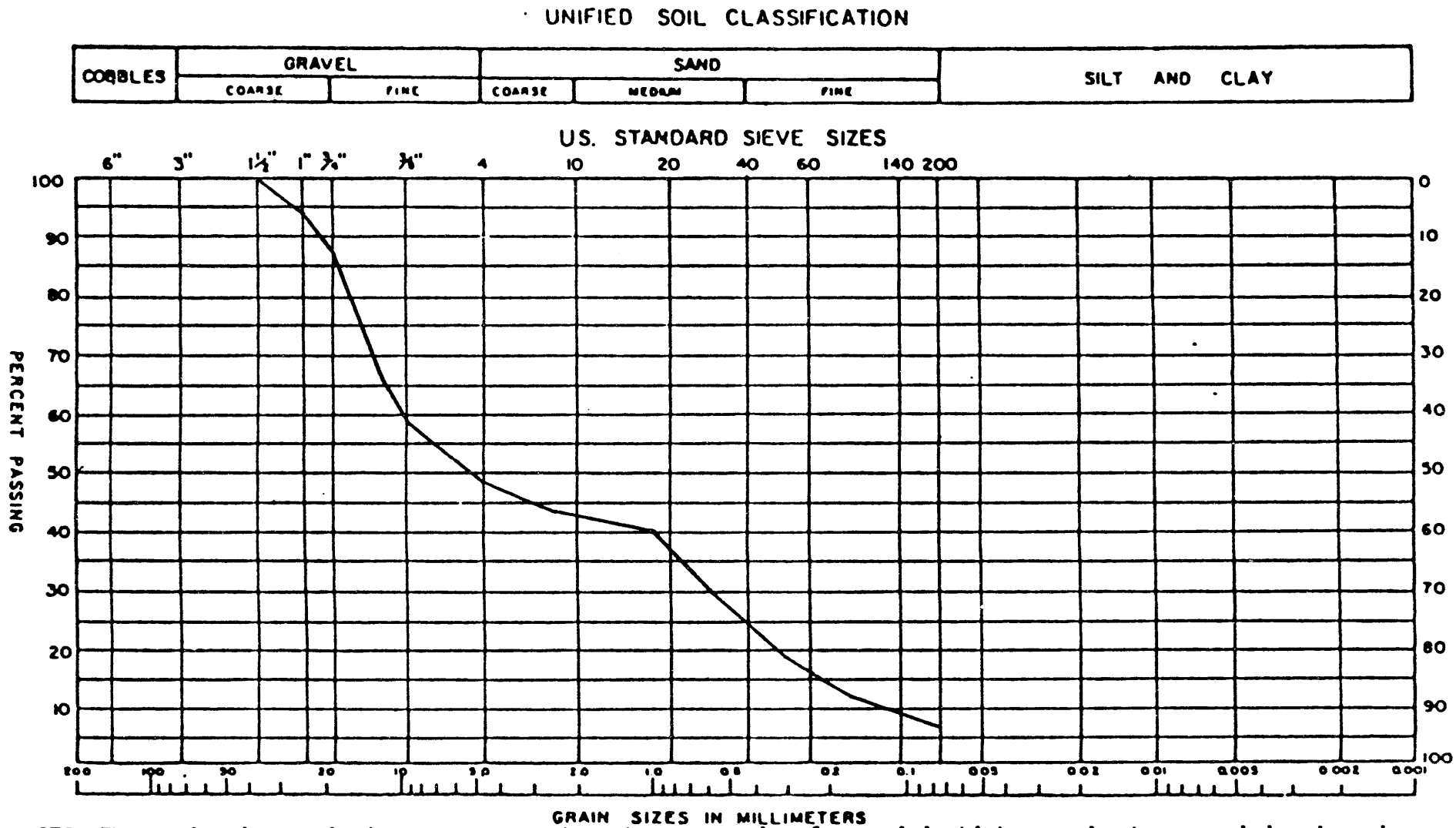
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT 32	5	--	--	----	19.0	2167
CLASSIFICATION	Sand, silty, (SM)					

Project: RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

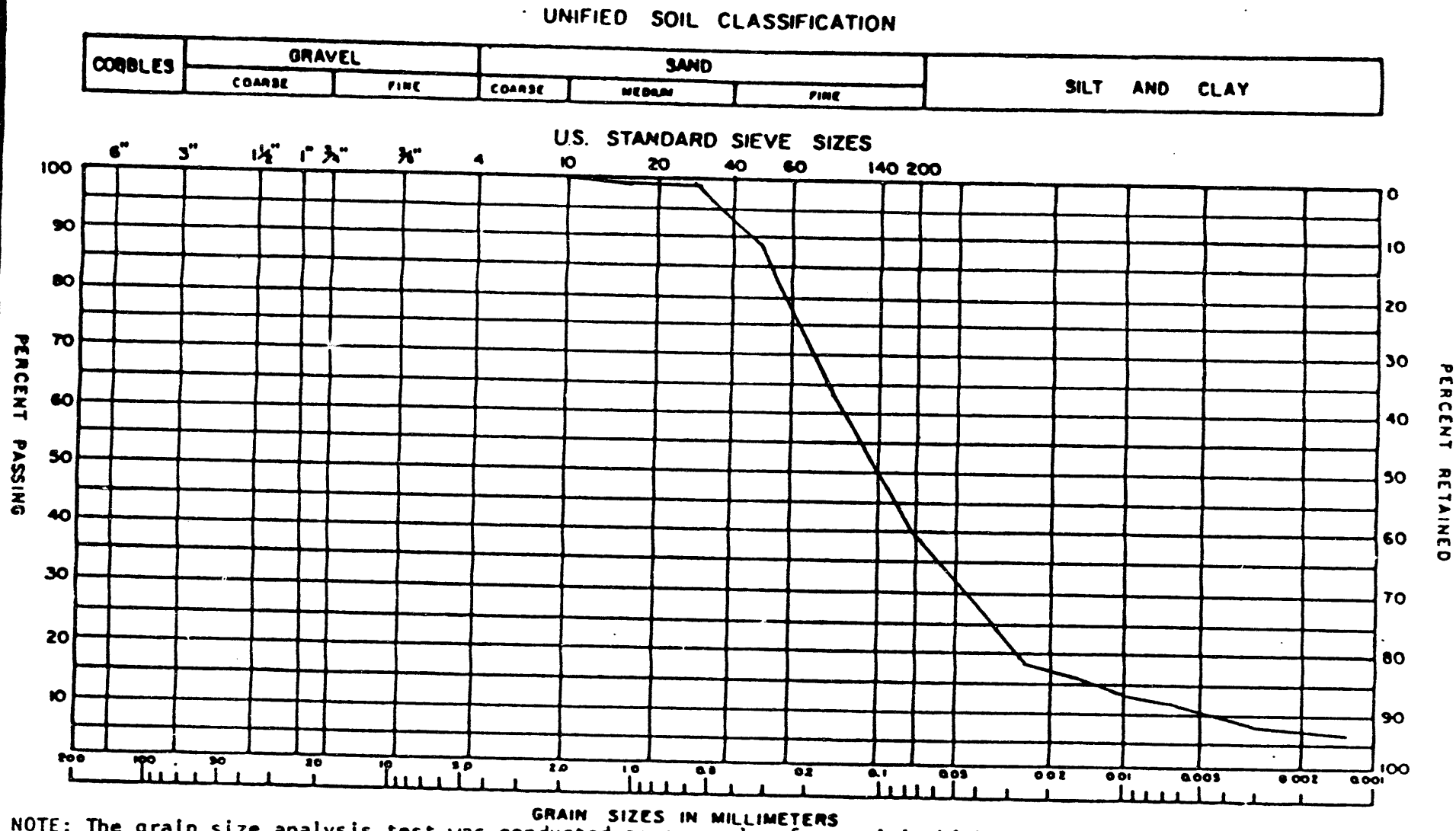
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-32	11½	--	--	---	11.7	2144
CLASSIFICATION	Gravel, very sandy, (GP-SP)					

Fig. 9

Project: RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT 33	1	22	NP	2.72	10.1	2168
CLASSIFICATION						

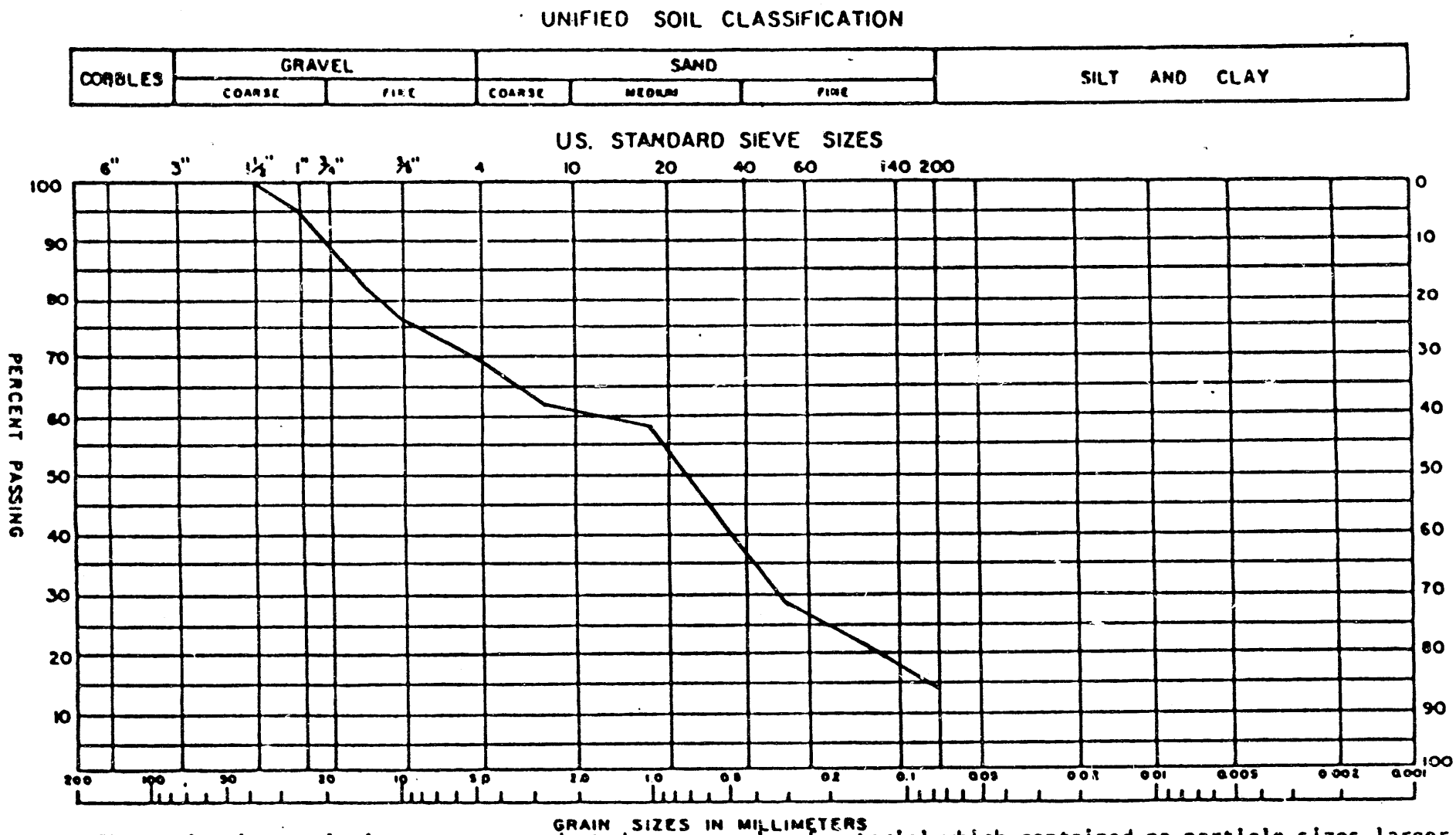
Fig 9

Project: RFL-87-01

M87054GF

GRAIN SIZE DISTRIBUTION CURVES

Fig.



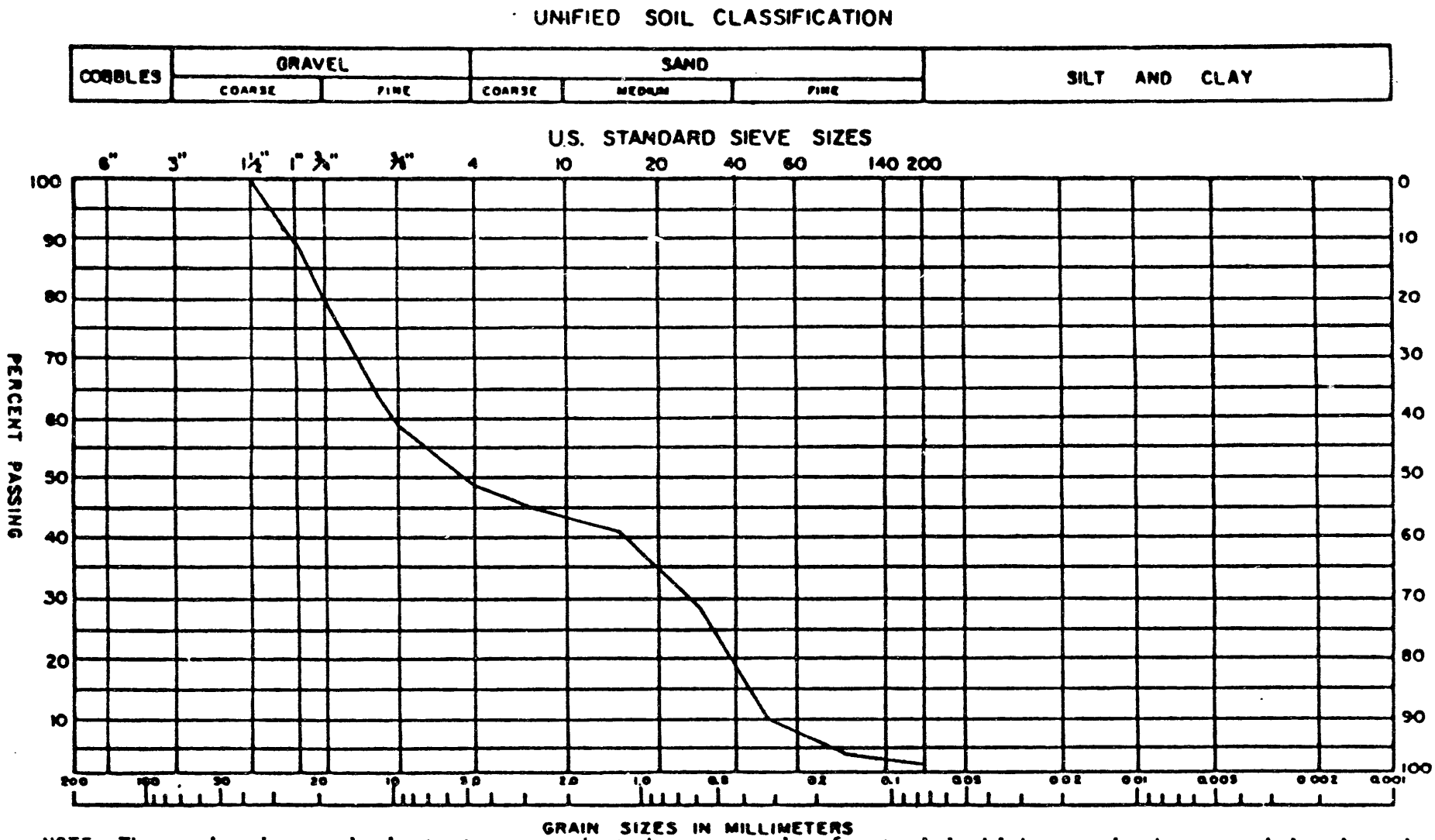
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-33	8	--	--	---	14.8	2145
CLASSIFICATION	Sand, gravelly, silty, (SM)					

Project: RFL-87-01, Rifle, Colorado

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

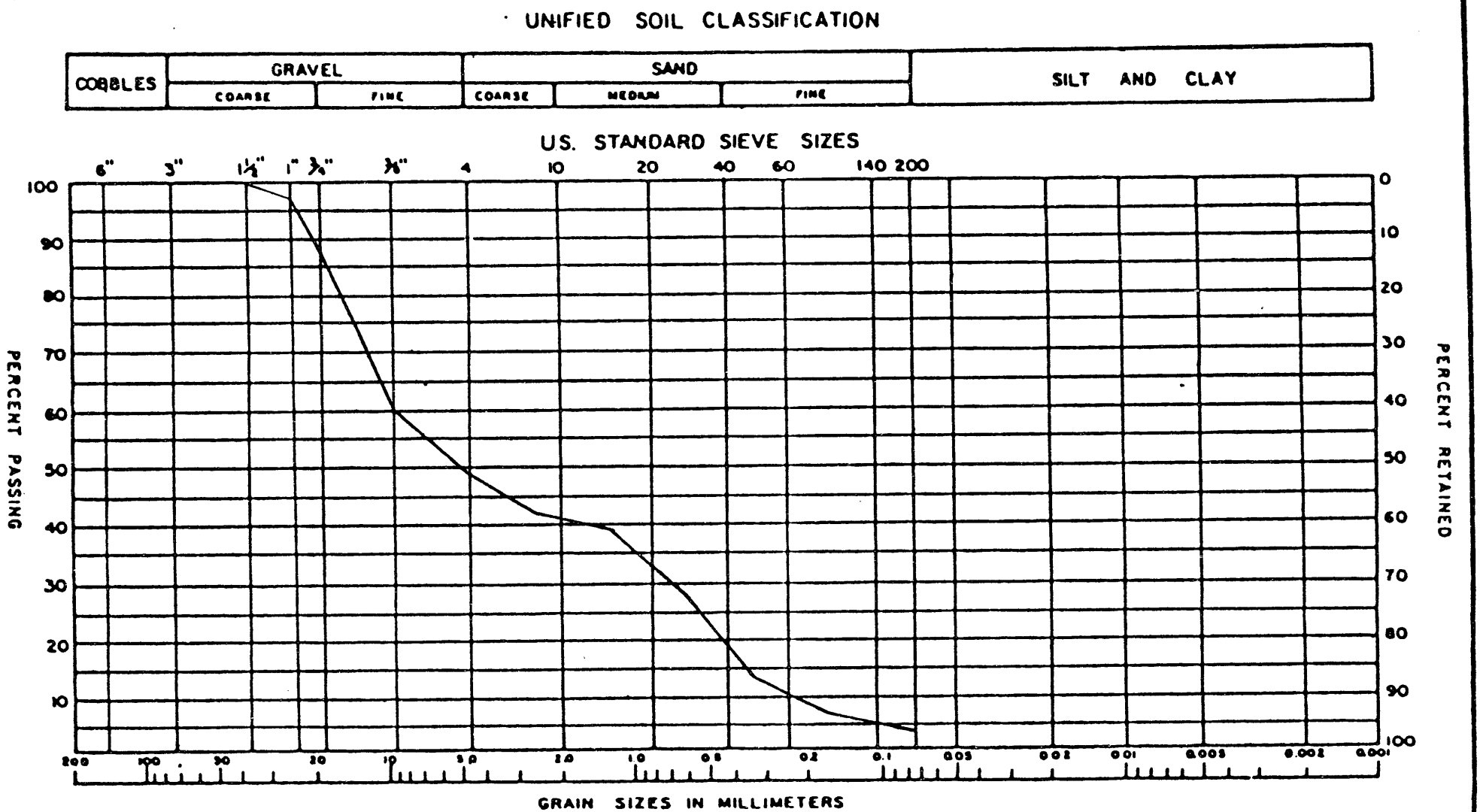
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT 33	10	--	--	----	12.4	2169
CLASSIFICATION	Gravel and sand, (GP-SP)					

Fig.

Project: RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

Fig.



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-33	12	--	--	---	12.1	2146
CLASSIFICATION	Gravel, very sandy, (GP-SP)					

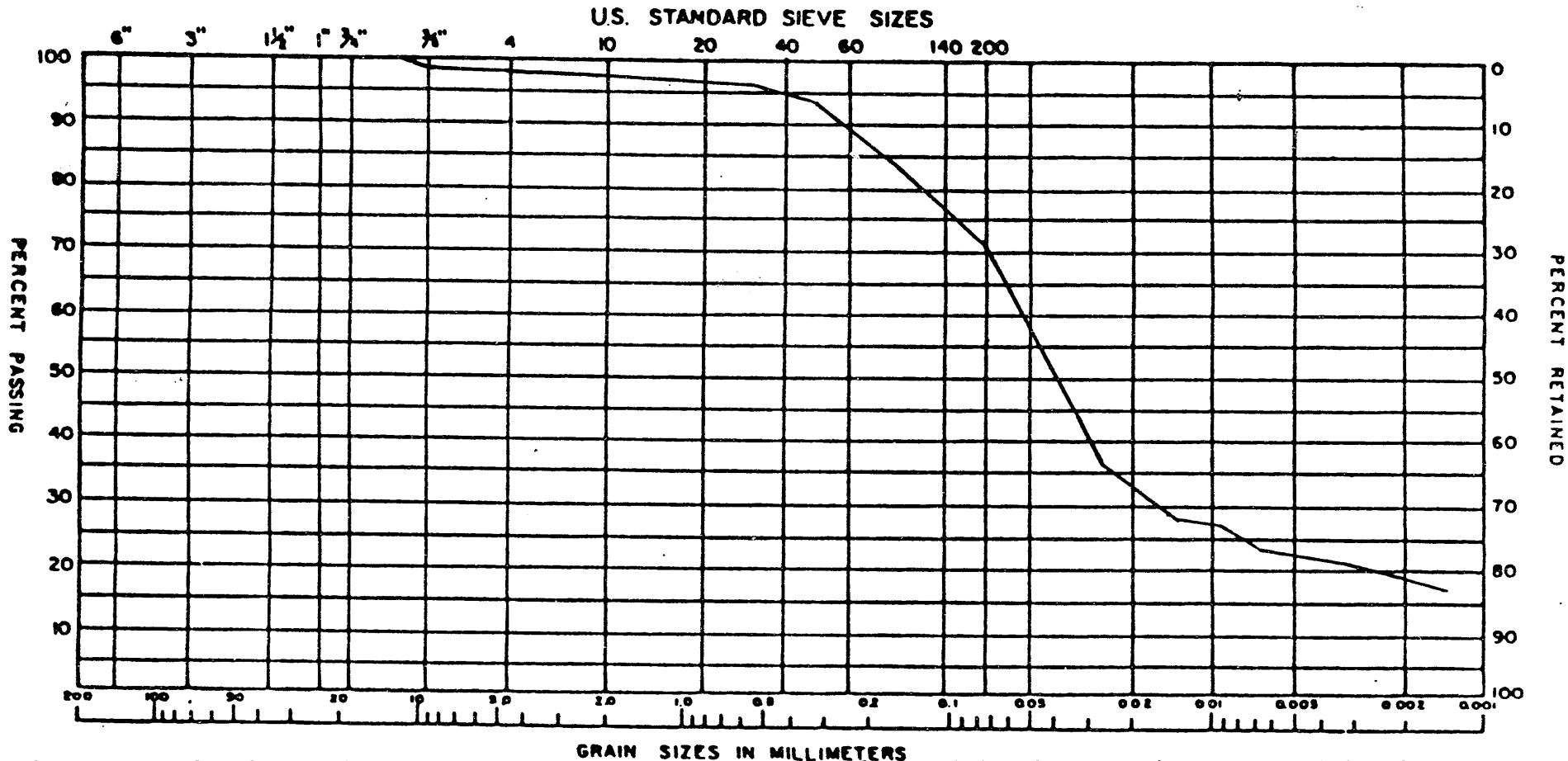
Project: RFL-87-01
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



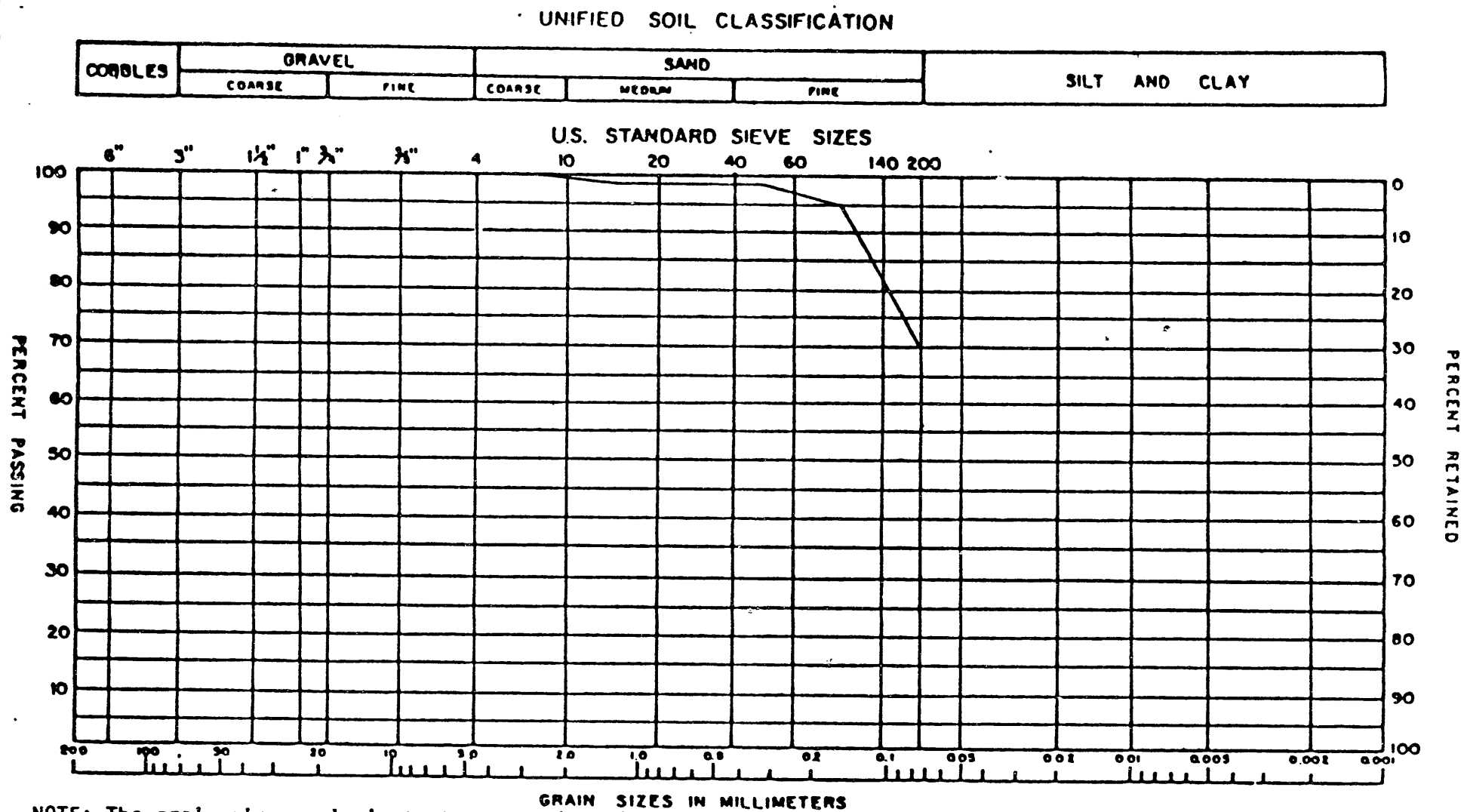
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT 34	1/2	24	6	----	----	2170
CLASSIFICATION						

Project: Rifle-RFL-87-01
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	
MOT-34	2½ feet	--	--	--	25.9	2171
CLASSIFICATION Silt, sandy, (ML)						

Project: RFL-87-01

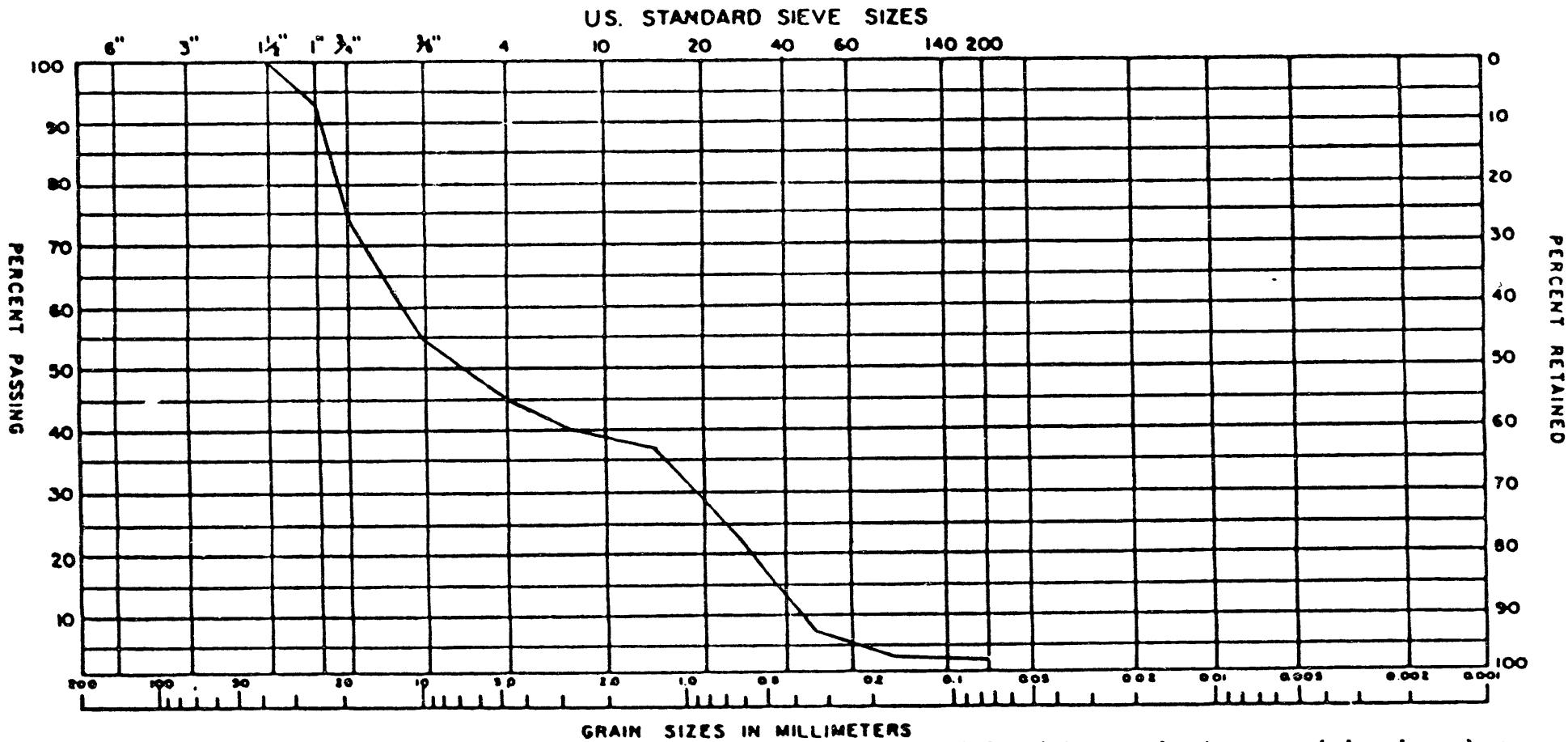
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-34	8	--	--	---	9.5	2147
CLASSIFICATION	Gravel, very sandy, (GP-SP)					

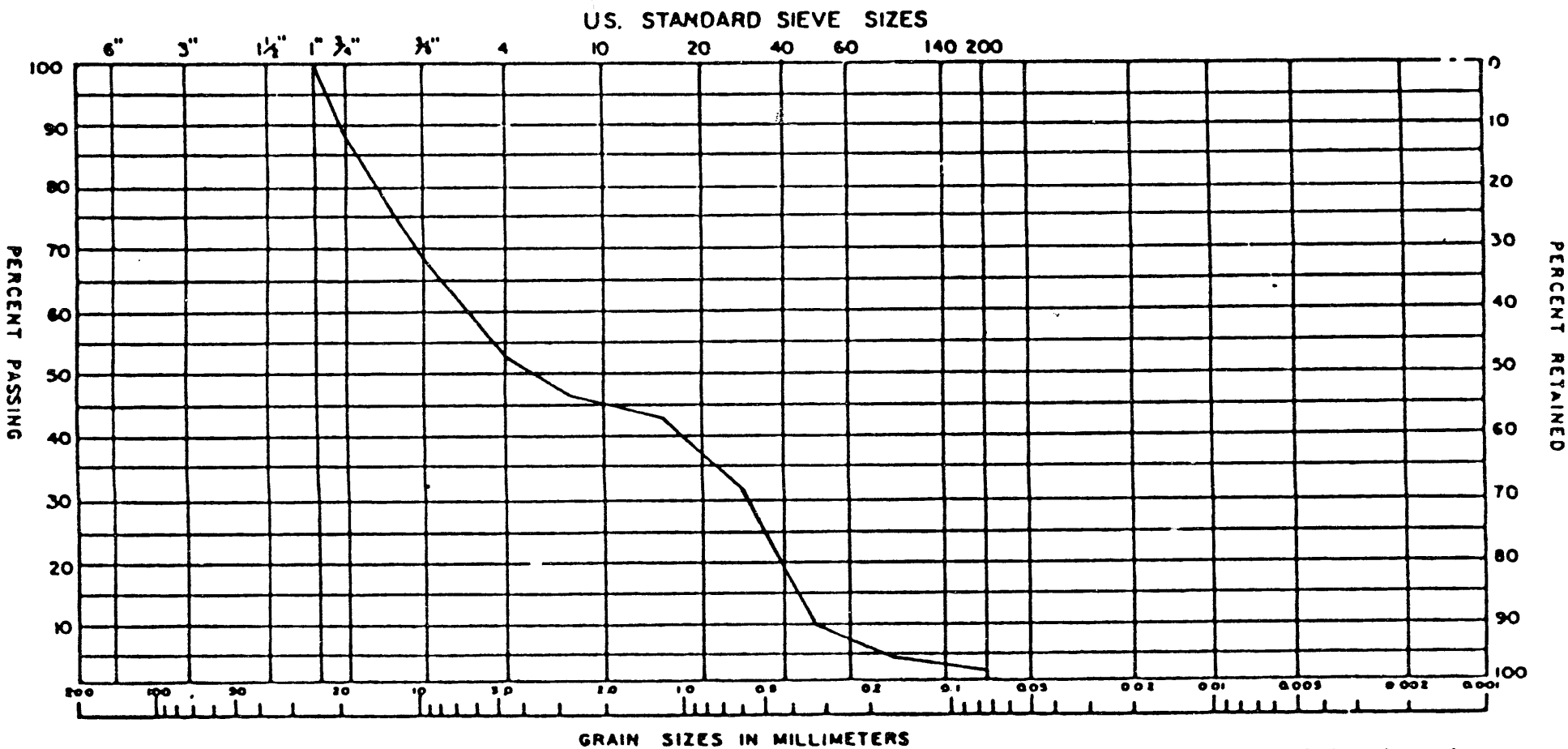
Project: RFL-87-01

Job Number M870546E

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOT-34	10	--	--	---	20.9	2148
CLASSIFICATION	Sand, very gravelly, (SP-GP)					

Fig.

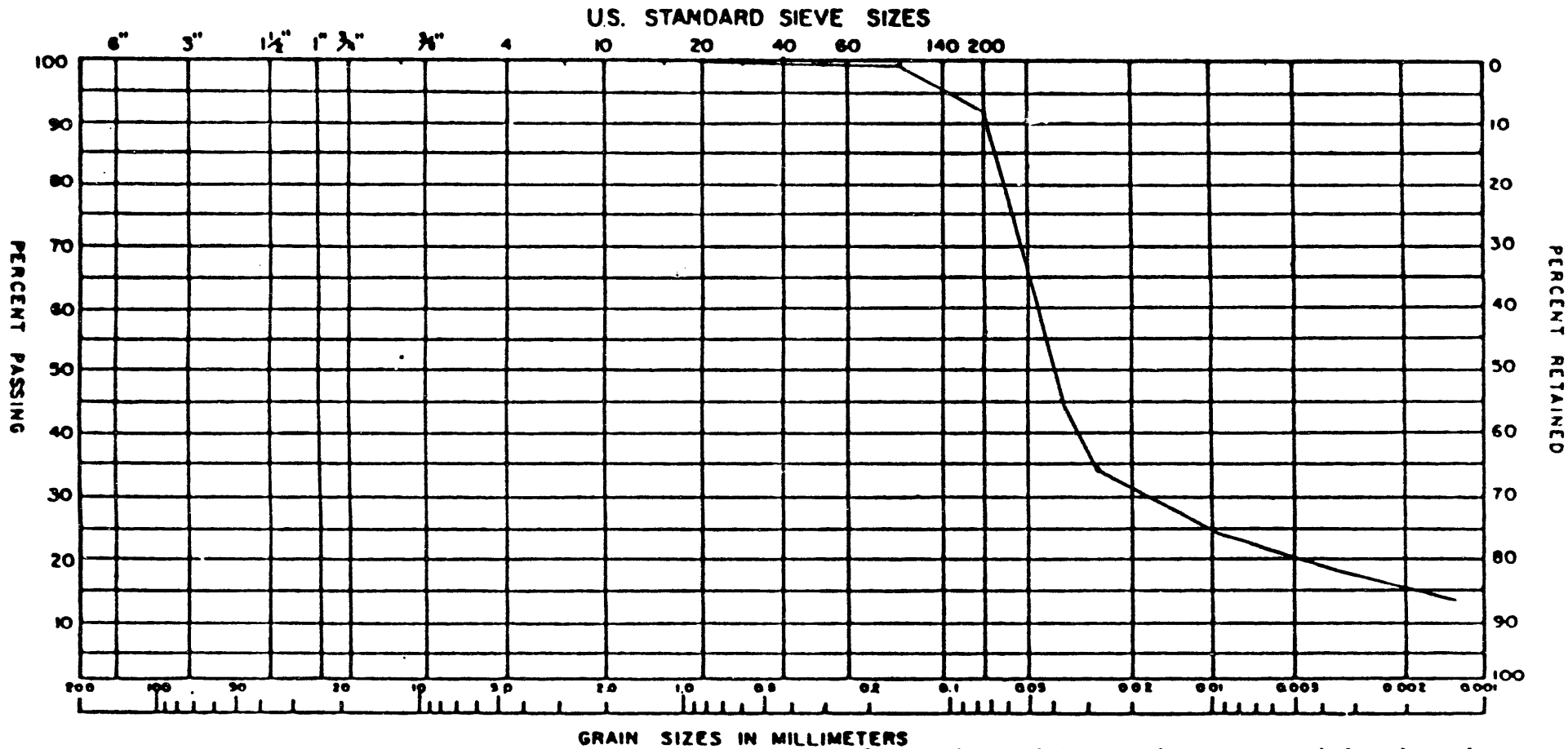
Project: Rifle-RFL-87-01
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOS-1	0' to 1'	32	8	2.68	--	2078
CLASSIFICATION						

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MOS-1 at 0 to 1 Foot

LABORATORY SAMPLE NUMBER: 2078

SAMPLE DESCRIPTION:

TRIAXIAL PERMEABILITY: 1.6×10^{-6} cm/sec

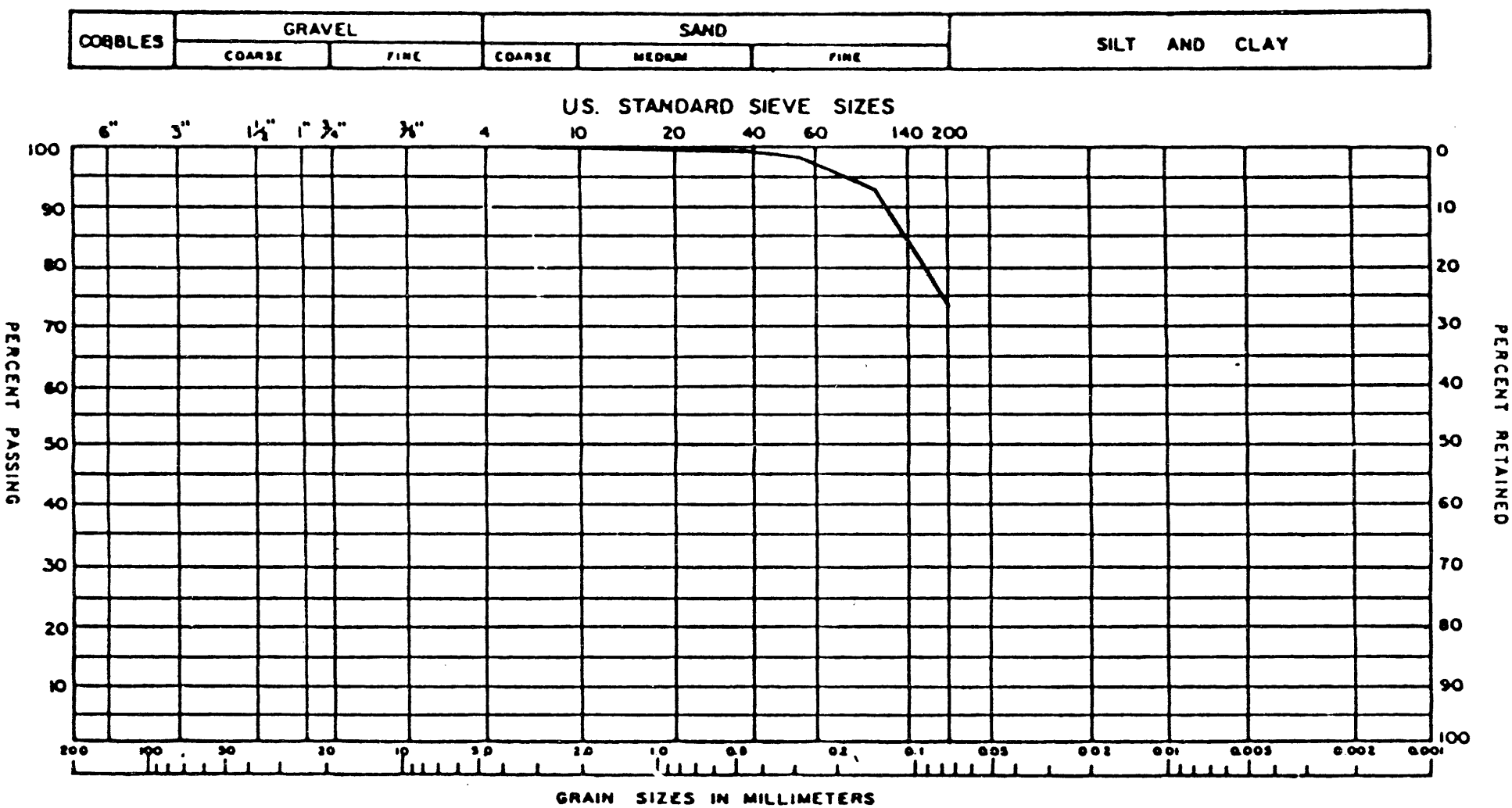
CONFINING PRESSURE: 2 psi

INITIAL DRY DENSITY: 90.5 pcf

INITIAL MOISTURE CONTENT: 19.0 percent

Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

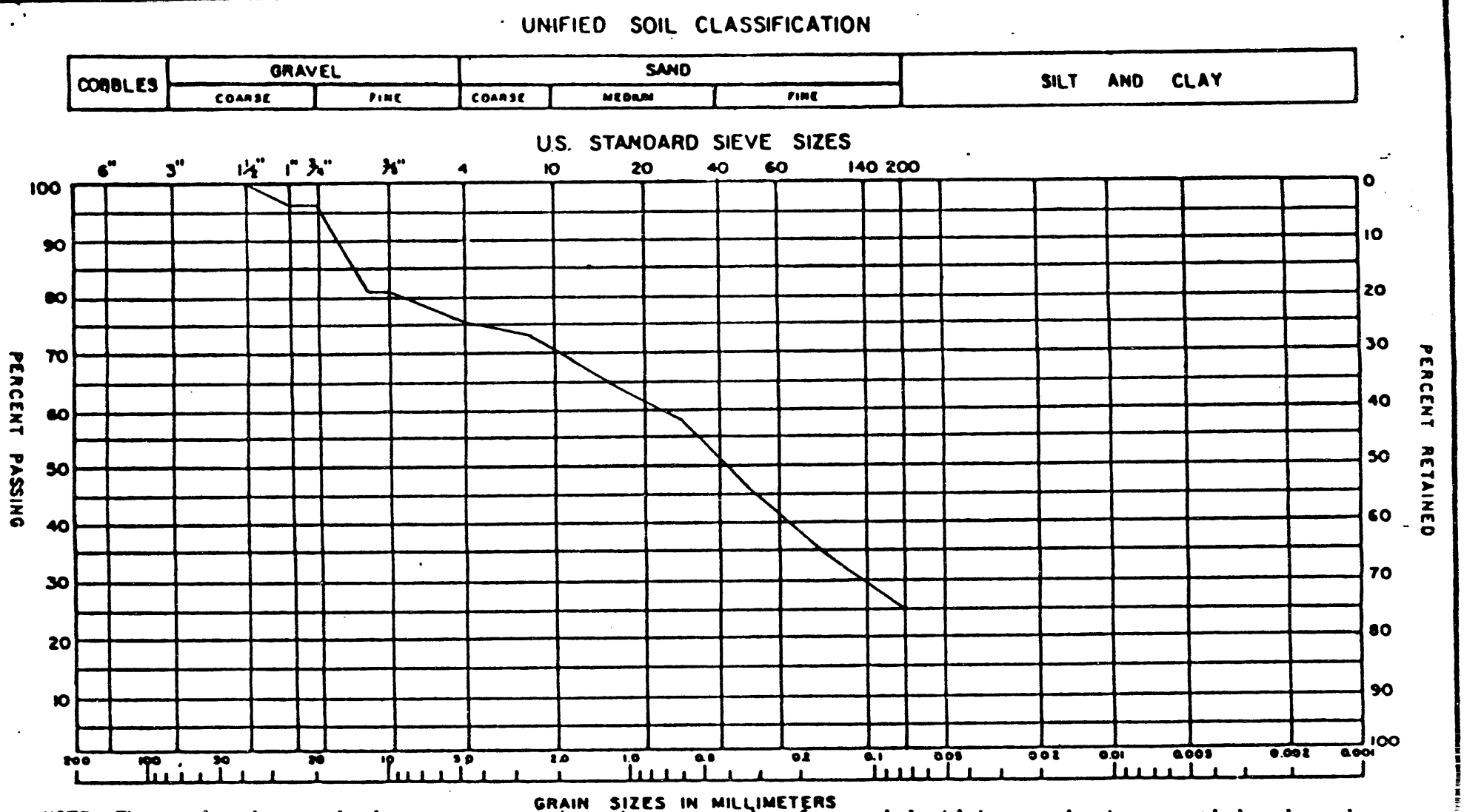
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOS-4	0' to 1'	--	--	--	3.0	2079
CLASSIFICATION	Silt, clayey, slightly sandy, (ML)					

Fig

Project: RFL-87-01
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

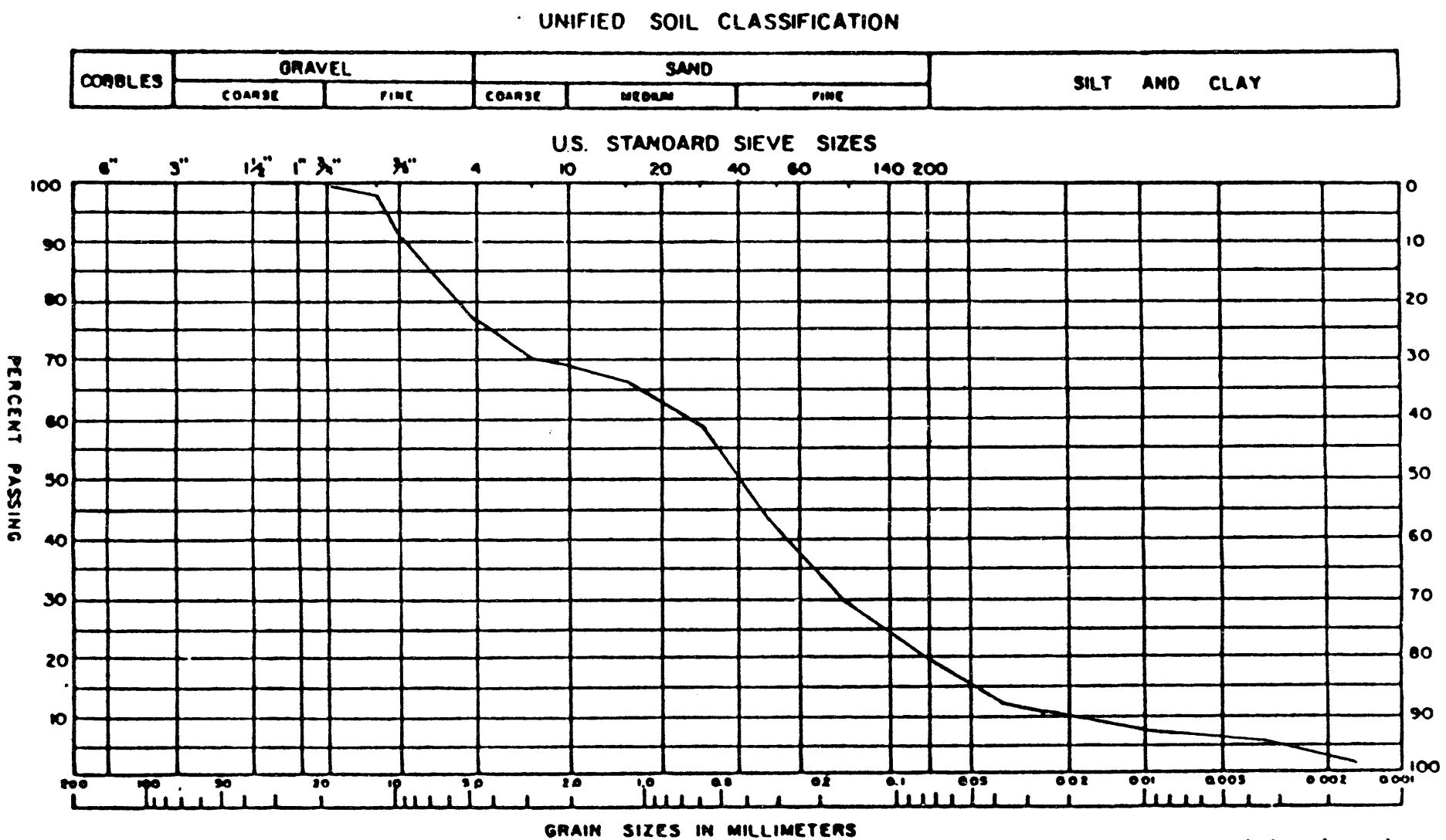
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOS-5B	1	--	--	---	9.1	2080
CLASSIFICATION	Sand, gravelly, (SP)					

Project: Rifle-RFL-87-01

Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.



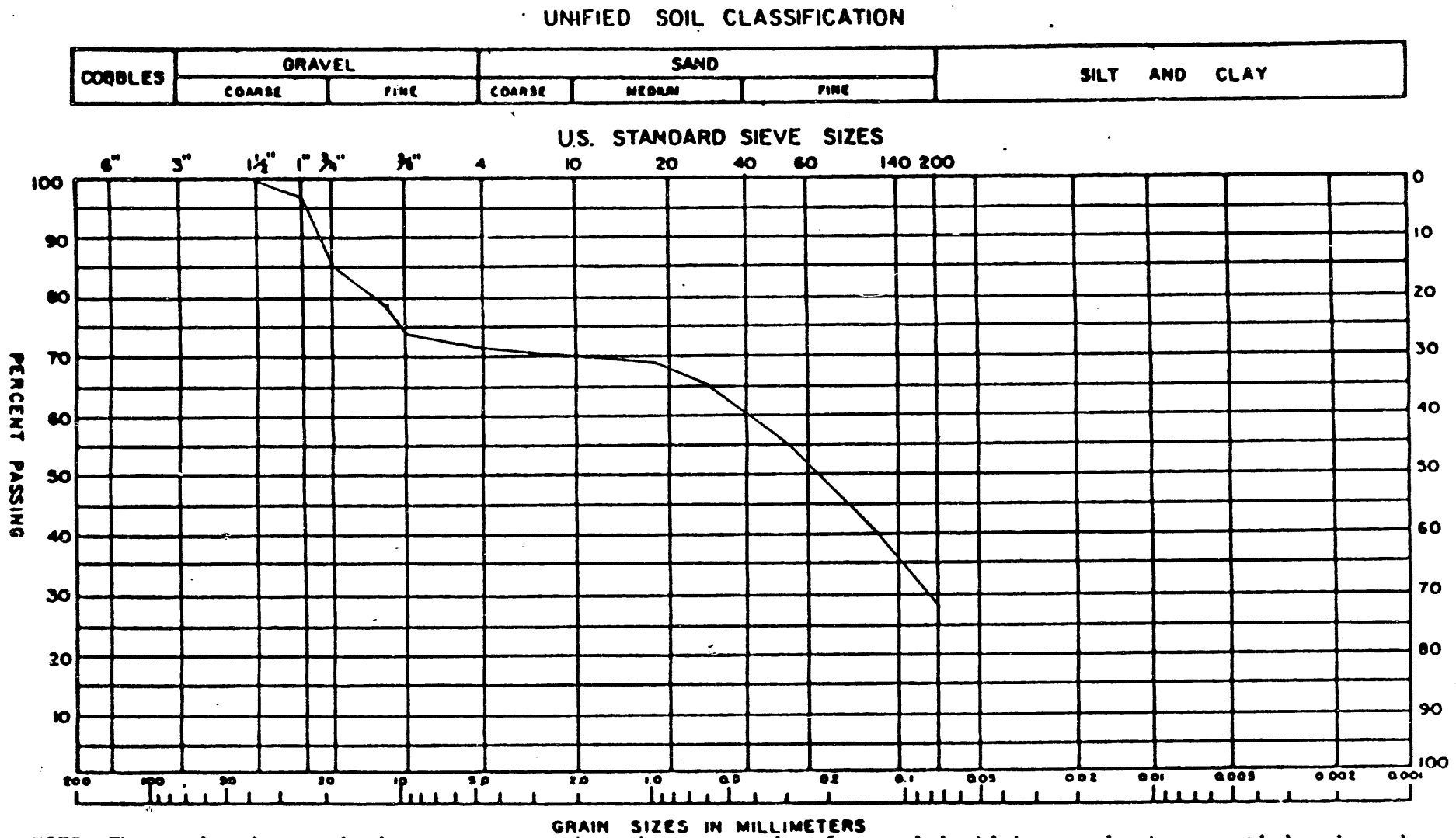
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOS-6B	Surface	NP	NP	--	--	2081
CLASSIFICATION						

Project: Rifle-RFL-87-01
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



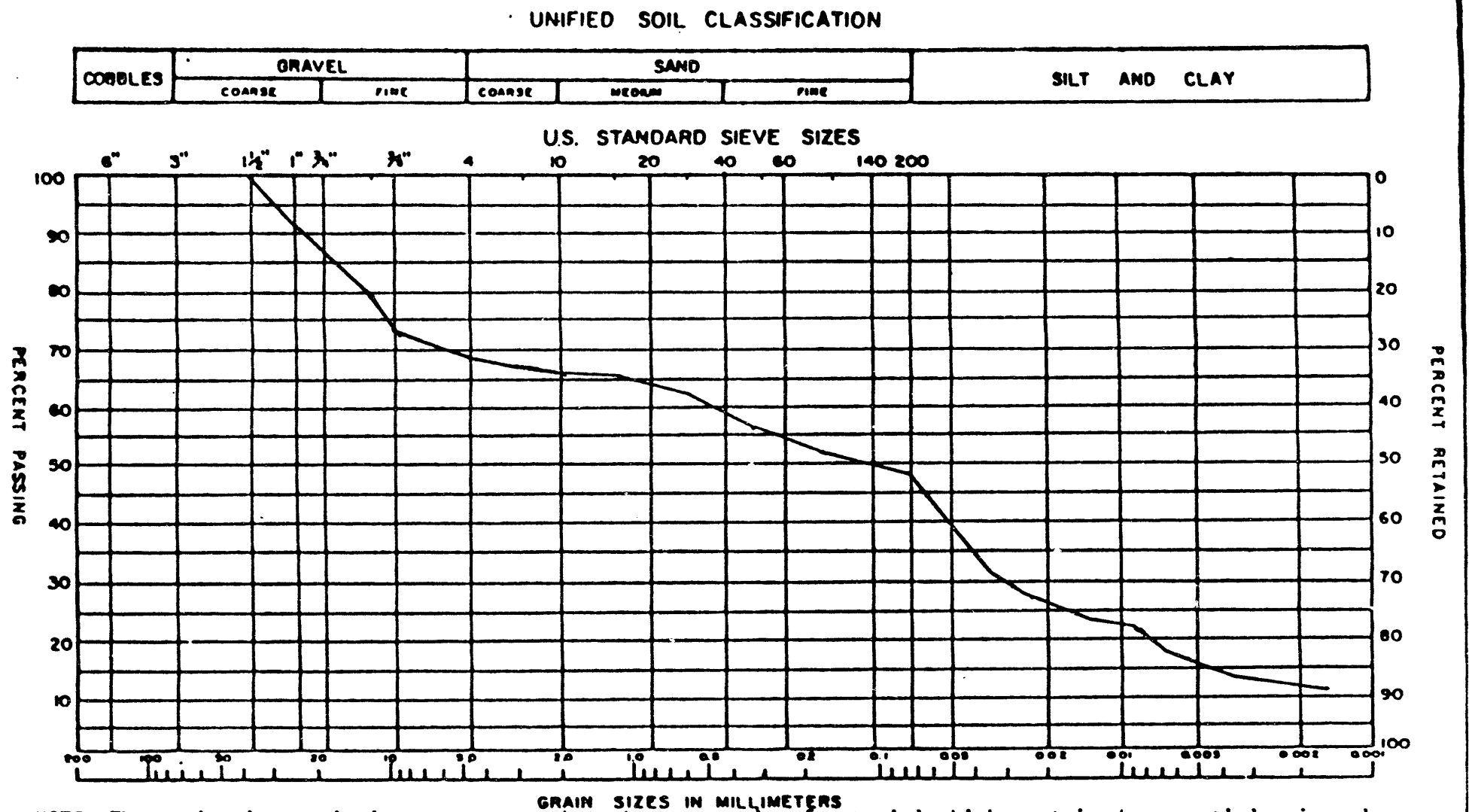
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MOS 6B	2	--	--	----	2.7	2082
CLASSIFICATION						

Project: Rifle-RFL-87-01

Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOS-7B	Surface	29	12	2.70	--	2083
CLASSIFICATION						

Fig

TEST RESULTS SHEET

PROJECT: RFL-87-01

TEST HOLE: MOS-7B at surface

LABORATORY SAMPLE NUMBER: 2084

INITIAL MOISTURE CONTENT: 1.5 percent

Project: RFL-87-01

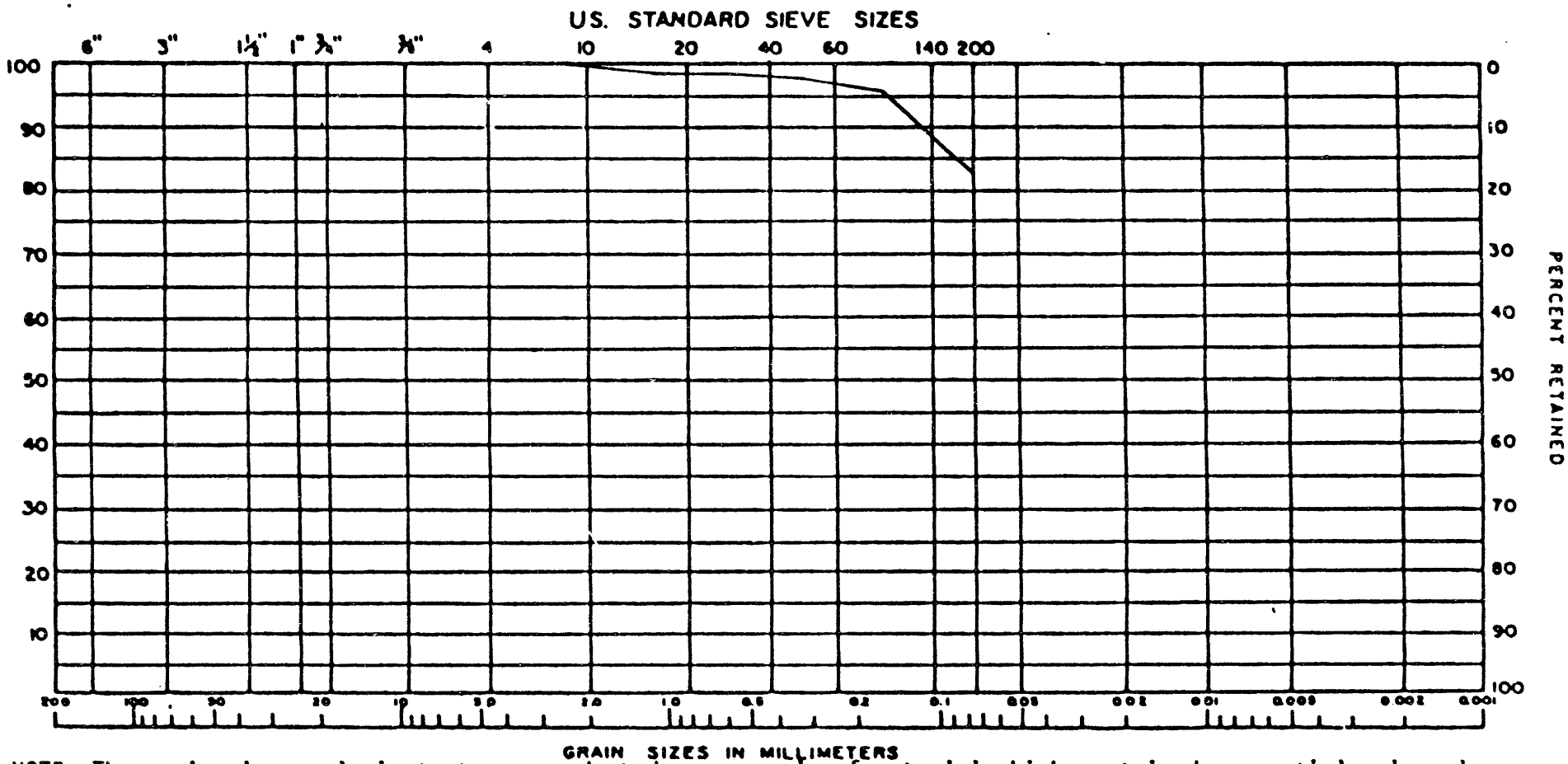
Job Number: M8705-GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOS 8	1/2	22	0	2.75	3.3	2085
CLASSIFICATION Silt, slightly sandy (ML)						

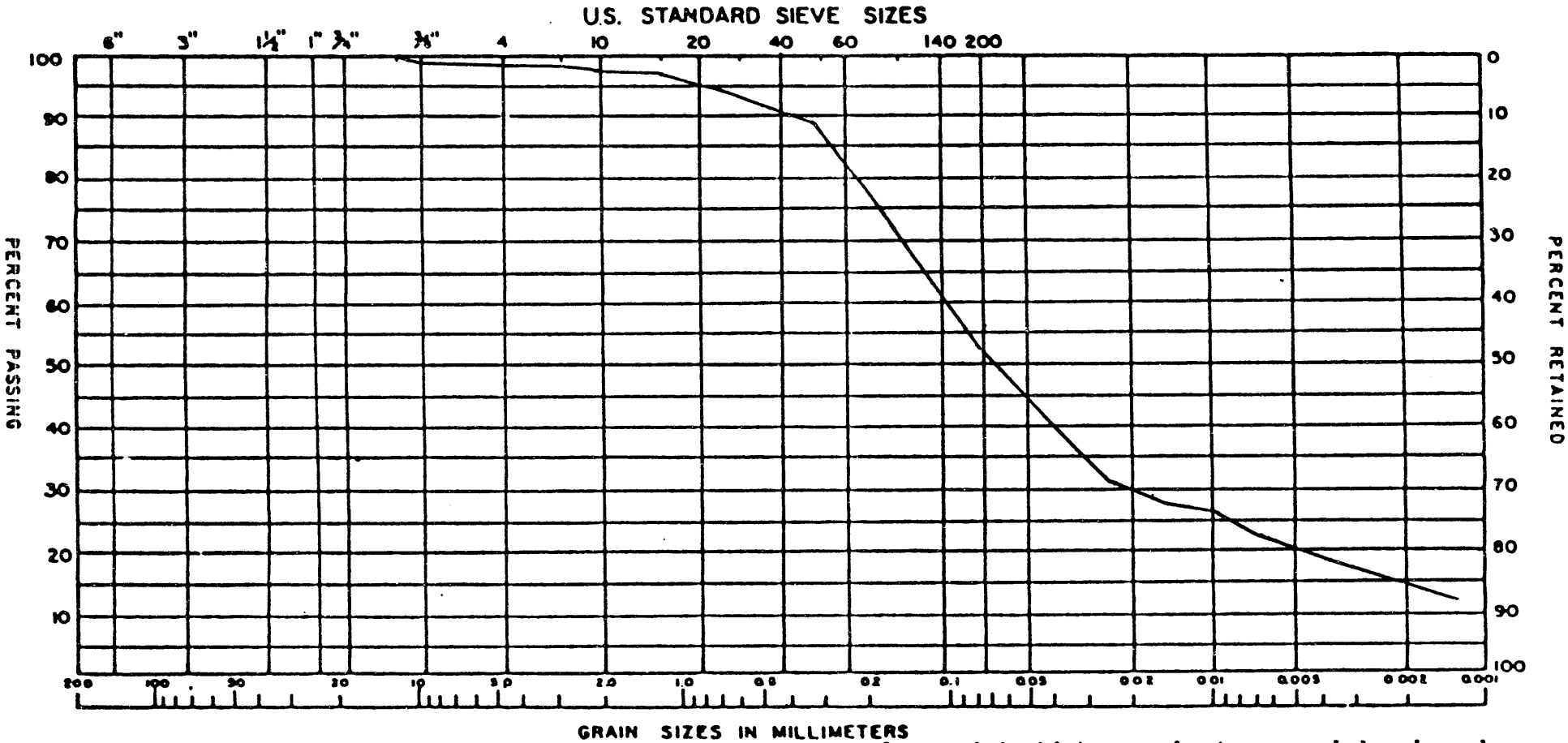
Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE; The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOS-10	1/2'	--	--	2.64		2086
CLASSIFICATION						

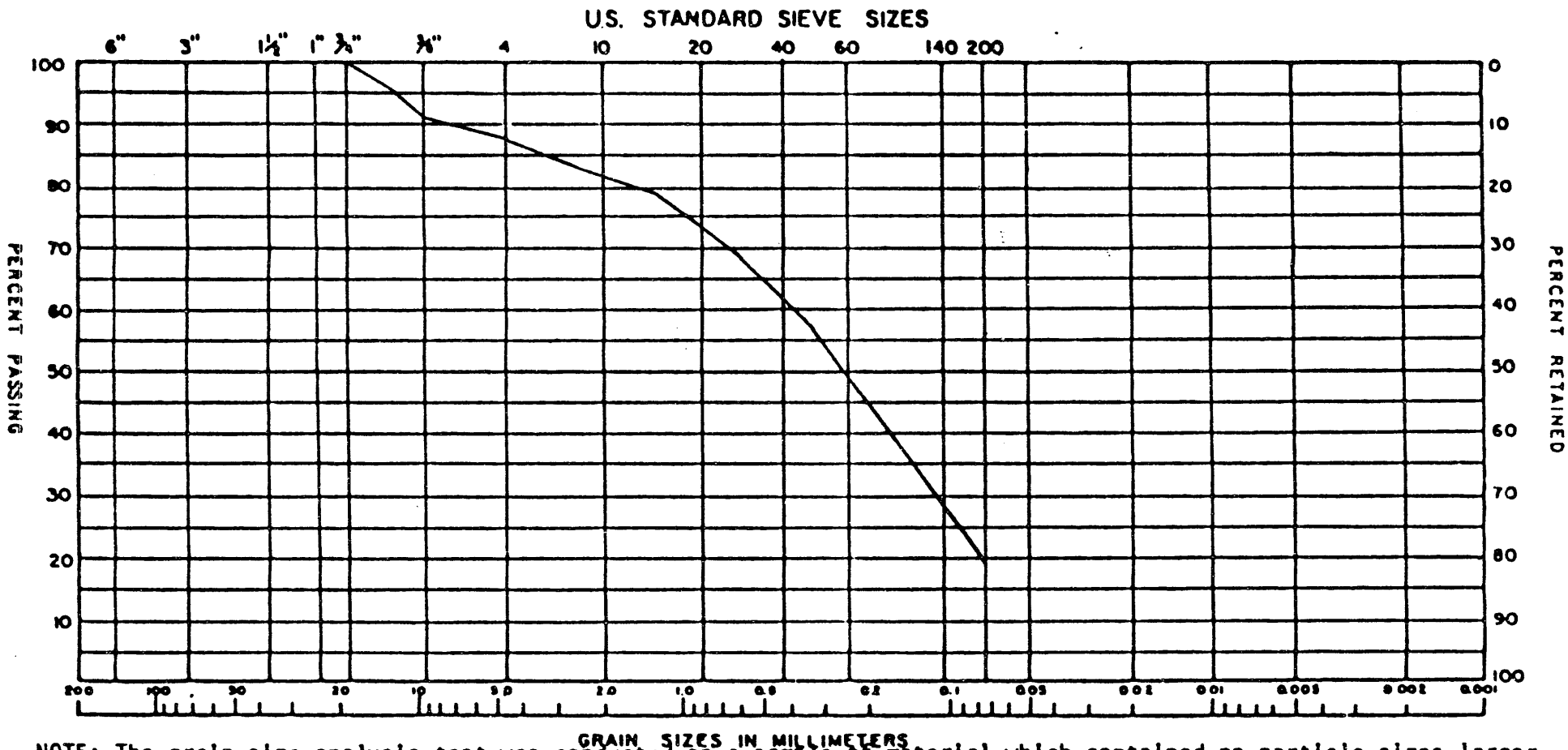
Project: RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOS-12	1/2				8.5	2087
CLASSIFICATION	Sand, silty, (SM)					

Project: Rifle-RFL-87-01

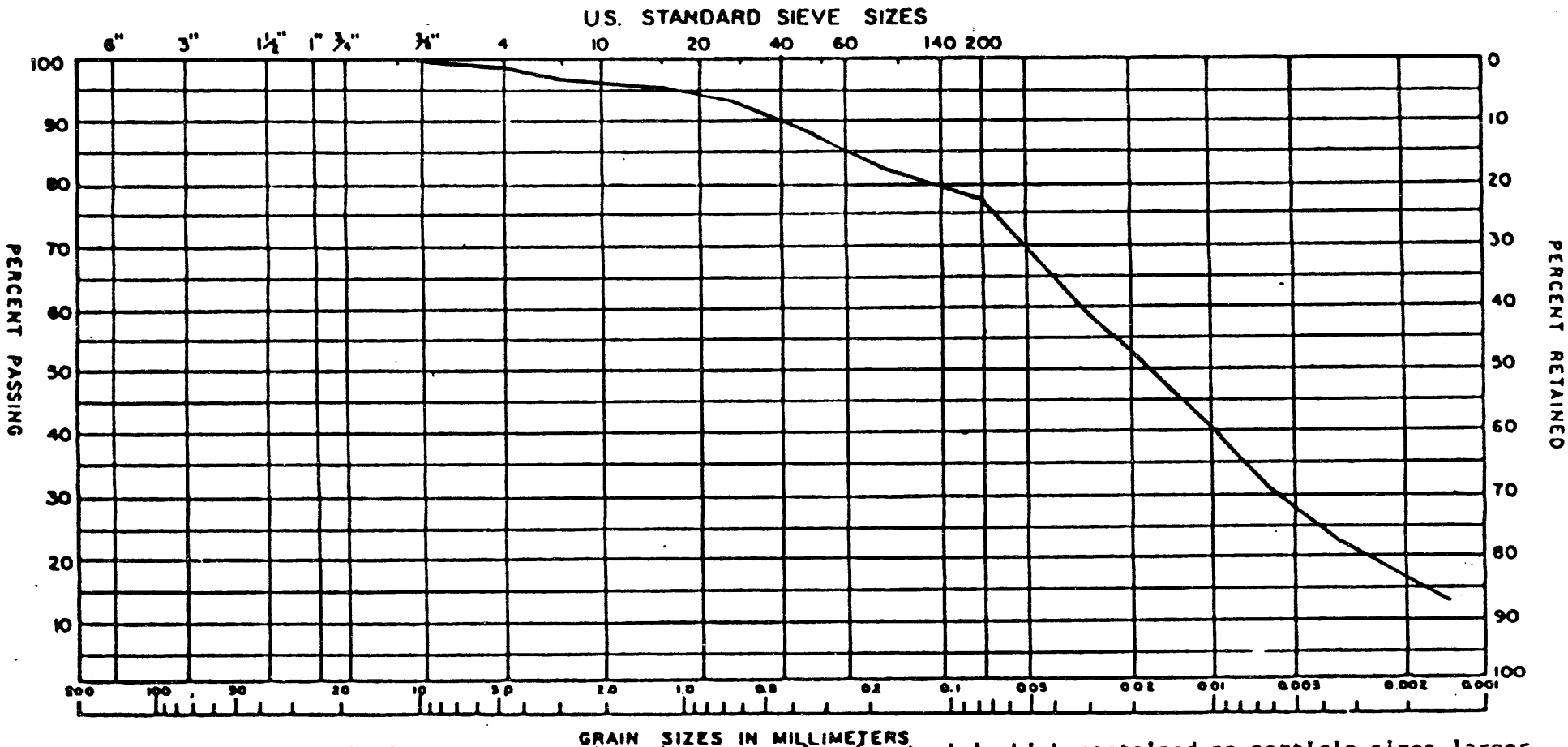
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

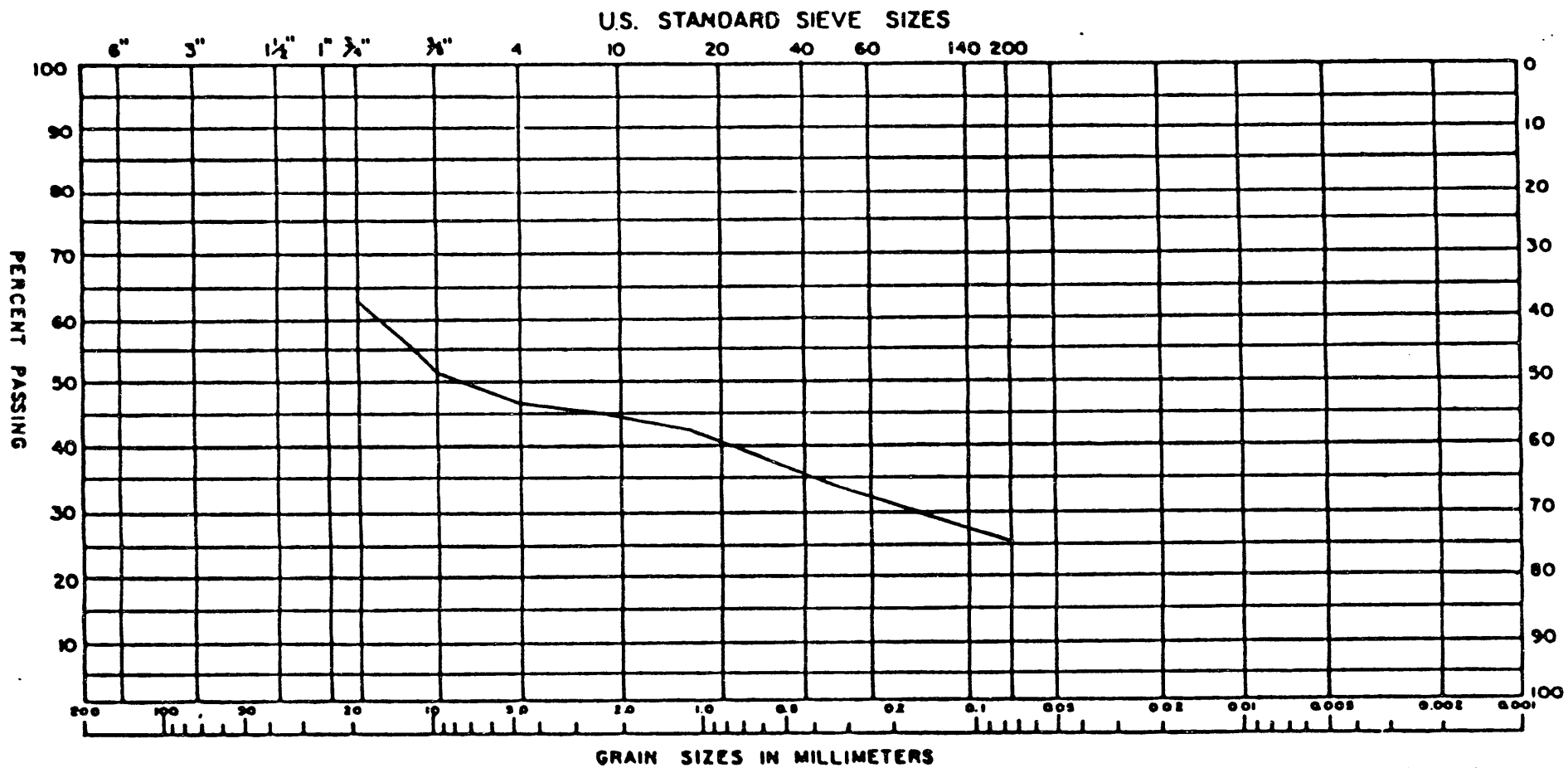
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MOS-13	1' to 2'	30	11	2.67	5.6	2088
CLASSIFICATION						

Project: RFL-87-01
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
M OS-14B	1/2				4.4	2089
CLASSIFICATION	Gravel, sandy, silty, (GM)					

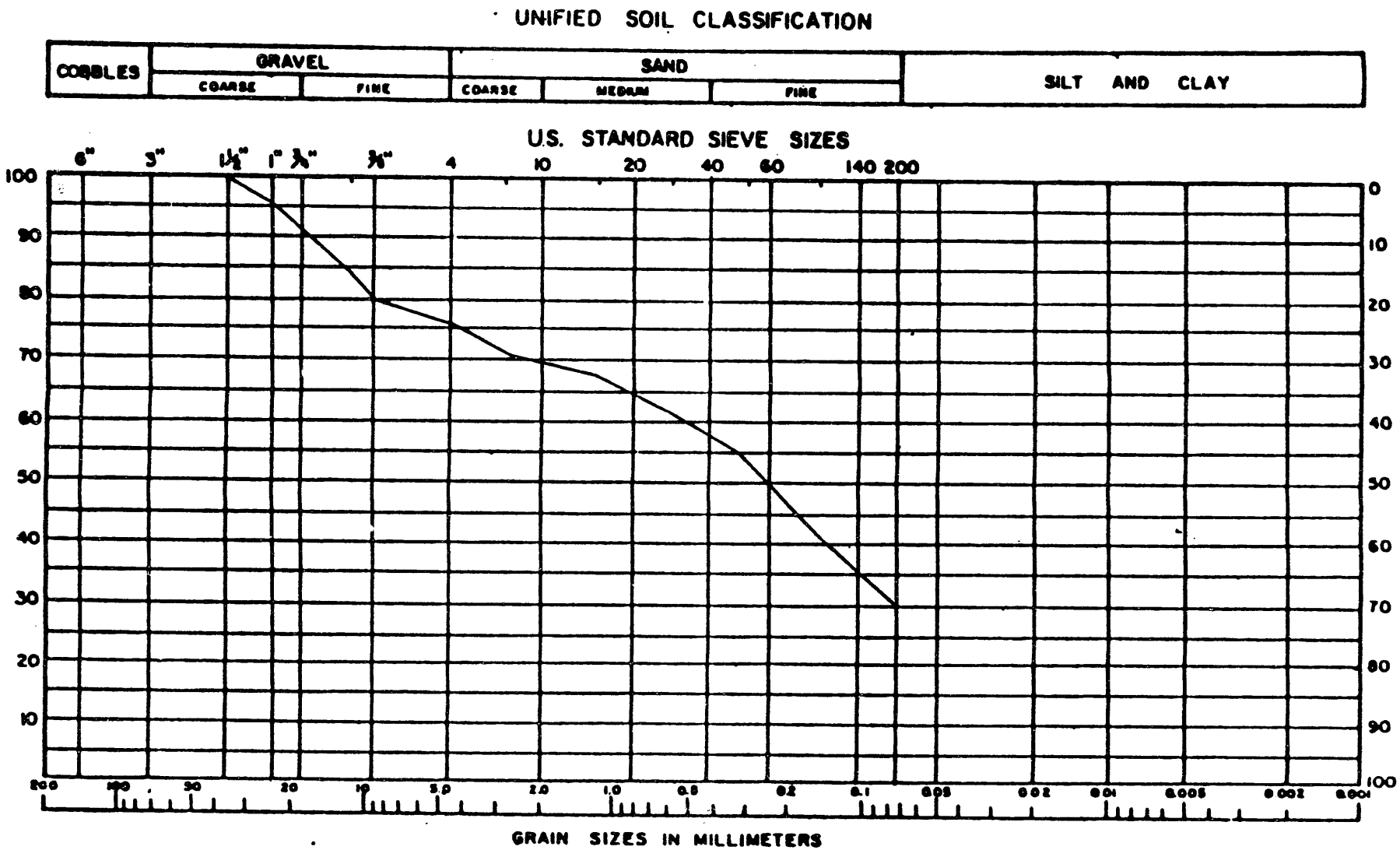
Fig.

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

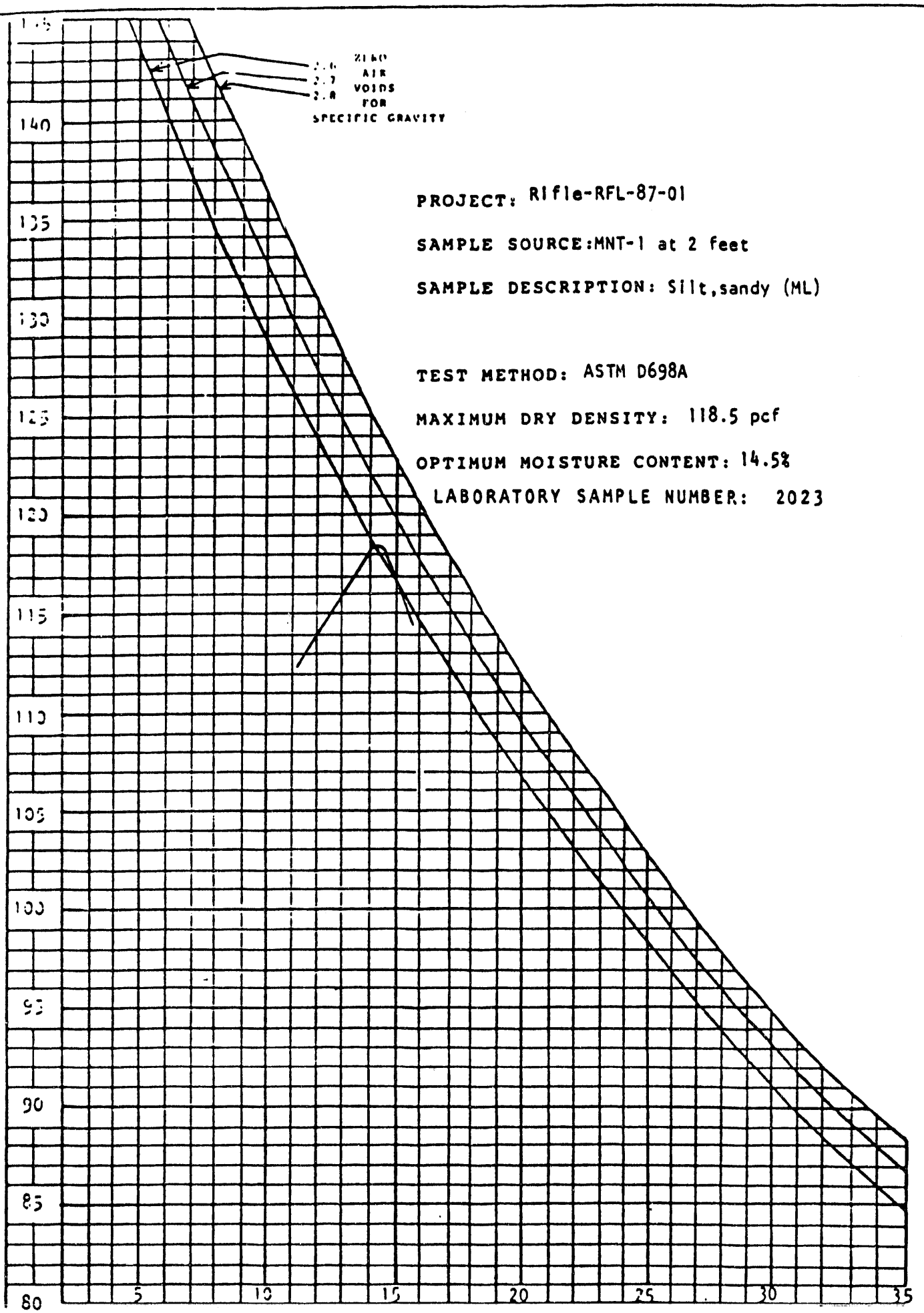
Fig:



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
C-3 Blend		--	--	--	16.8	2239

CLASSIFICATION

Intermediate materials from all 4 Mesa Rifle



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MNT-1 at 2 feet

SAMPLE DESCRIPTION: Silt, sandy (ML)

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 118.5 pcf

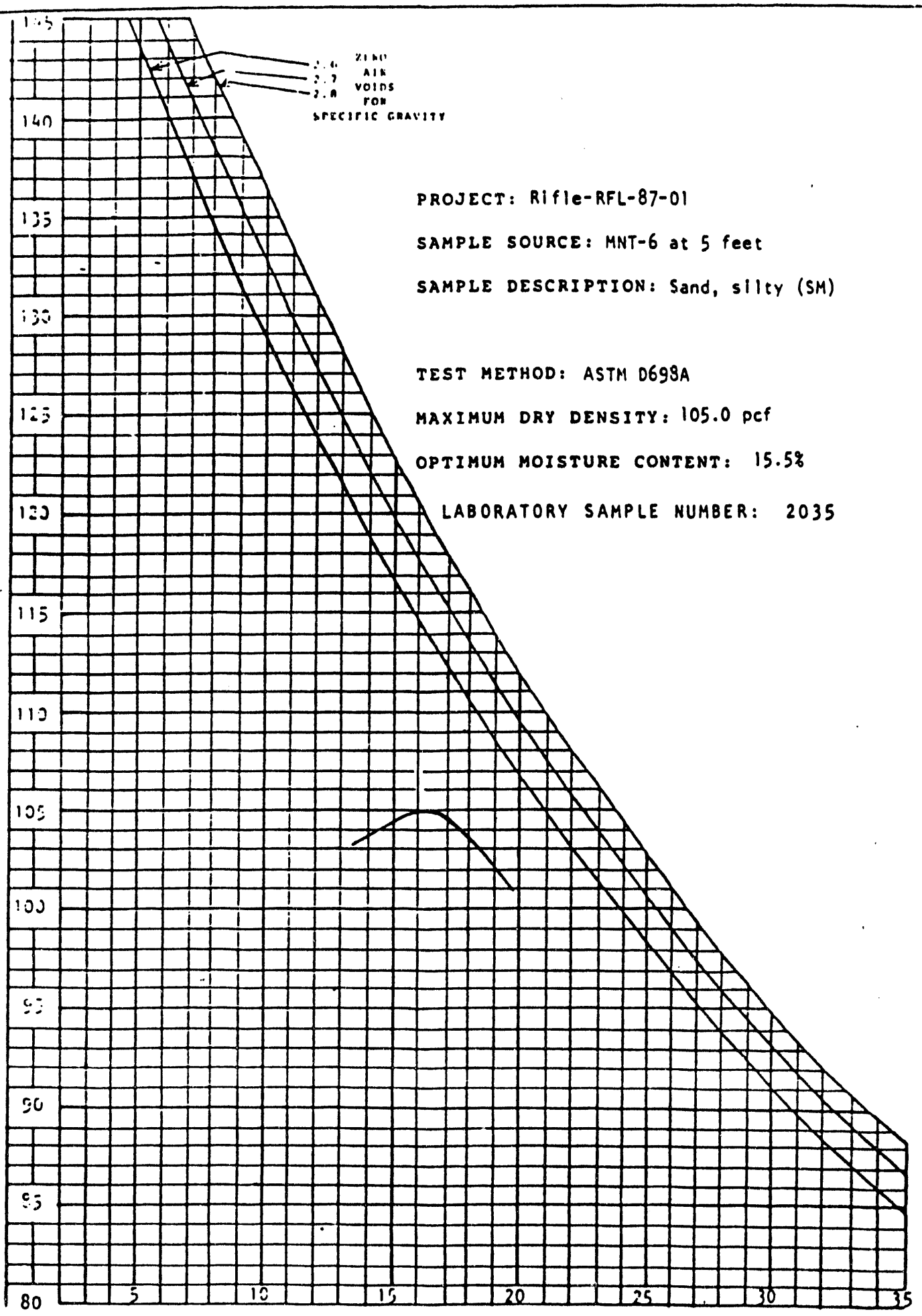
OPTIMUM MOISTURE CONTENT: 14.5%

LABORATORY SAMPLE NUMBER: 2023

Lambert and Associates

Project No.: [illegible]

Date:



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MNT-6 at 5 feet

SAMPLE DESCRIPTION: Sand, silty (SM)

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 105.0 pcf

OPTIMUM MOISTURE CONTENT: 15.5%

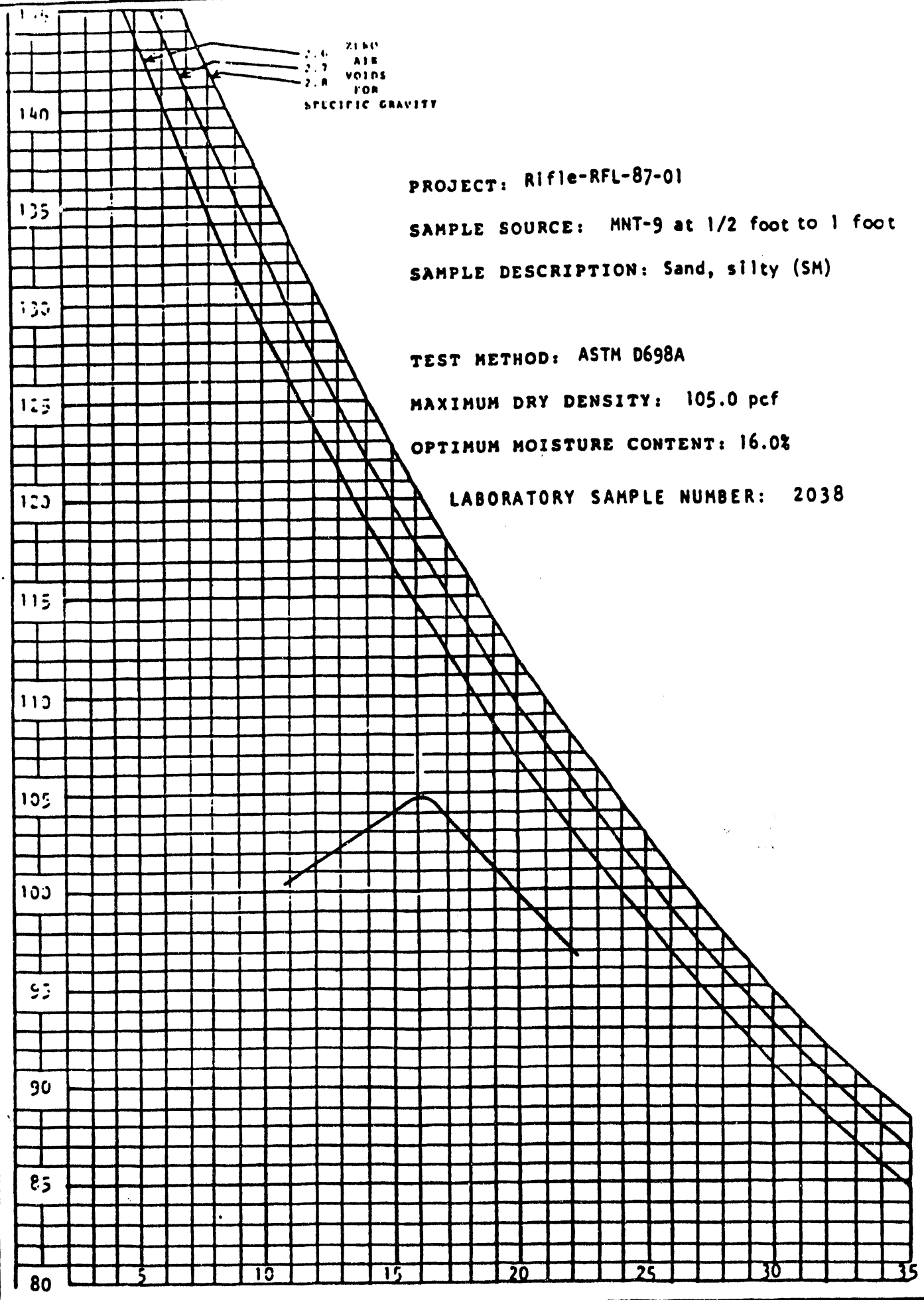
LABORATORY SAMPLE NUMBER: 2035

Lambert and Associates

Project No.: H8705-5E

Date:

Figure:



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MNT-9 at 1/2 foot to 1 foot

SAMPLE DESCRIPTION: Sand, silty (SM)

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 105.0 pcf

OPTIMUM MOISTURE CONTENT: 16.0%

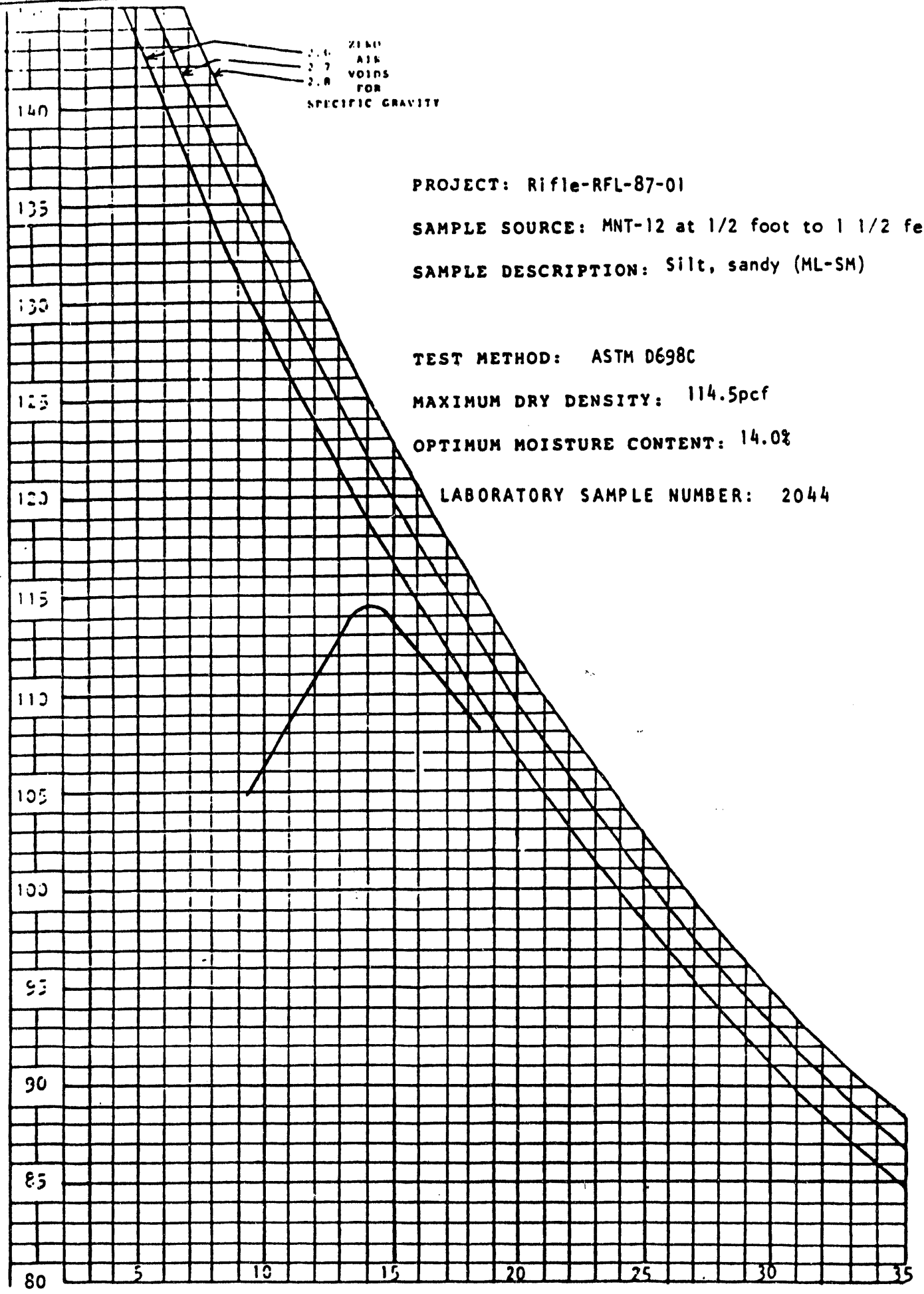
LABORATORY SAMPLE NUMBER: 2038

Lambert and Associates

Project No.: M87054GE

Date:

Figure:



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MNT-12 at 1/2 foot to 1 1/2 feet

SAMPLE DESCRIPTION: Silt, sandy (ML-SM)

TEST METHOD: ASTM D698C

MAXIMUM DRY DENSITY: 114.5pcf

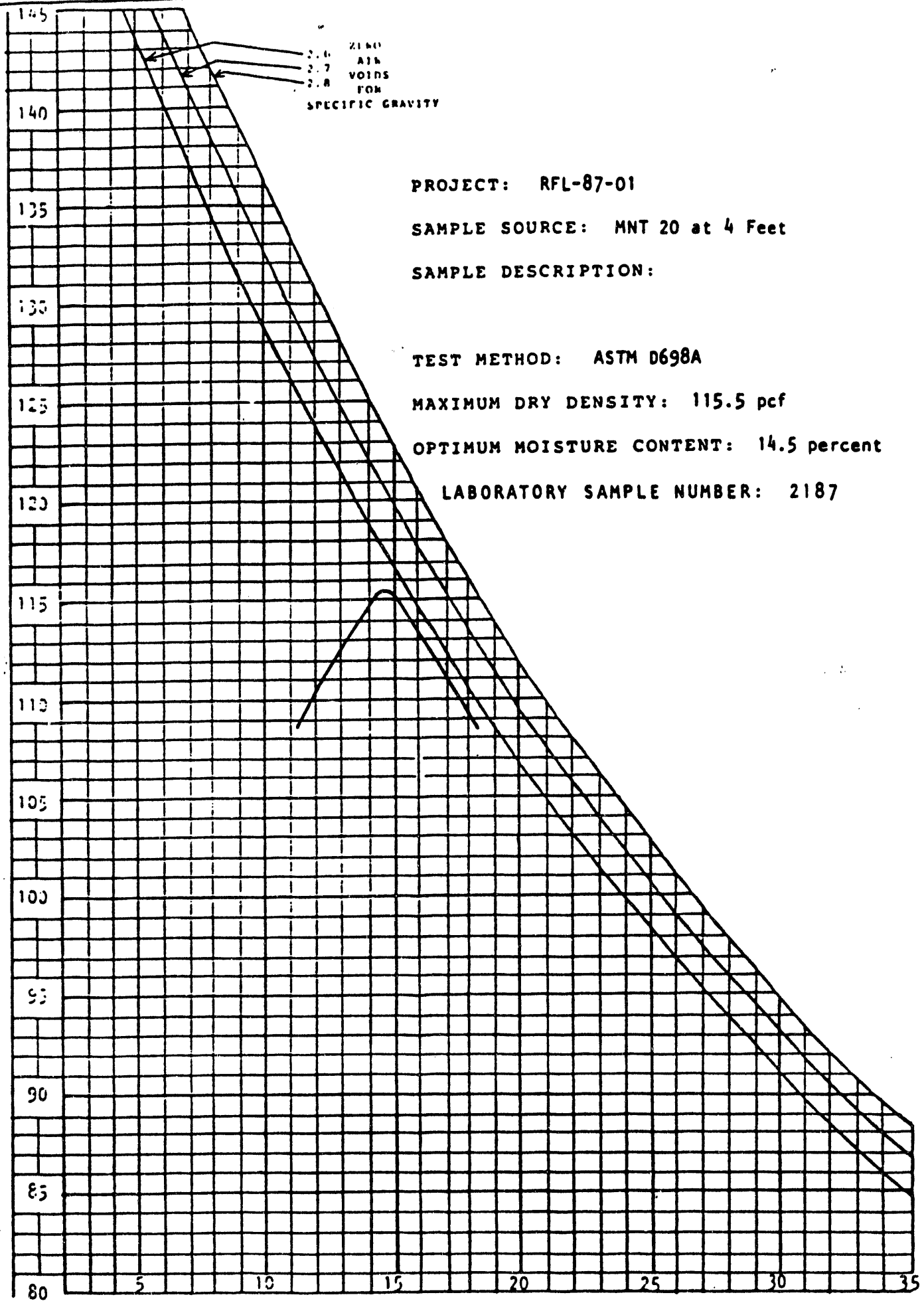
OPTIMUM MOISTURE CONTENT: 14.0%

LABORATORY SAMPLE NUMBER: 2044

Lambert and Associates

Project No.: M8705465

Date:



PROJECT: RFL-87-01

SAMPLE SOURCE: MNT 20 at 4 Feet

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 115.5 pcf

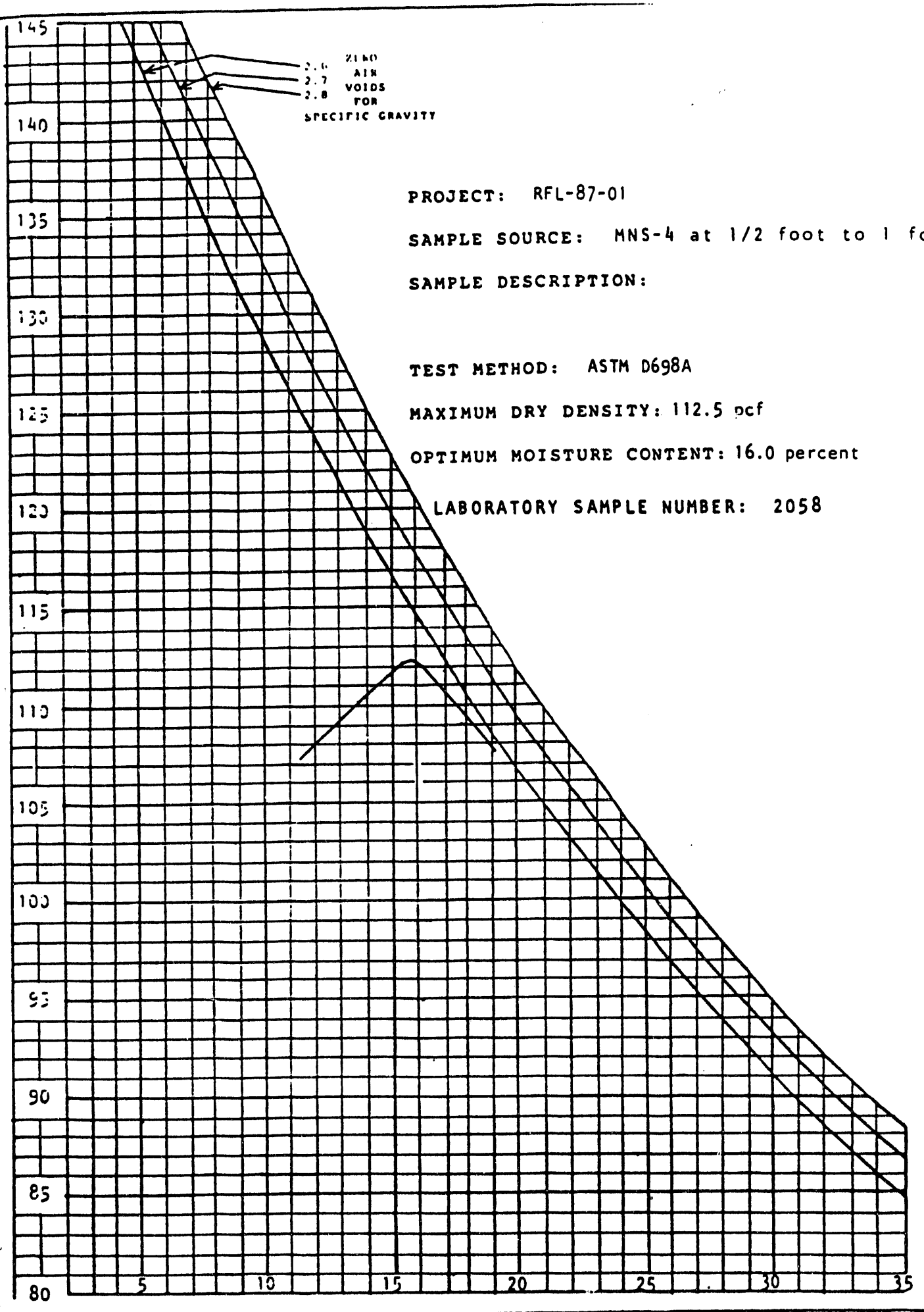
OPTIMUM MOISTURE CONTENT: 14.5 percent

LABORATORY SAMPLE NUMBER: 2187

Lambert and Associates

Project No.: M87054GE

Date:



PROJECT: RFL-87-01

SAMPLE SOURCE: MNS-4 at 1/2 foot to 1 foot

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 112.5 pcf

OPTIMUM MOISTURE CONTENT: 16.0 percent

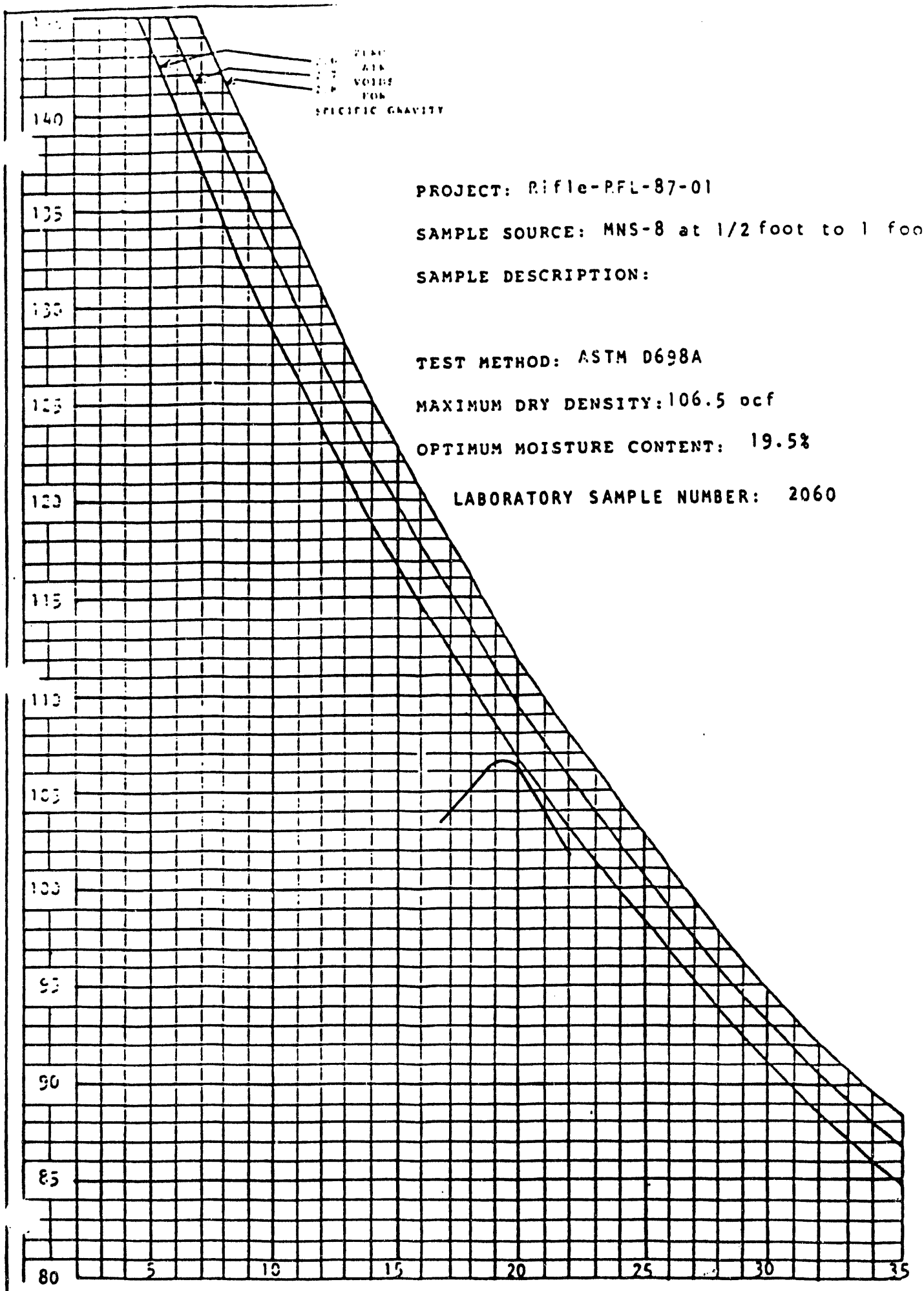
LABORATORY SAMPLE NUMBER: 2058

Lambert and Associates

Project No.: M87054GE

Date:

Figure:



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MNS-8 at 1/2 foot to 1 foot

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 106.5 pcf

OPTIMUM MOISTURE CONTENT: 19.5%

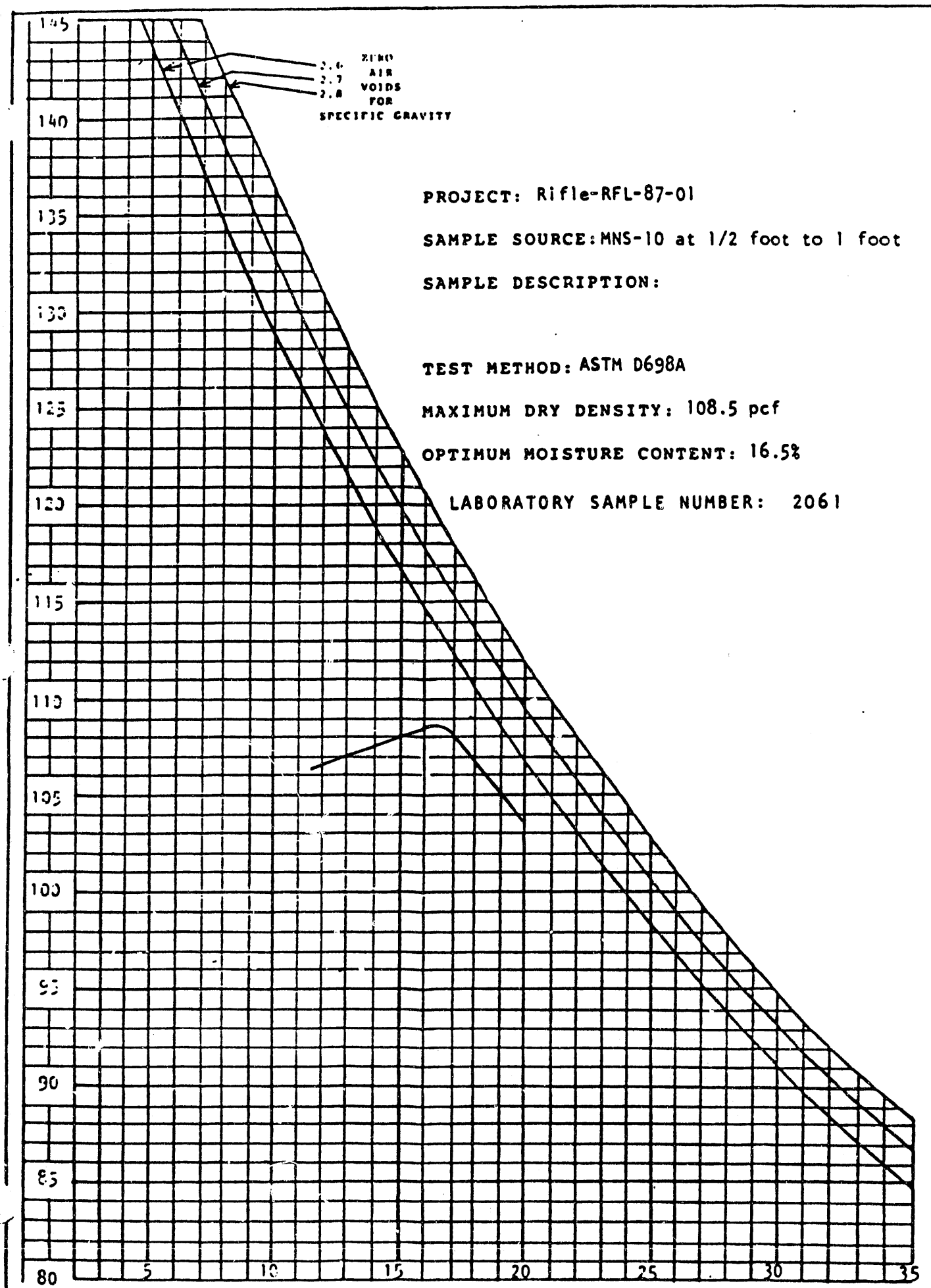
LABORATORY SAMPLE NUMBER: 2060

Lambert and Associates

Project No.: M87054GE

Date:

Figure:



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MNS-10 at 1/2 foot to 1 foot

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 108.5 pcf

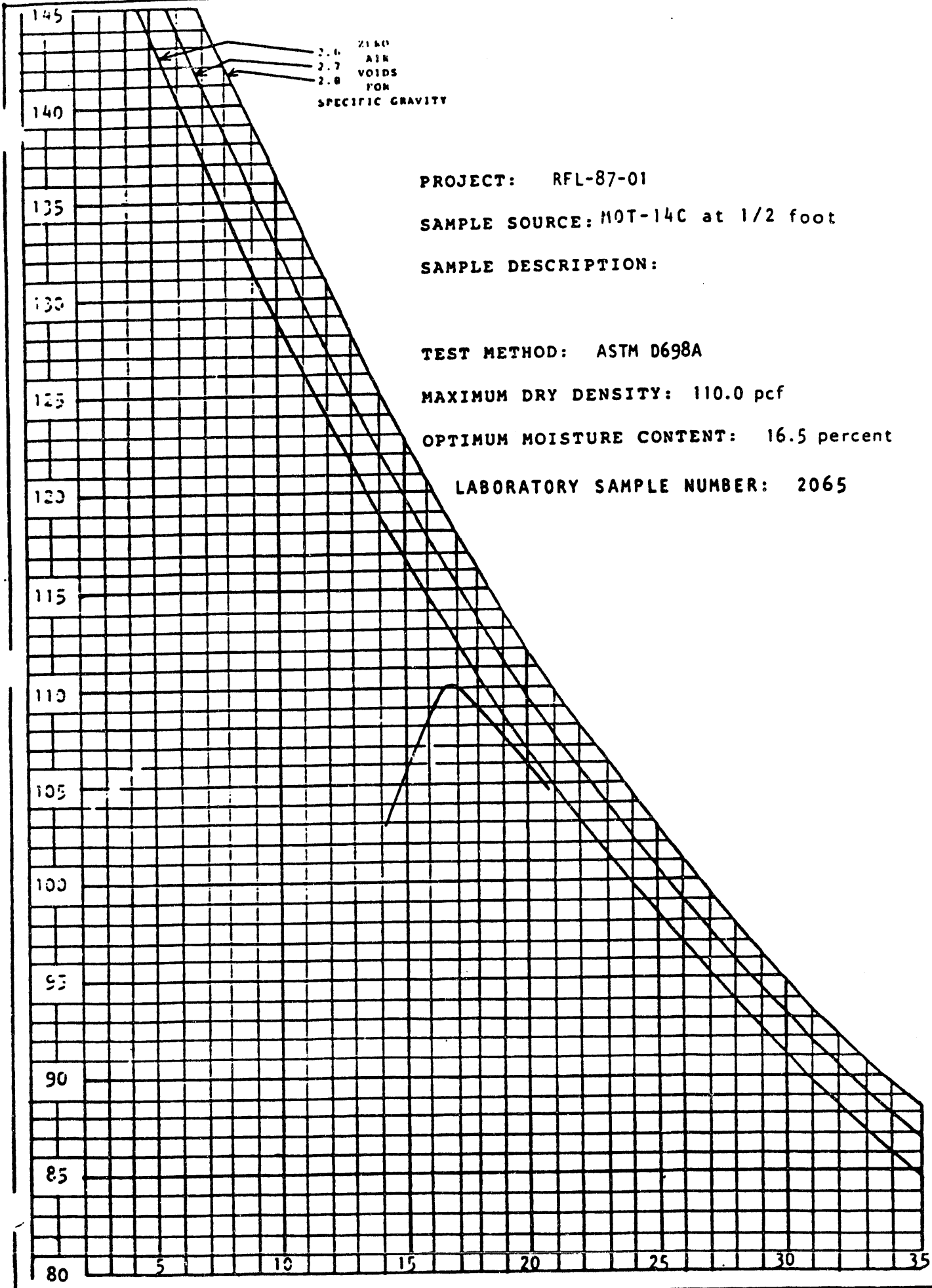
OPTIMUM MOISTURE CONTENT: 16.5%

LABORATORY SAMPLE NUMBER: 2061

Lambert and Associates

Project No.: M87054GE

Date:



PROJECT: RFL-87-01

SAMPLE SOURCE: MOT-14C at 1/2 foot

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 110.0 pcf

OPTIMUM MOISTURE CONTENT: 16.5 percent

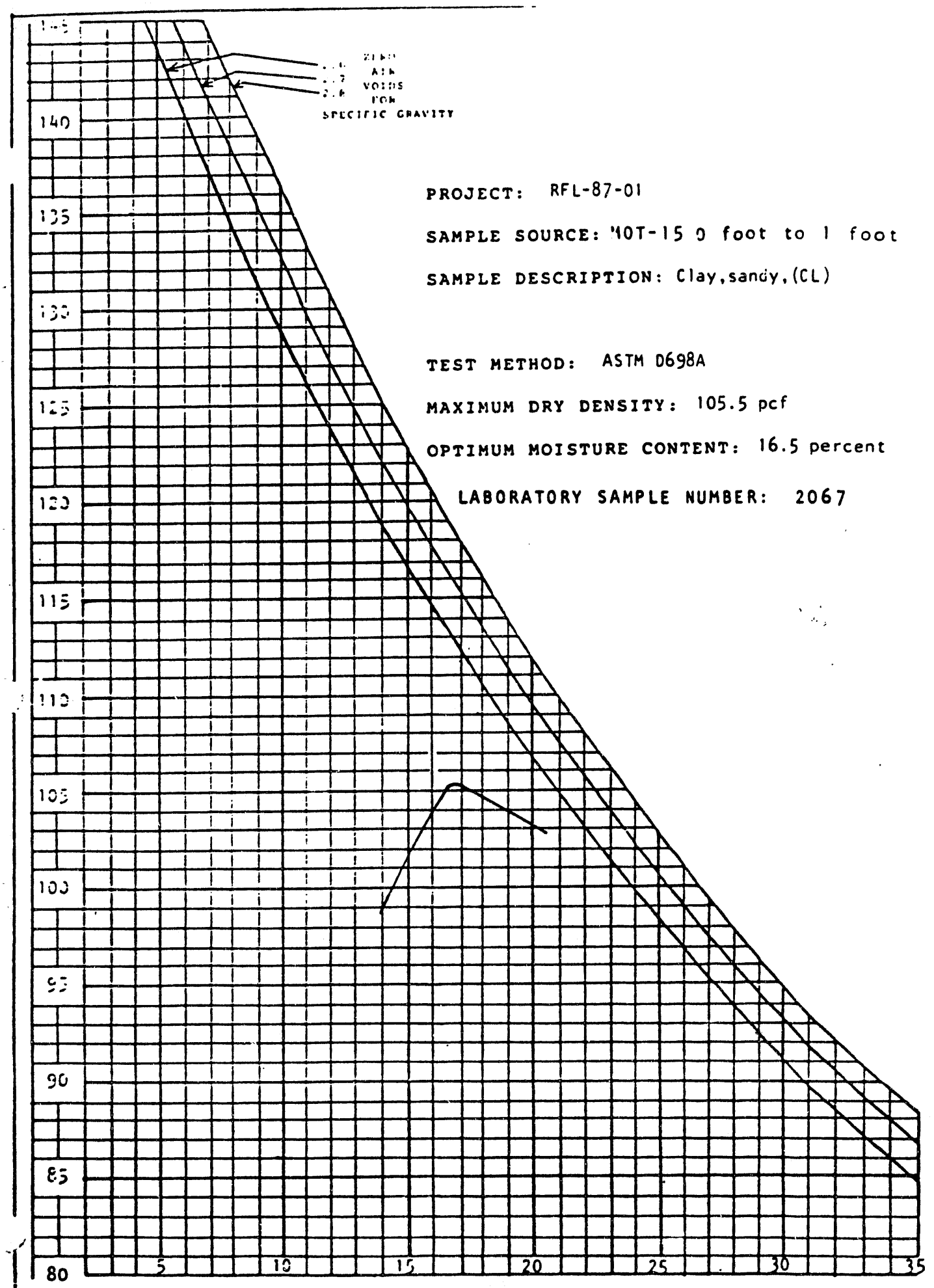
LABORATORY SAMPLE NUMBER: 2065

Lambert and Associates

Project No.: M8705-GE

Date:

Figure:



PROJECT: RFL-87-01

SAMPLE SOURCE: 40T-15 0 foot to 1 foot

SAMPLE DESCRIPTION: Clay,sandy,(CL)

TEST METHOD: ASTM D698A

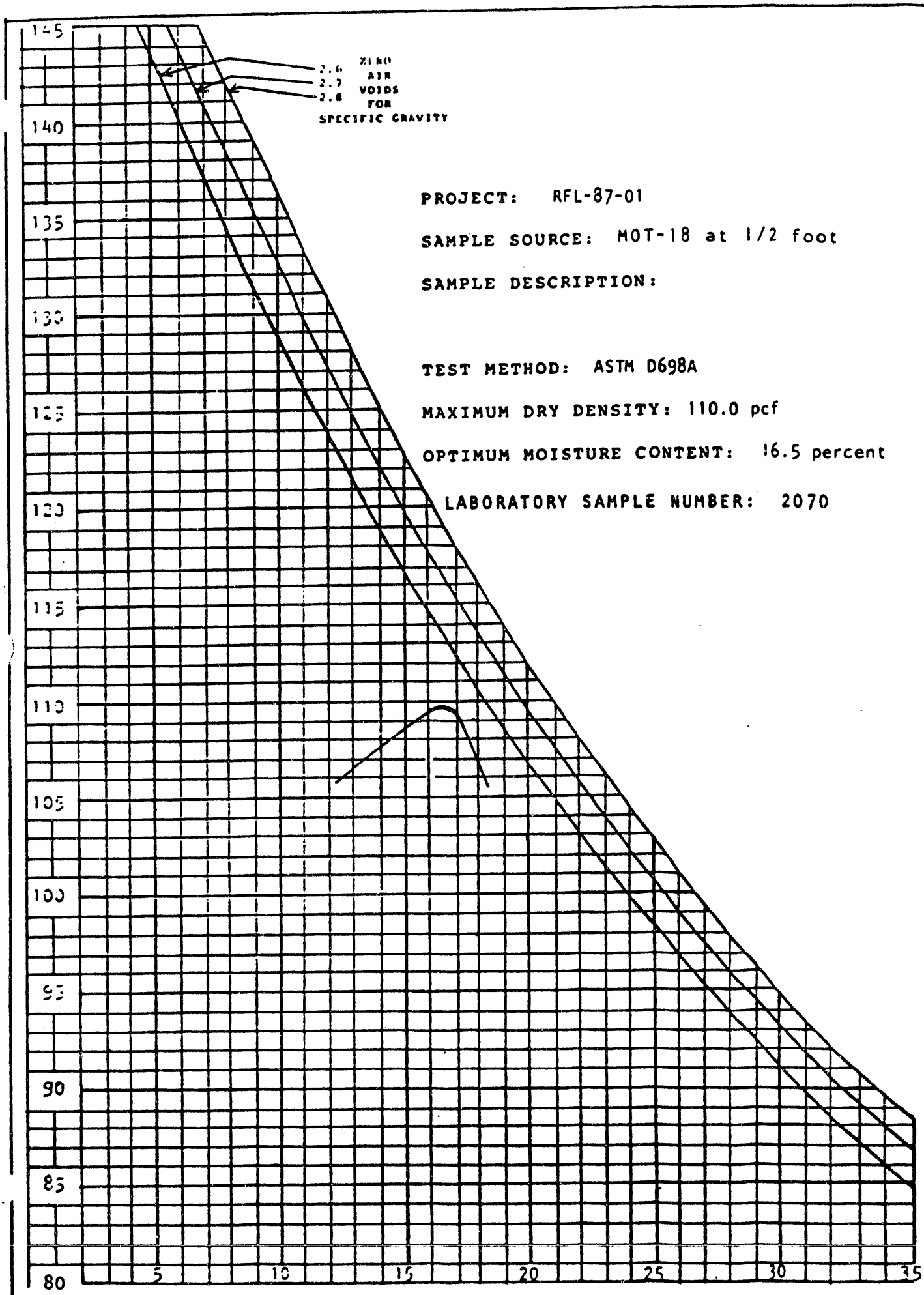
MAXIMUM DRY DENSITY: 105.5 pcf

OPTIMUM MOISTURE CONTENT: 16.5 percent

LABORATORY SAMPLE NUMBER: 2067

Lambert and Associates

Project No.:	M87054GE
Date:	
Figure:	



PROJECT: RFL-87-01

SAMPLE SOURCE: MOT-18 at 1/2 foot

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

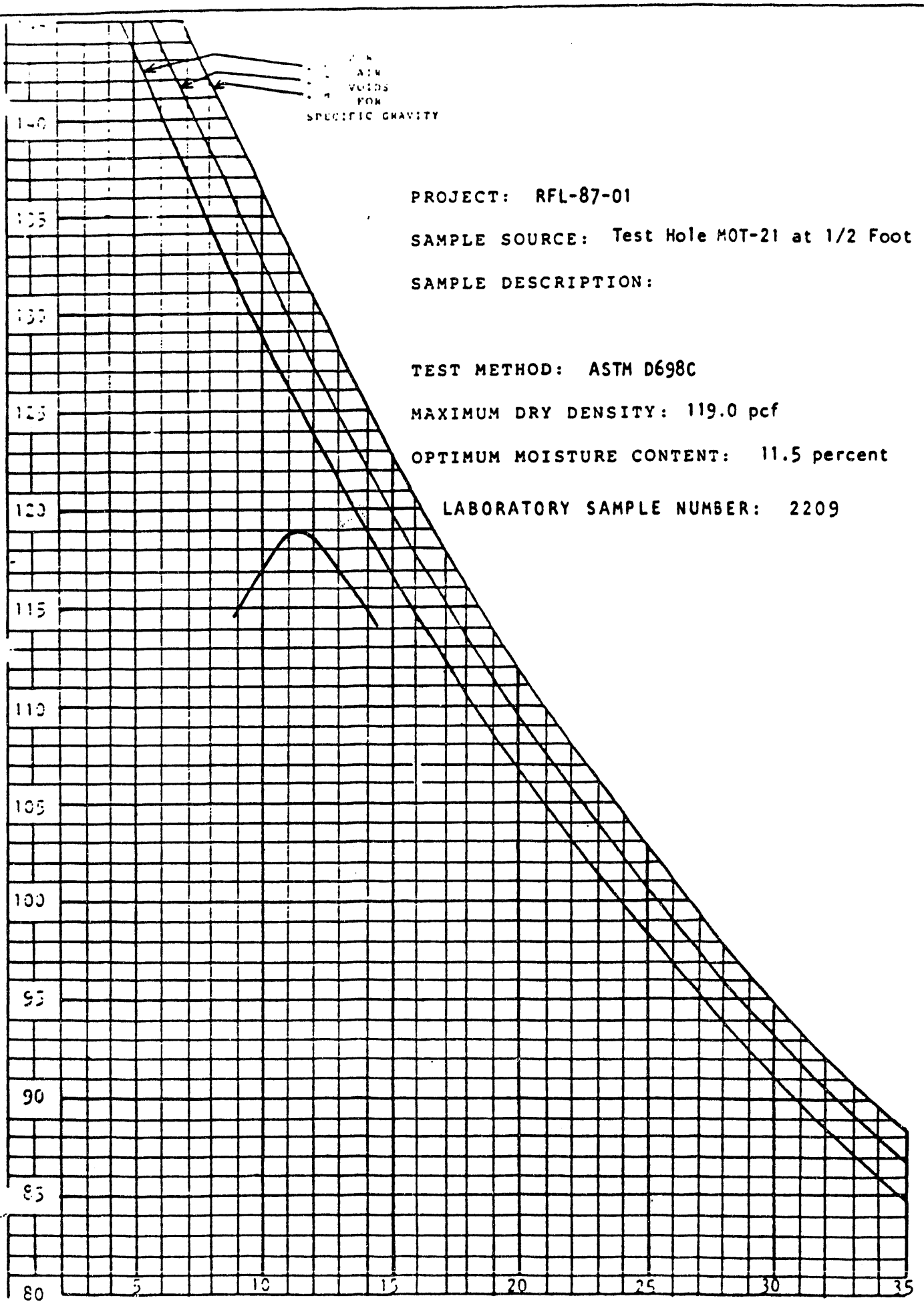
MAXIMUM DRY DENSITY: 110.0 pcf

OPTIMUM MOISTURE CONTENT: 16.5 percent

LABORATORY SAMPLE NUMBER: 2070

Lambert and Associates

Project No.: M87354GE



PROJECT: RFL-87-01

SAMPLE SOURCE: Test Hole MOT-21 at 1/2 Foot

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698C

MAXIMUM DRY DENSITY: 119.0 pcf

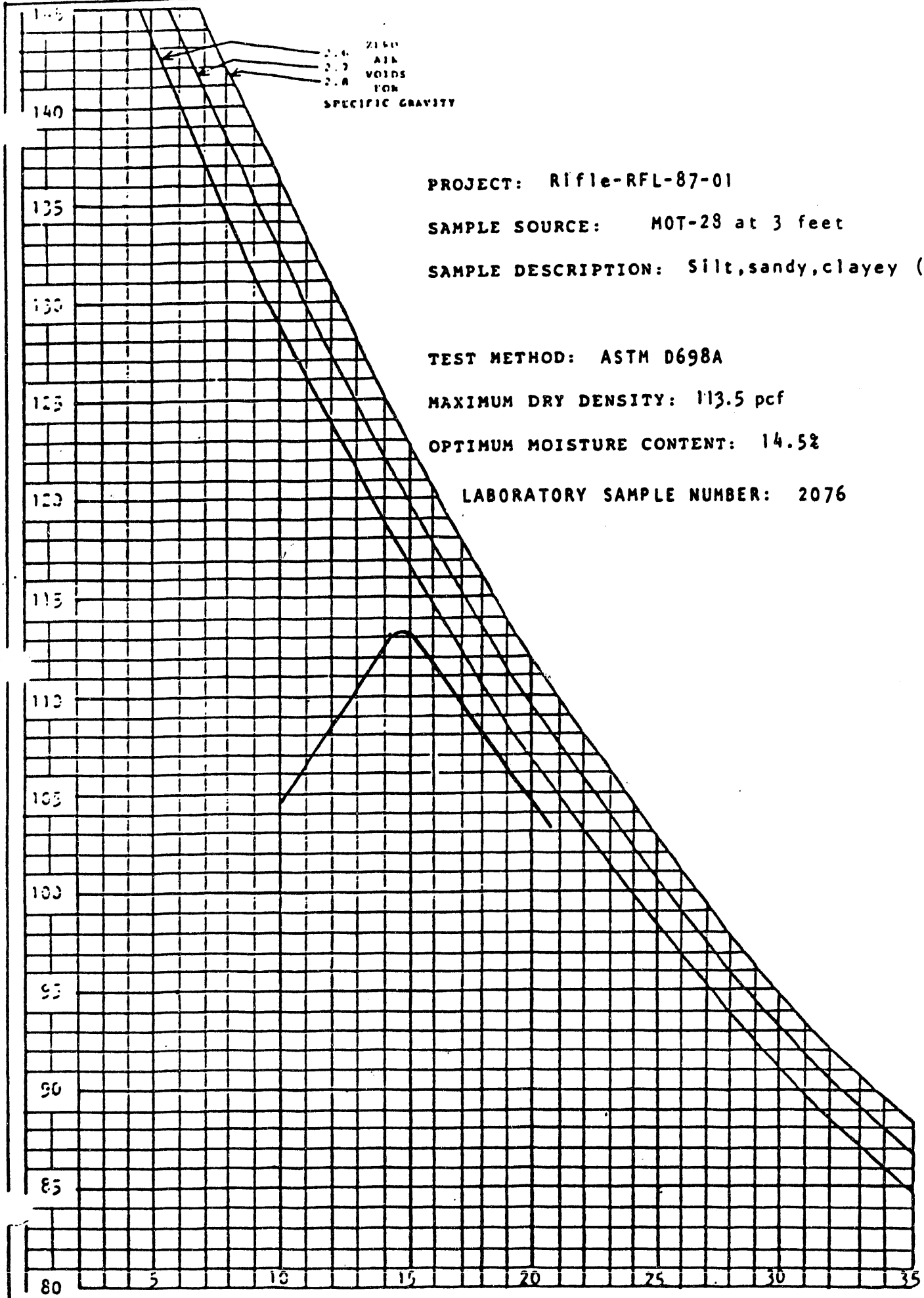
OPTIMUM MOISTURE CONTENT: 11.5 percent

LABORATORY SAMPLE NUMBER: 2209

Lambert and Associates

Project No.: M87054GE

Date:



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MOT-28 at 3 feet

SAMPLE DESCRIPTION: Silt,sandy,clayey (ML)

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 113.5 pcf

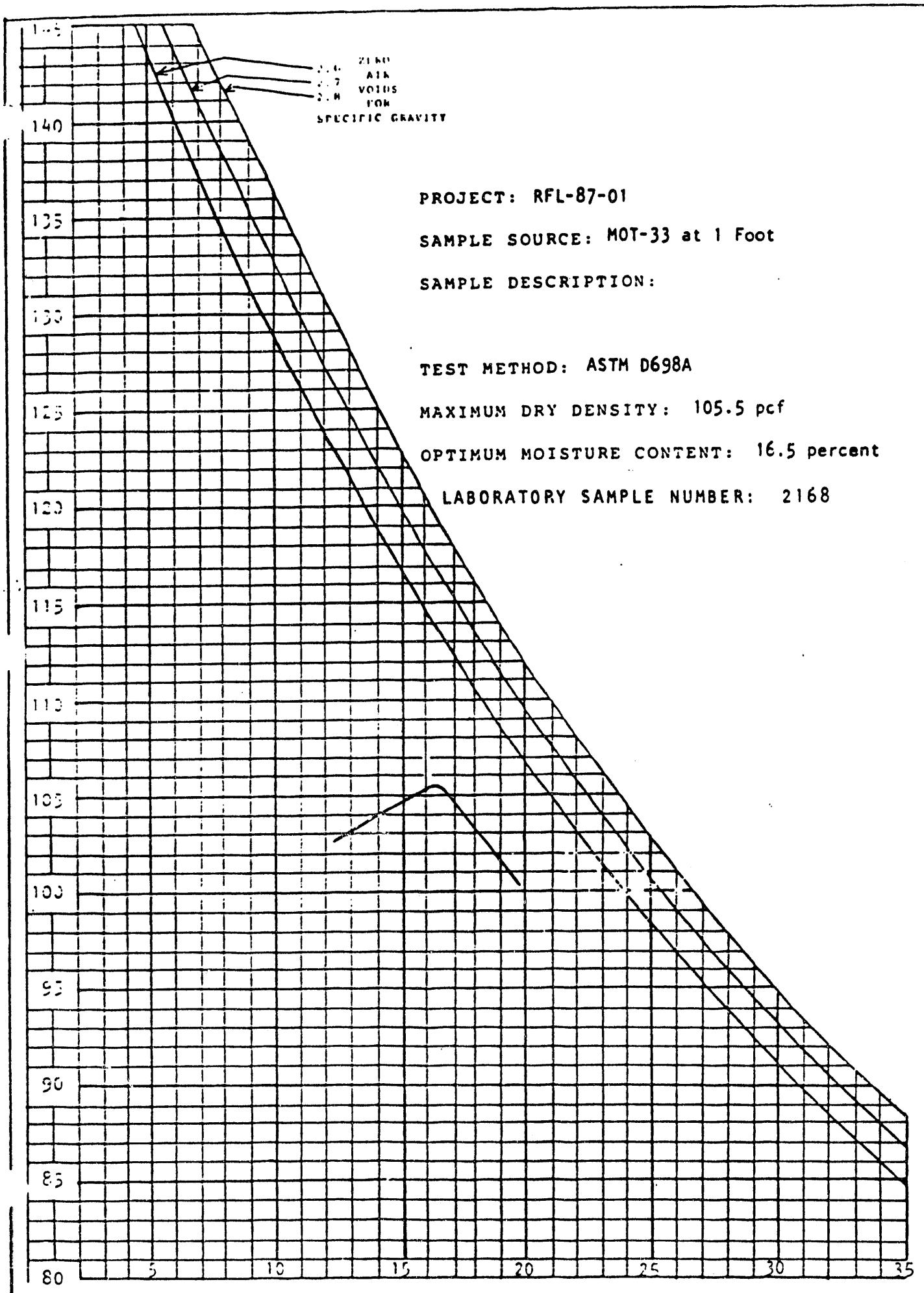
OPTIMUM MOISTURE CONTENT: 14.5%

LABORATORY SAMPLE NUMBER: 2076

Lambert and Associates

Project No.: M87054GE

Date:



PROJECT: RFL-87-01

SAMPLE SOURCE: MOT-33 at 1 Foot

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 105.5 pcf

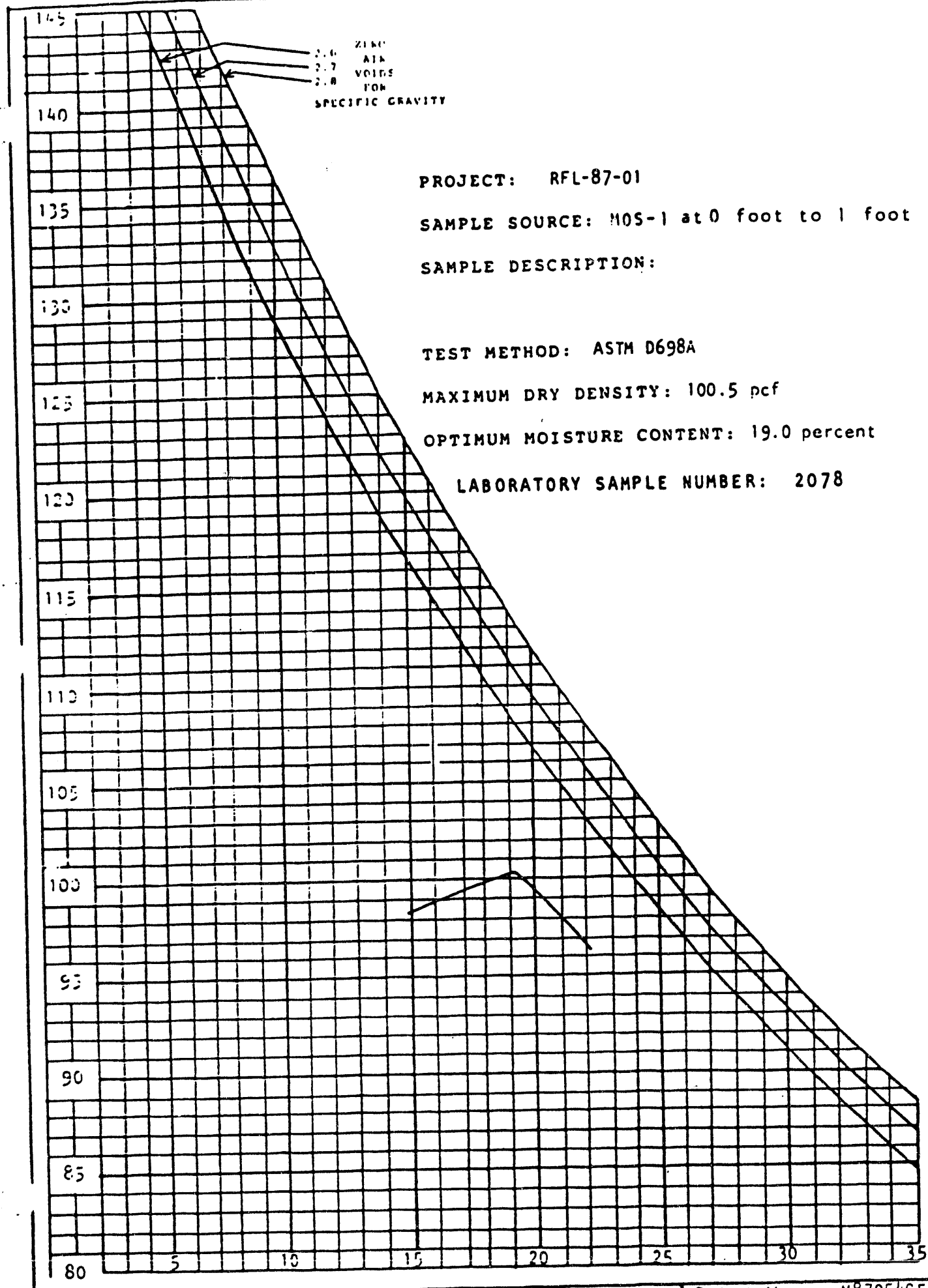
OPTIMUM MOISTURE CONTENT: 16.5 percent

LABORATORY SAMPLE NUMBER: 2168

Lambert and Associates

Project No.: M87054GE

Date:



PROJECT: RFL-87-01

SAMPLE SOURCE: MOS-1 at 0 foot to 1 foot

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 100.5 pcf

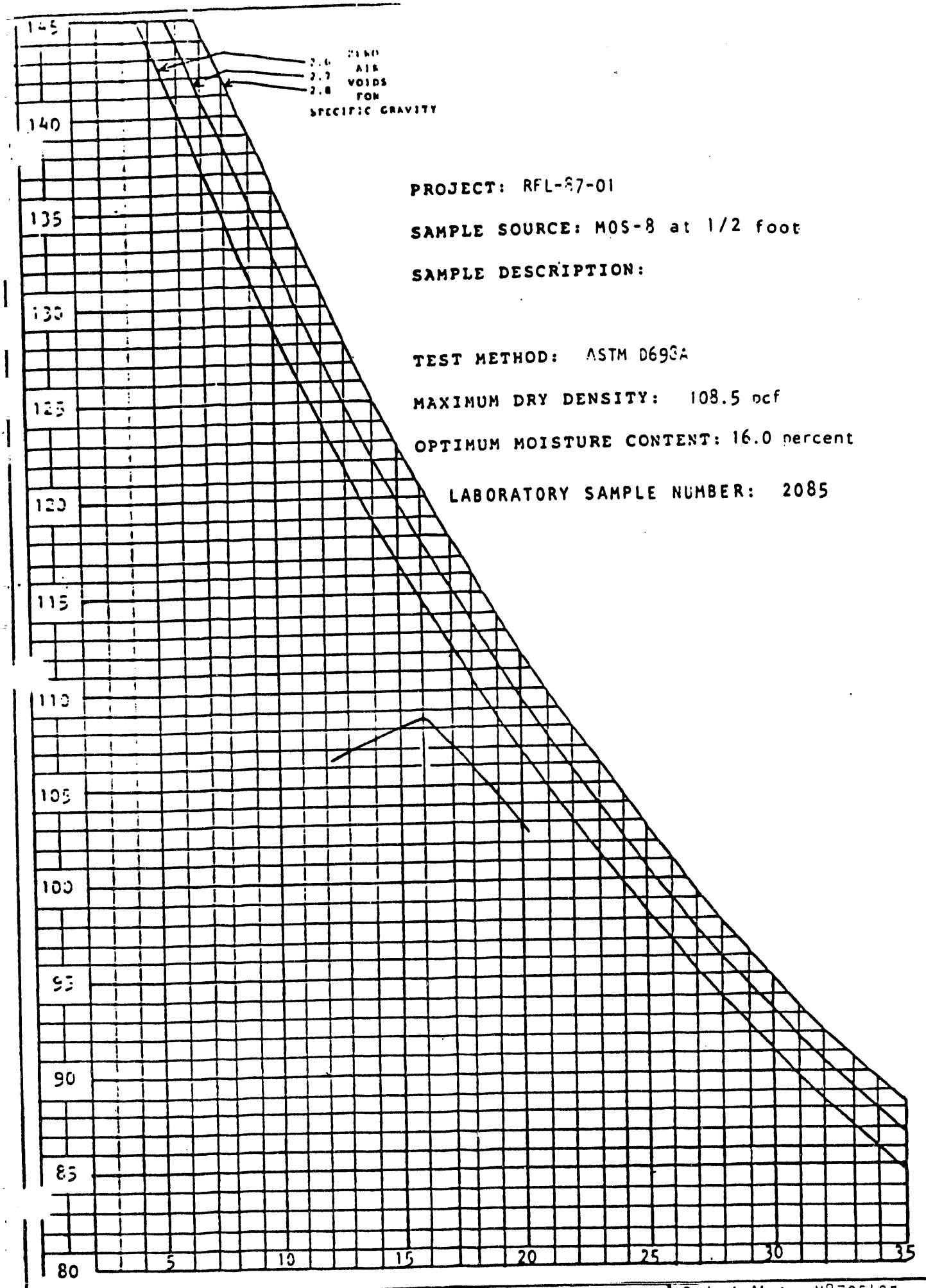
OPTIMUM MOISTURE CONTENT: 19.0 percent

LABORATORY SAMPLE NUMBER: 2078

Lambert and Associates

Project No.: M87054GE

Date:



PROJECT: RFL-87-01

SAMPLE SOURCE: MOS-8 at 1/2 foot

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 108.5 pcf

OPTIMUM MOISTURE CONTENT: 16.0 percent

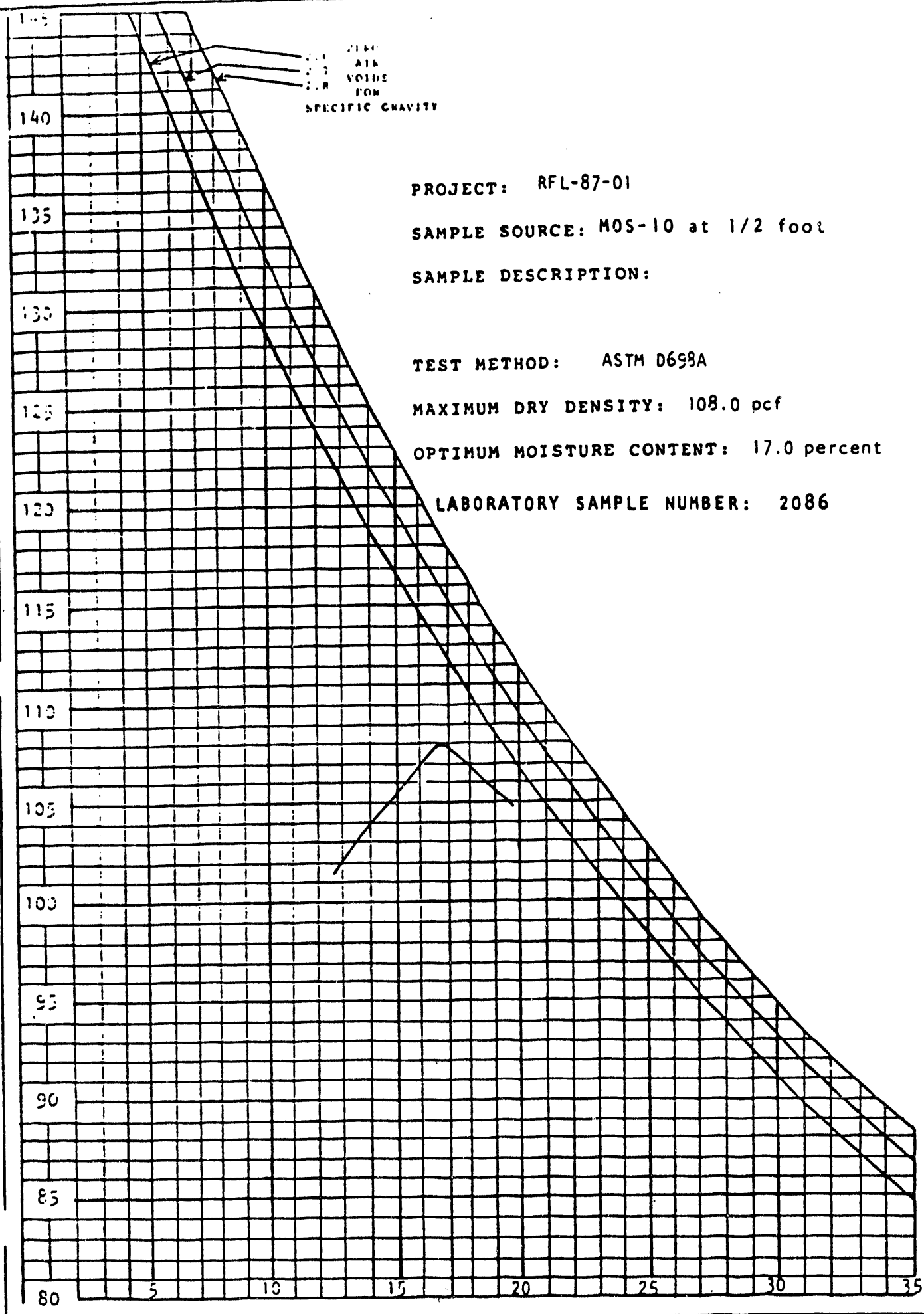
LABORATORY SAMPLE NUMBER: 2085

Lambert and Associates

Project No.: M87054GE

Date:

Figure:



PROJECT: RFL-87-01

SAMPLE SOURCE: MOS-10 at 1/2 foot

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 108.0 pcf

OPTIMUM MOISTURE CONTENT: 17.0 percent

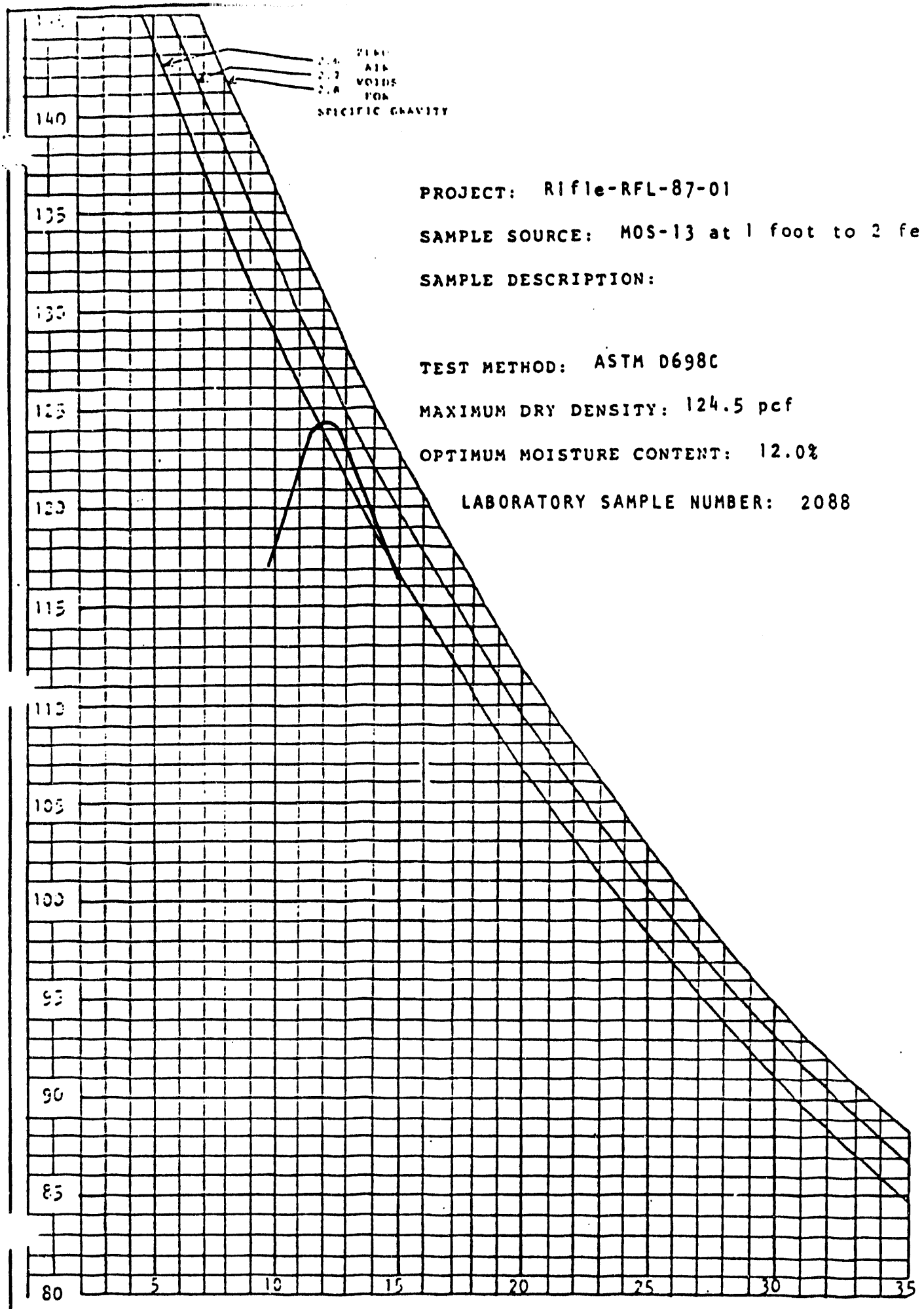
LABORATORY SAMPLE NUMBER: 2086

Lambert and Associates

Project No.: M87054GE

Date:

Figure:



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MOS-13 at 1 foot to 2 feet

SAMPLE DESCRIPTION:

TEST METHOD: ASTM D698C

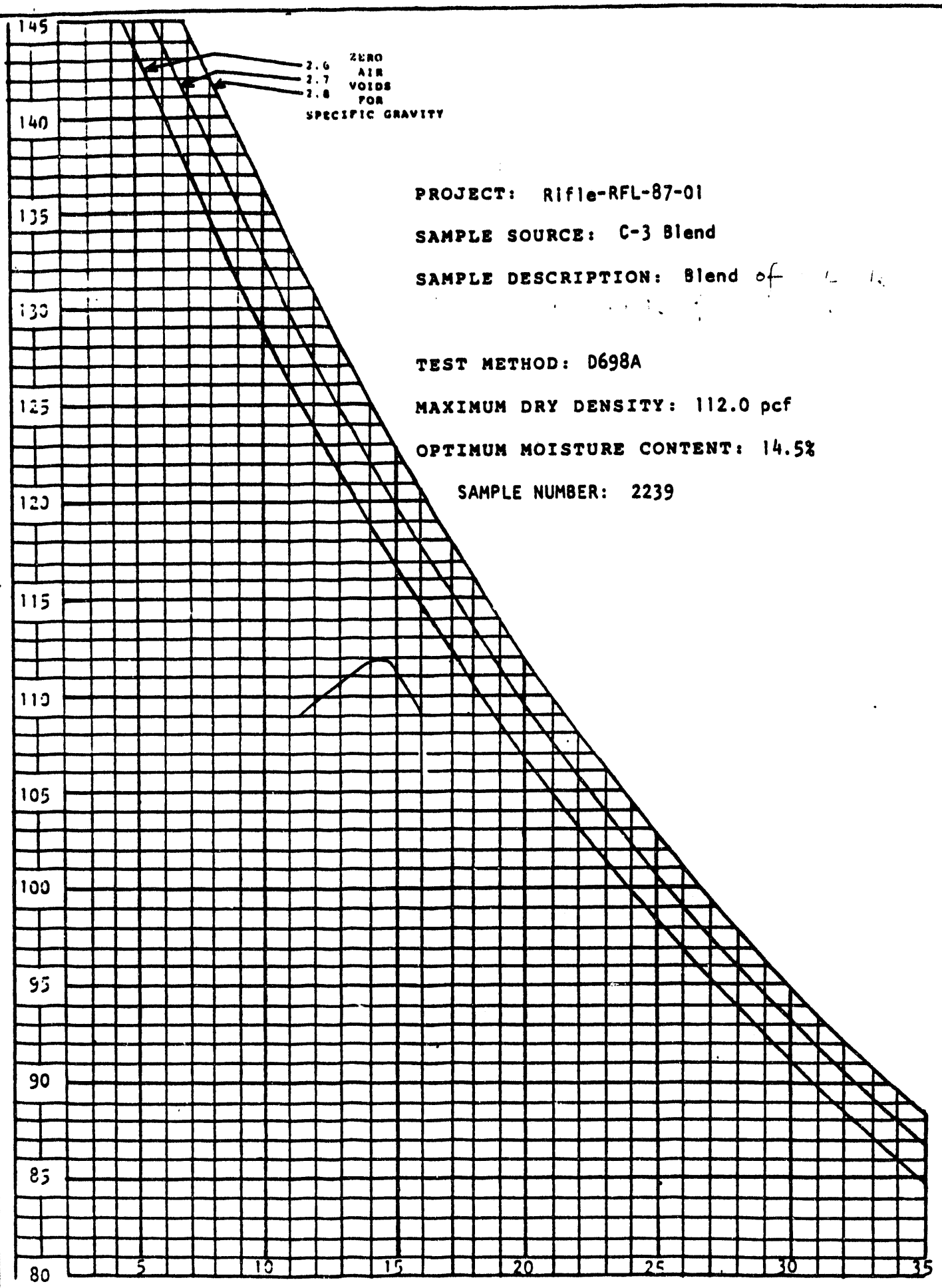
MAXIMUM DRY DENSITY: 124.5 pcf

OPTIMUM MOISTURE CONTENT: 12.0%

LABORATORY SAMPLE NUMBER: 2088

Lambert and Associates

Project No.:	M87054GE
Date:	
Figure:	



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: C-3 Blend

SAMPLE DESCRIPTION: Blend of

TEST METHOD: D698A

MAXIMUM DRY DENSITY: 112.0 pcf

OPTIMUM MOISTURE CONTENT: 14.5%

SAMPLE NUMBER: 2239

Lambert and Associates

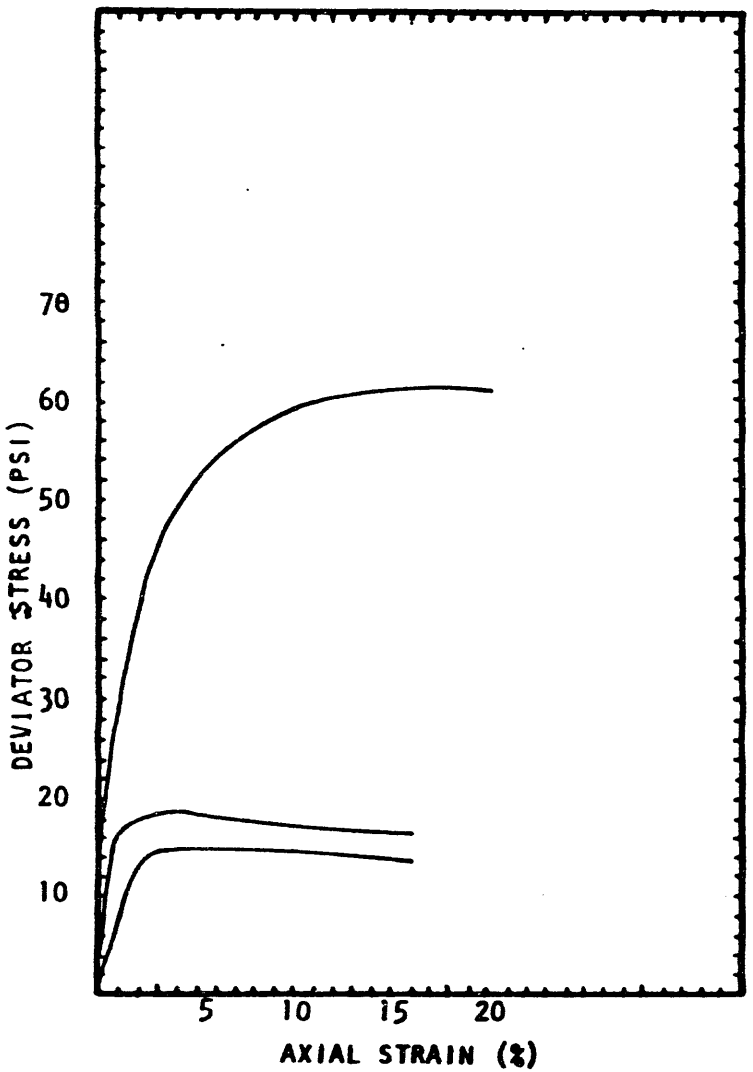
Project No.: M87054GE

Date:

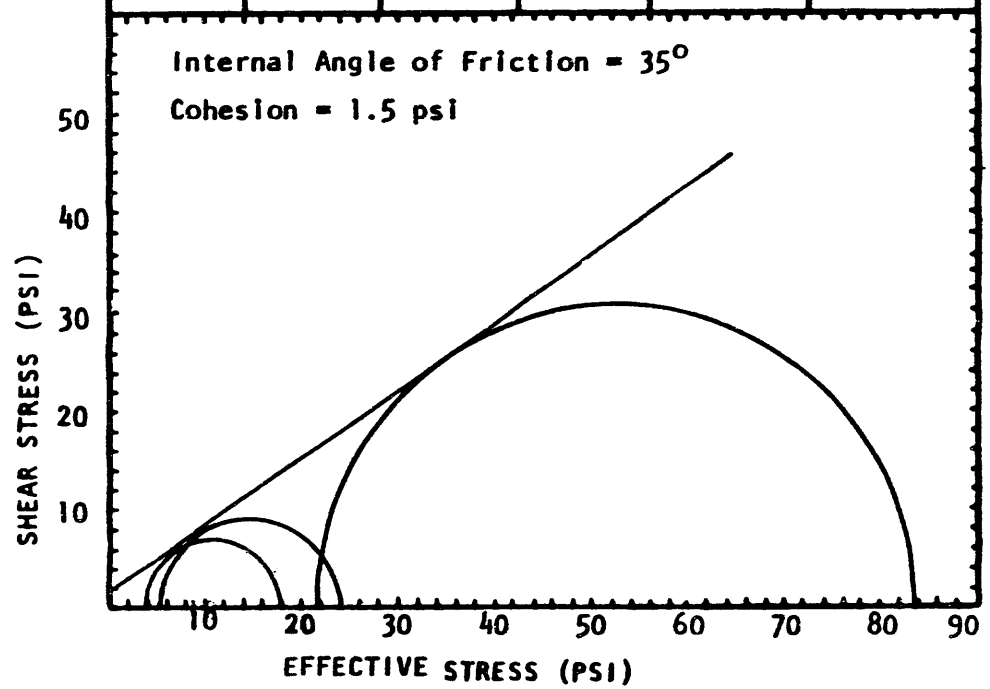
Figure:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	13.9	97.7	21½	14.4	18
2	13.9	97.7	24	18.7	19
3	13.9	97.7	39	62.1	18



LABORATORY NUMBER: 2236

TEST HOLE: MNS-10 at 1/2 to 1 foot

SAMPLE DESCRIPTION:

TYPE OF TEST: Consolidated- Undrained

Project No.: M87054GE

Date:

Figure:

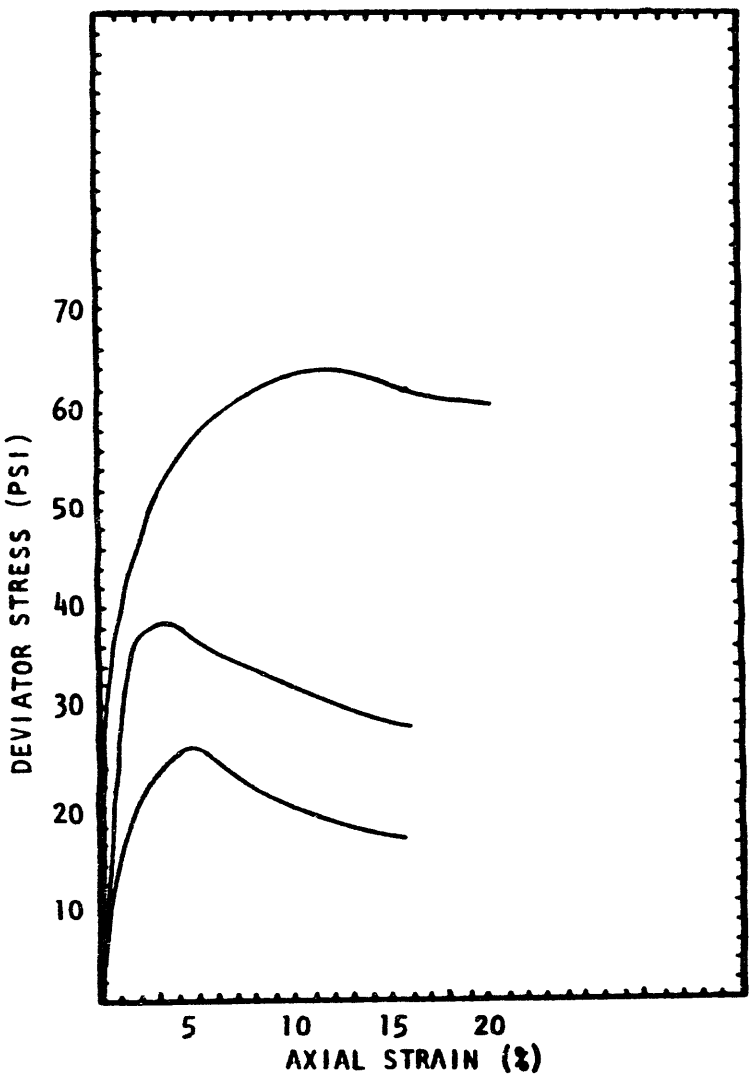
Lambert and Associates

TRIAXIAL COMPRESSION TEST

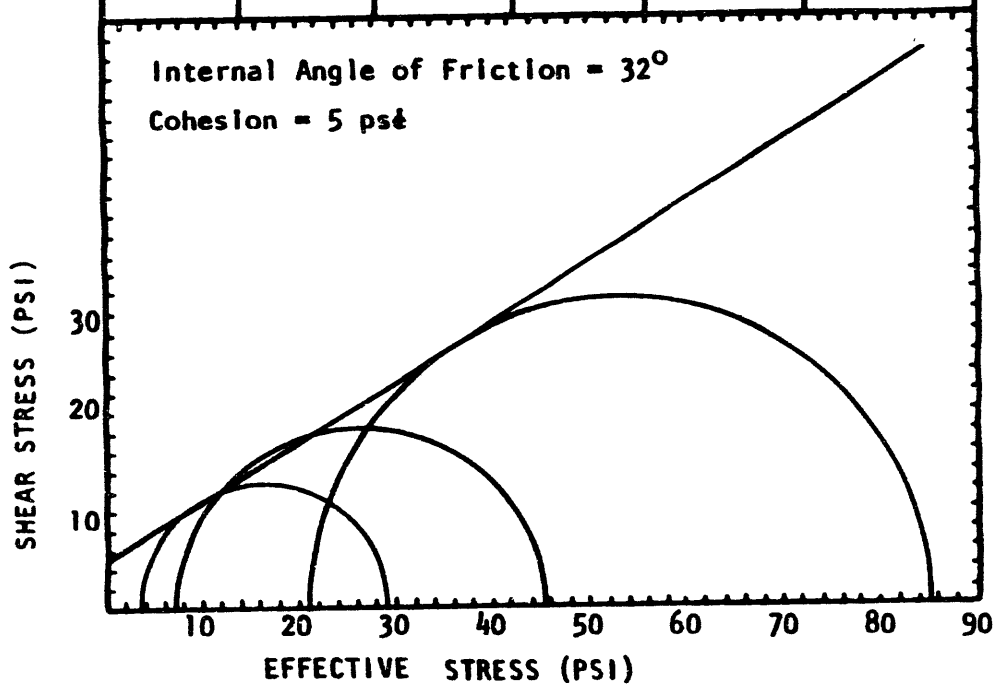
Project No.: M87054GE

Date:

Figure:



SAMPLE NUMBER	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	14.0	103.1	21.5	25.8	18
2	14.0	103.1	25	38.7	18
3	14.0	103.1	39	63.6	18



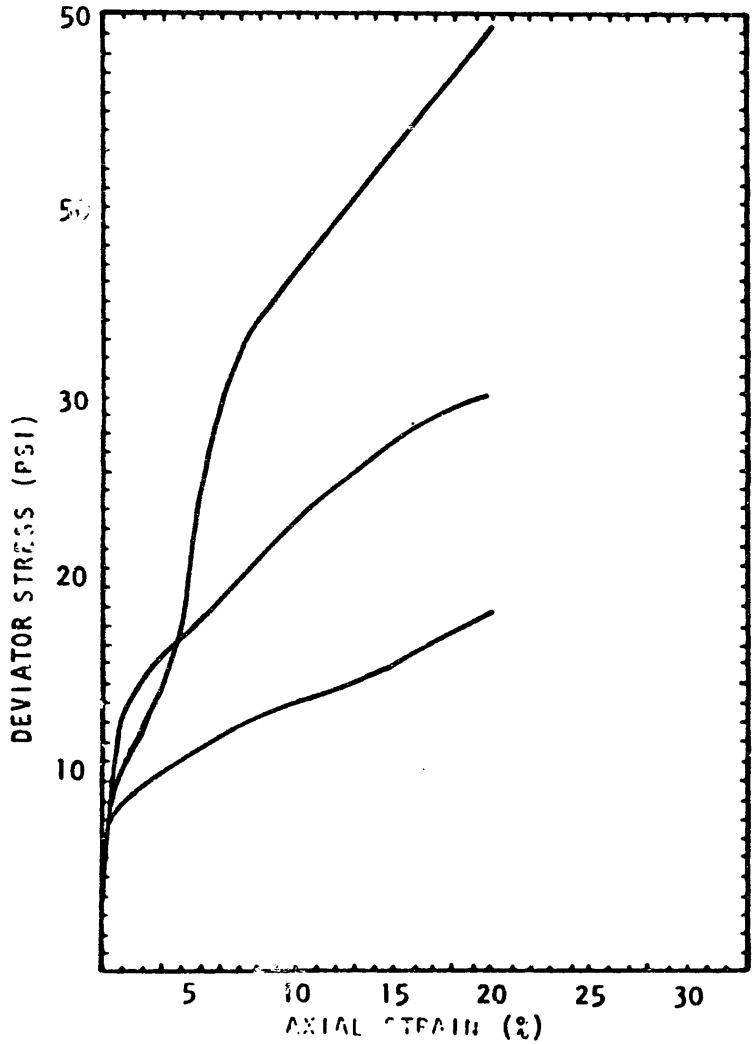
LABORATORY NUMBER: 2235

TEST HOLE: MNT-12 at 1/2 to 1 1/2 feet

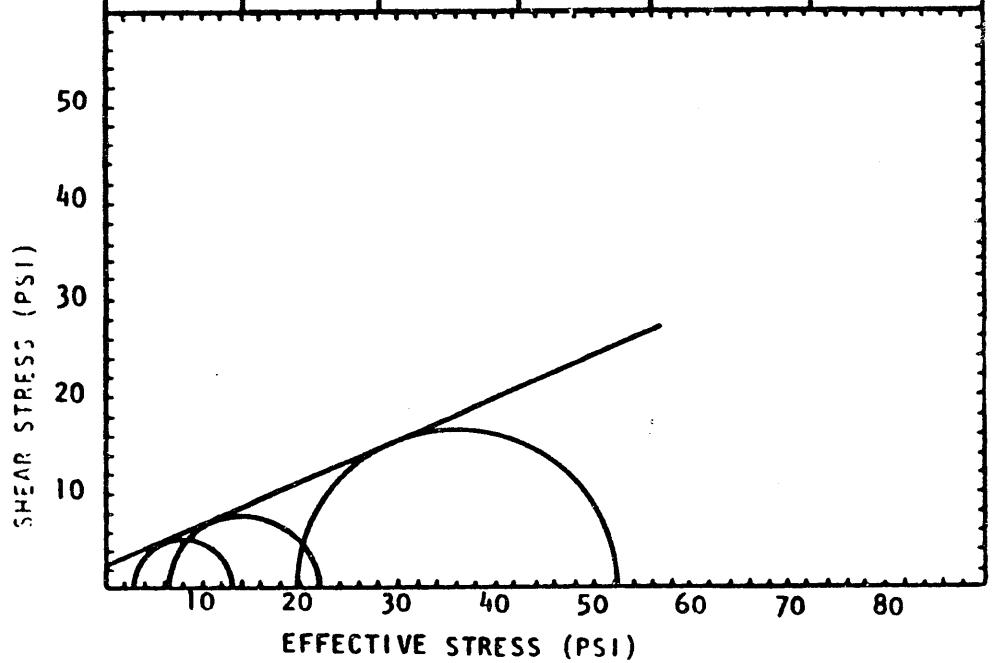
SAMPLE DESCRIPTION:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	14.5	104.0	19½	8.8	16
2	14.5	104.0	22	14.7	15
3	14.5	104.0	36	32.1	16



LABORATORY SAMPLE NUMBER: 2187

TEST HOLE: MNT-20 at 4 feet

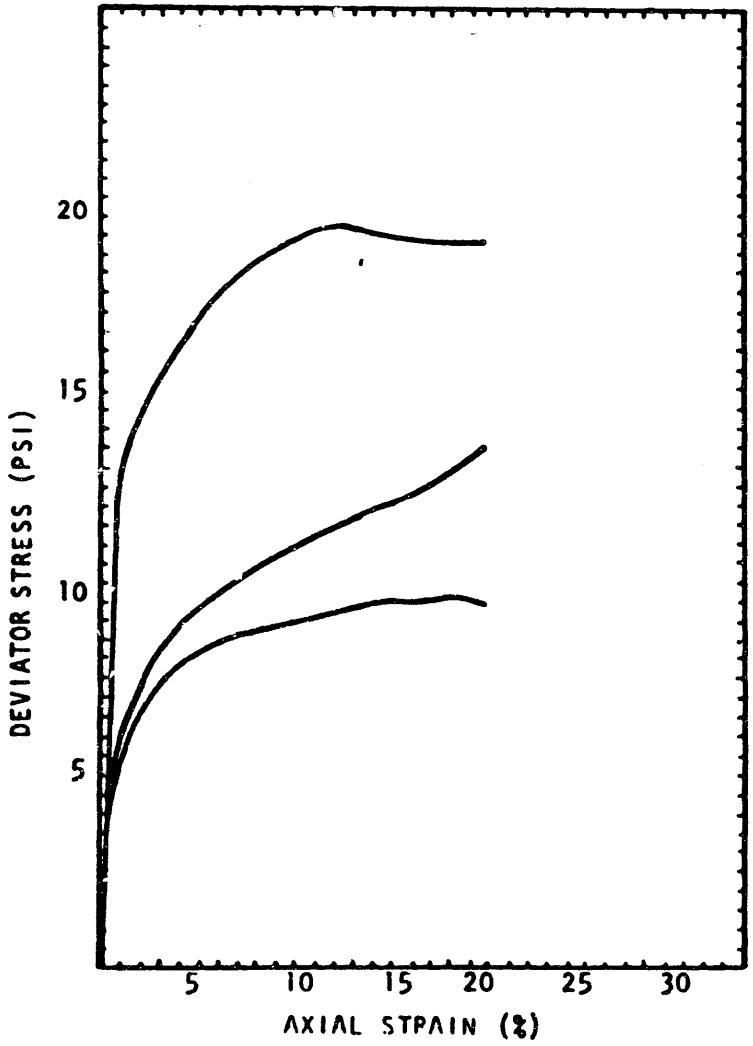
SAMPLE DESCRIPTION:

TYPE OF TEST: Consolidated undrained

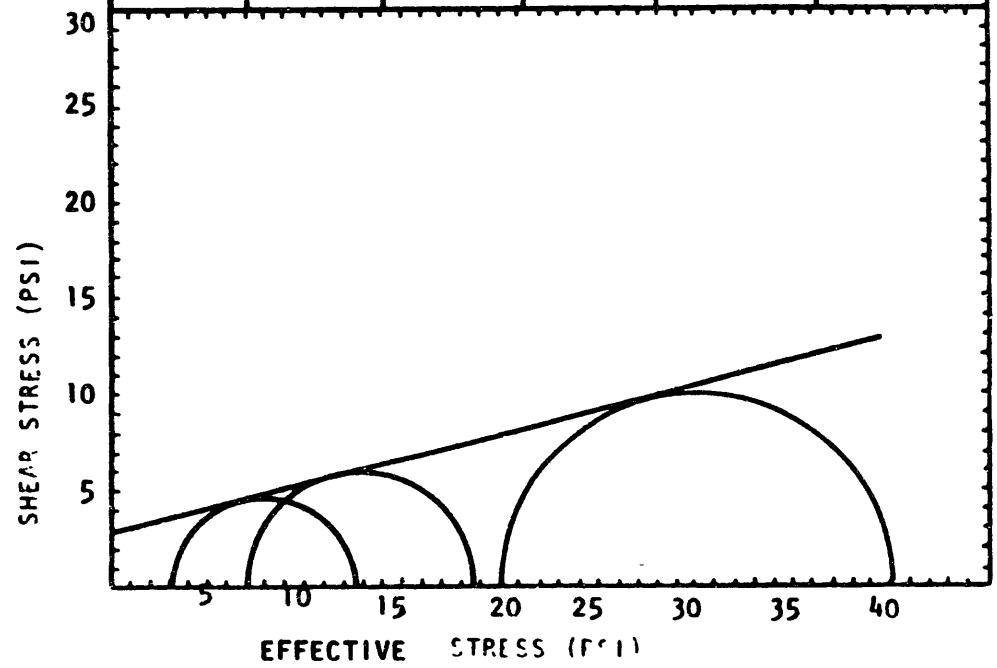
Project No.: M87054GE
Date:
Figure:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	14.5	104.0	13½	9.4	10
2	14.5	104.0	17	12.2	10
3	14.5	104.0	31	19.1	11



LABORATORY SAMPLE NUMBER: 2187

TEST HOLE: MNT-20 at 4 feet

SAMPLE DESCRIPTION:

TYPE OF TEST: Unconsolidated undrained

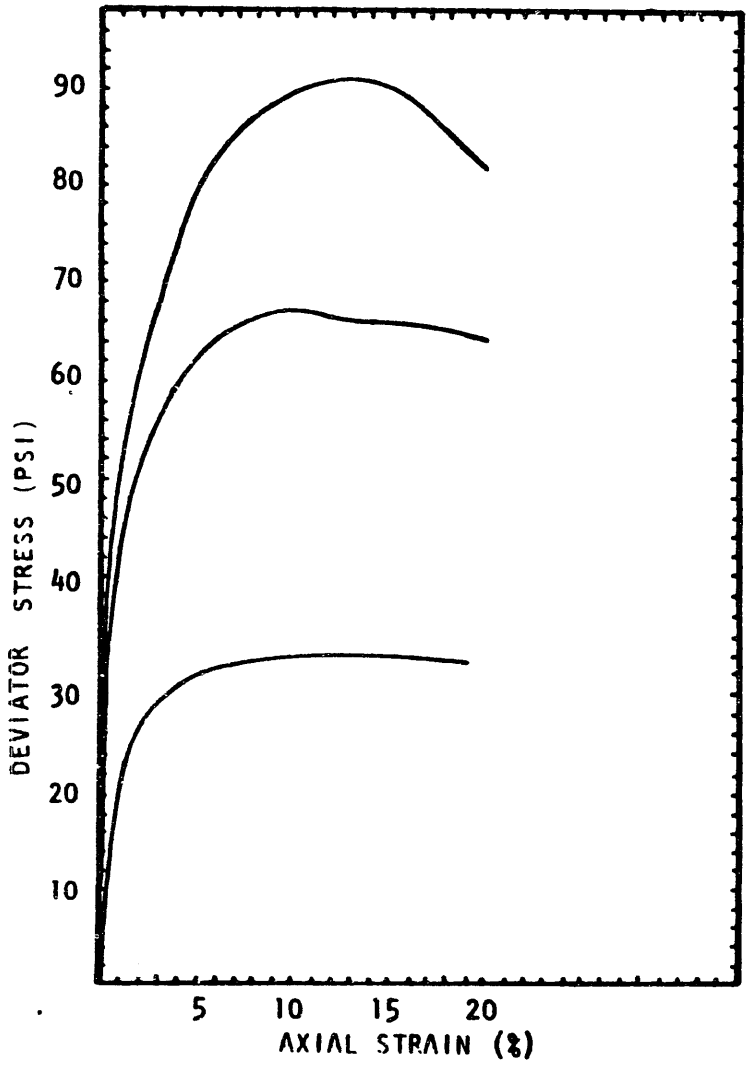
Project No.: M87054GE

Date:

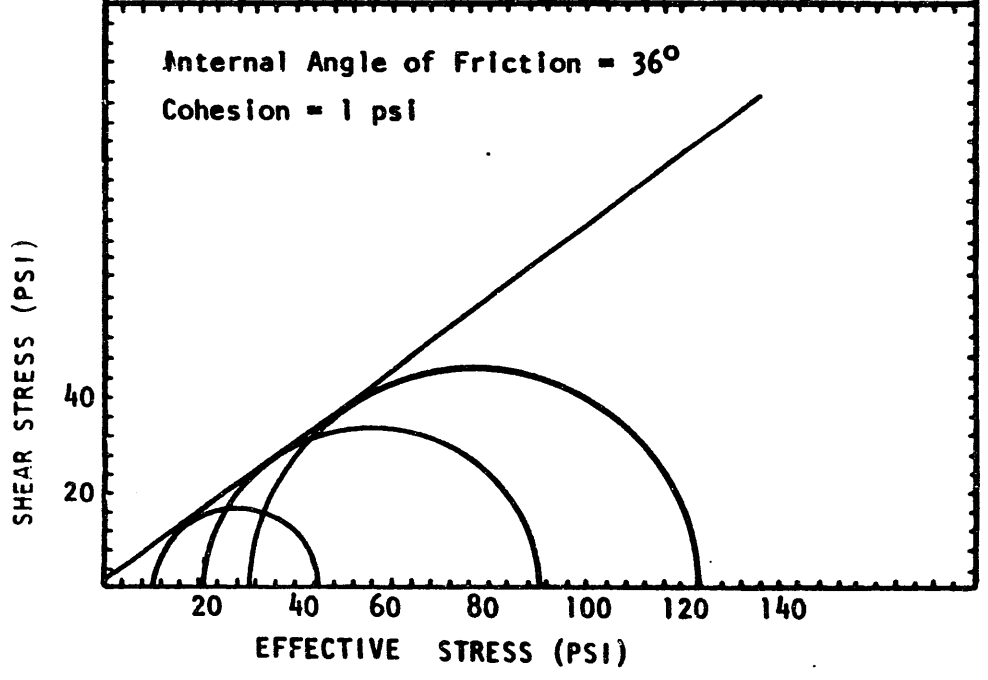
Figure:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	14½	100.8	28½	33.4	18
2	14½	100.8	39	69.0	18
3	14½	100.8	49	92.9	18



LABORATORY NUMBER: 2239

TEST HOLE: C-3 Blend of subpile materials from Mill & Main Rifle

SAMPLE DESCRIPTION:

TYPE OF TEST: Consolidated, undrained

Project No.: M87054GE
Date:
Figure:

Chen & Associates
Consulting Geotechnical Engineers

96 South Zuni
Denver, Colorado 80223
303 744-7105

Casper
Colorado Springs
Ft. Collins
Glenwood Springs
Phoenix
Rock Springs
Salt Lake City
San Antonio

March 4, 1988

Subject: Laboratory Testing, UMTRAP, Rifle, Colorado

P.O. No. 3050-511-9602

Job No. 1 125 88

Mr. R.E. Cooney
MK-Ferguson Company
P.O. Box 9136
Albuquerque, New Mexico 87119

Dear Mr. Cooney:

As requested, we have performed capillary-moisture relationship tests on each of fourteen soil samples received January 21, 1988, at our Denver laboratory. The results are presented on Table I, enclosed. All specimens were remolded to approximately 90% of the standard Proctor density at the optimum moisture content, as provided by you.

If you have any questions or need further assistance, please call.

Sincerely,

CHEN & ASSOCIATES, INC.

By Sally K. Miller
Sally K. Miller, A.E.T.
Soils Laboratory Supervisor

SKM/djb
Rev. By: KRC
Enclosures: 5025-RFL-C-09-01063-00
cc: Mr. Robert Heneks
MK Engineers, Inc.

RECEIVED · MKE
MAR 08 1988
UMTRA-S.F.

March 4, 1988
UMTRAP, Rifle, Colorado
Job No. 1 125 88

CHEN AND ASSOCIATES, INC.

TABLE I

SUMMARY OF CAPILLARY-MOISTURE RELATIONSHIP TEST RESULTS

Sample No.	MNB-1	MNB-5	MNB-6	MNS-8	MNS-10	MNT-6
Depth	30'-34'	18'-28'	9'-19'	1/2'-1'	1/2'-1'	5'
Average Initial Moisture Content, %	19.23	17.04	11.60	19.11	16.43	15.63
Average Initial Dry Density, pcf	94.3	92.3	98.5	95.9	97.7	94.4
Average Initial Compaction, %	89.8	89.6	89.6	90.0	90.0	89.9
Tension, bars	Moisture Content, %					
0.1	25.28	15.54	13.12	25.47	13.43	11.80
0.5	19.94	9.76	8.10	20.81	8.67	7.65
1.0	18.47	8.80	7.03	19.74	7.44	6.64
2.0	15.94	5.70	4.42	18.16	5.64	5.54
4.0	15.58	5.30	3.61	17.98	5.54	4.92
7.0	15.92	5.48	3.87	17.37	6.02	4.54
15.0	15.03	4.56	3.09	17.62	5.24	4.70

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MAR 0 8 1988
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CHEN AND ASSOCIATES, INC.

TABLE I

SUMMARY OF CAPILLARY-MOISTURE RELATIONSHIP TEST RESULTS

Sample No.	MNT-12	MNT-20	MOB-1	MOB-4	MOT-15	MOT-18	MOT-28	MOT-33
Depth	1/2'-1 1/2'	4' 2	1/2'-7 1/2'	9-14'	0-1'	1/2'	3'	1/2'
Average Initial Moisture Content, %	13.96	14.68	16.48	17.23	16.22	16.46	14.84	16.63
Average Initial Dry Density, pcf	103.1	103.8	91.4	92.1	95.2	99.1	101.8	94.8
Average Initial Compaction, %	90.0	89.9	90.0	89.8	90.2	90.1	89.7	89.9
Tension, bars	Moisture Content, %							
0.1	21.04	16.83	11.91	13.44	22.32	20.32	17.84	19.37
0.5	13.90	14.60	6.73	7.44	16.39	14.71	14.06	14.06
1.0	13.06	14.28	6.12	6.70	15.62	13.63	13.53	12.54
2.0	11.53	13.55	4.18	4.62	13.26	10.88	12.48	11.40
4.0	10.87	13.02	3.98	4.24	13.88	10.86	12.12	10.72
7.0	10.84	12.88	4.10	4.46	14.07	11.10	11.38	10.42
15.0	11.48	12.90	3.62	3.74	14.26	10.54	11.94	10.08

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS

TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 3/18/88

CONTRACT CB717 - 112

BY RYB / KPN

SAMPLE IDENTIFICATION Tailings -- Rifle, CO

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MNB-6 (9-19')	6.9	1.57	2.6E-02	0.25	0.44
MNB-6 (9-19')	14.0	1.59	1.8E-02	0.52	0.43
MNB-6 (9-19')	22.5	1.59	8.8E-06	0.35	0.42

[a] BASED ON A SPECIFIC GRAVITY OF 2.77 g/cm^3.

JEG-AL-AS-2 (r-87)

* Water seeping out -- exceeded drainage limit.

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MNB-5 (18-28')	8.7	1.49	1.7E-02	0.29	0.45
MNB-5 (18-28')	14.9	1.49	1.2E-02	0.48	0.46
MNB-5 (18-28')	22.4	1.49	6.4E-04	0.73	0.46

[a] BASED ON A SPECIFIC GRAVITY OF 2.73 g/cm^3.

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS
TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 3/18/88

CONTRACT CB717 - 112

BY RYB /KKW

SAMPLE IDENTIFICATION Tailings and other contaminated Soils -- Rifle, CO

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm3)	RADON DIFFUSION COEFF. (cm2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MOB-4 (9-14')	5.6	1.48	2.4E-02	0.18	0.45
MOB-4 (9-14')	15.1	1.48	1.2E-02	0.49	0.45
MOB-4 (9-14')	25.4	1.49	4.0E-06	0.84	0.45

[a] BASED ON A SPECIFIC GRAVITY OF 2.70 g/cm3.

[illegible] exceeded drainage limit

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm3)	RADON DIFFUSION COEFF. (cm2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MNT-20 (4')	4.2	1.67	2.6E-02	0.18	0.38
MNT-20 (4')	8.7	1.67	2.6E-02	0.38	0.38
MNT-20 (4')	12.7	1.68	1.6E-02	0.56	0.38
MNT-20 (4')	19.5	1.67	1.1E-04	0.85	0.38

[a] BASED ON A SPECIFIC GRAVITY OF 2.70 g/cm3.

JEG-AL-AS-2 (8/87)

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm3)	RADON DIFFUSION COEFF. (cm2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MOT-33 (½')	8.2	1.53	2.4E-02	0.29	0.44
MOT-33 (½')	14.0	1.53	1.1E-02	0.49	0.44
MOT-33 (½')	22.2	1.53	7.0E-04	0.77	0.44

[a] BASED ON A SPECIFIC GRAVITY OF 2.72 g/cm3.

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS

TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 3/18/88

CONTRACT C8717 - 112

BY RYB / KWD

SAMPLE IDENTIFICATION Tailings - Rifle, CO

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MNS-10 (½-1')	10.4	1.58	1.1E-02	0.39	0.42
MNS-10 (½-1')	15.7	1.57	9.5E-03	0.59	0.42
MNS-10 (½-1')	22.0	1.56	1.4E-04	0.81	0.42

[a] BASED ON A SPECIFIC GRAVITY OF 2.70 g/cm^3.

JEG-AL-AS-2 (8/86)

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MNT-6 (5')	8.4	1.52	2.2E-02	0.29	0.44
MNT-6 (5')	17.2	1.51	7.4E-03	0.59	0.44
MNT-6 (5')	20.7	1.54	1.4E-05	0.74	0.43

[a] BASED ON A SPECIFIC GRAVITY OF 2.70 g/cm^3.

JEG-AL-AS-2 (2/87)

* Water seeping out -- exceeded drainage limit.

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MNB-1 (30-34')	5.3	1.52	3.1E-02	0.18	0.44
MNB-1 (30-34')	10.9	1.52	2.4E-02	0.38	0.44
MNB-1 (30-34')	17.1	1.52	1.5E-02	0.58	0.45
MNB-1 (30-34')	23.8	1.61	2.4E-06	0.94	0.41

[a] BASED ON A SPECIFIC GRAVITY OF 2.73 g/cm^3.

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS

TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 3/18/88

CONTRACT C8717 - 112

BY RYB /KPN

SAMPLE IDENTIFICATION Tailings and other contaminated soils -- Rifle, CO

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MOT-28 (3')	6.0	1.62	2.7E-02	0.25	0.40
MOT-28 (3')	10.9	1.62	2.0E-02	0.44	0.40
MOT-28 (3')	14.0	1.64	4.6E-03	0.59	0.39
MOT-28 (3')	20.0	1.63	6.4E-05	0.84	0.39

[a] BASED ON A SPECIFIC GRAVITY OF 2.68 g/cm^3.

JEG-AL-AS-4 (8/87)

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MOB-1 (2½-7½')	9.0	1.46	2.4E-02	0.29	0.46
MOB-1 (2½-7½')	15.1	1.47	9.3E-03	0.48	0.46
MOB-1 (2½-7½')	22.5	1.47	5.5E-06	0.73	0.46

[a] BASED ON A SPECIFIC GRAVITY OF 2.70 g/cm^3.

JEG-AL-AS-2 (8/87) * Water seeping out -- drainage limit exceeded.

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MOT-15 (0-1')	7.9	1.53	1.9E-02	0.29	0.41
MOT-15 (0-1')	15.9	1.52	7.9E-03	0.58	0.42
MOT-15 (0-1')	22.8	1.53	1.3E-03	0.84	0.42

[a] BASED ON A SPECIFIC GRAVITY OF 2.62 g/cm^3.

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS

TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 3/18/88

CONTRACT C8717 - 112

BY RYB / KKN

SAMPLE IDENTIFICATION ~~Tailings~~ Offsite/Windblown Soils -- Rifle, CO

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MOT-18 (½')	6.5	1.60	2.6E-02	0.27	0.39
MOT-18 (½')	11.8	1.59	1.8E-02	0.49	0.39
MOT-18 (½')	17.5	1.59	[illegible]		

[a] BASED ON A SPECIFIC GRAVITY OF 2.60 g/cm^3.

JEG-AL-AS-2 (3/86)

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MNT-12 (½-1½')	6.0	1.66	2.8E-02	0.26	0.38
MNT-12 (½-1½')	11.0	1.66	1.5E-02	0.47	0.38
MNT-12 (½-1½')	18.0	1.65	1.0E-03	0.76	0.39

[a] BASED ON A SPECIFIC GRAVITY OF 2.69 g/cm^3.

JEG-AL-AS-2 (3/86)

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MNS-8 (½-1')	8.0	1.54	1.5E-02	0.28	0.44
MNS-8 (½-1')	13.1	1.55	1.7E-02	0.46	0.44
MNS-8 (½-1')	22.3	1.53	4.4E-04	0.76	0.45

[a] BASED ON A SPECIFIC GRAVITY OF 2.76 g/cm^3.

JEG-AL-AS-2 (3/87)

LABORATORY TEST DATA FROM MK-F INVESTIGATION, 1987-88

ESTES GULCH DISPOSAL SITE

5025-RFL-R-01-00750-01
4256U/0125U

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-2 at 2 1/2 Feet

LABORATORY SAMPLE NUMBER: 1951

SAMPLE DESCRIPTION: Clay,silty,(CL)

ATTERBERG LIMITS: Liquid Limit = 36
Plastic Limit = 17
Plasticity Index = 19

Project: Rifle-RFL-87-01

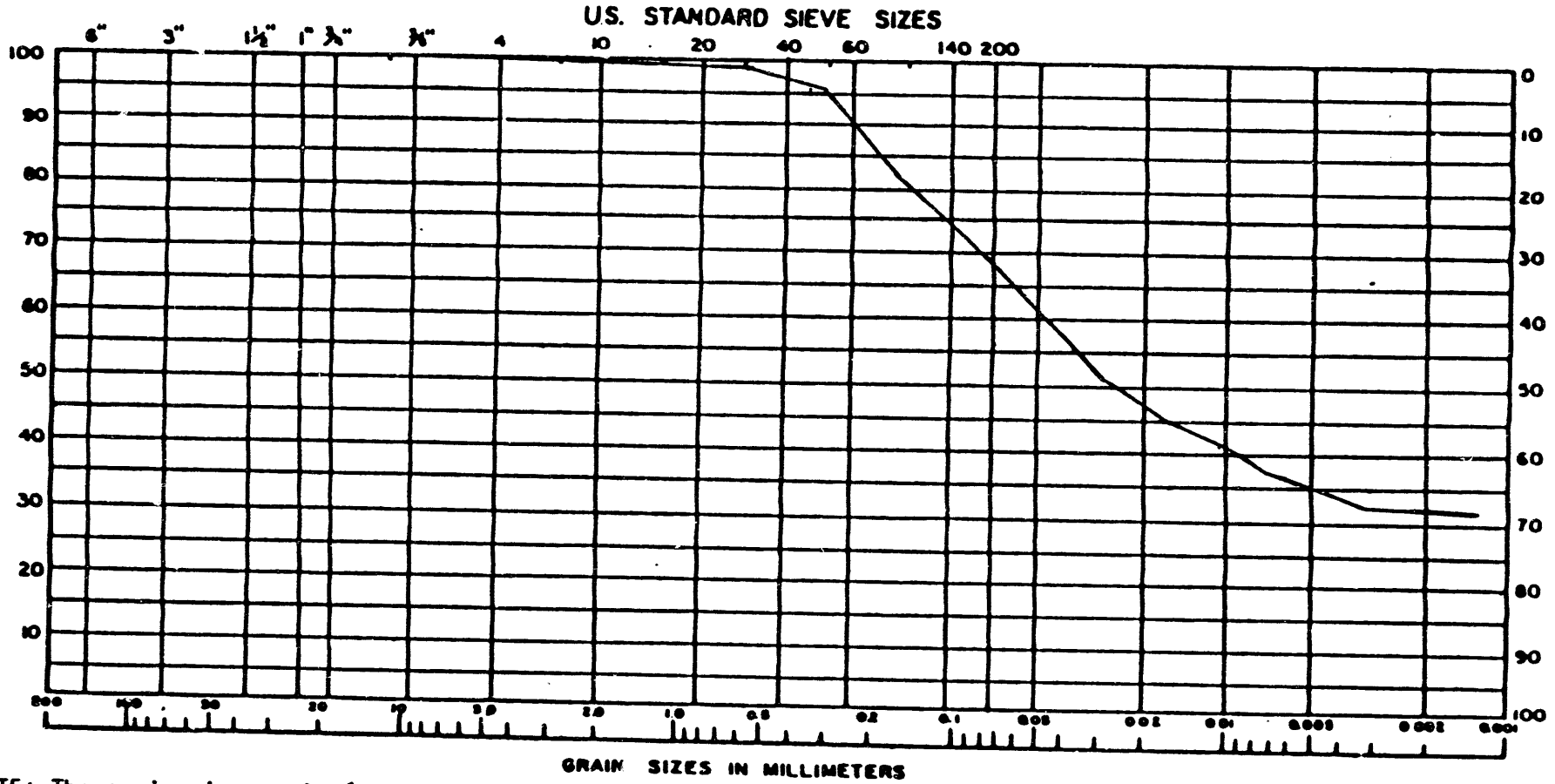
Job Number M37054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-2	10'	--	--	--		1952
CLASSIFICATION						

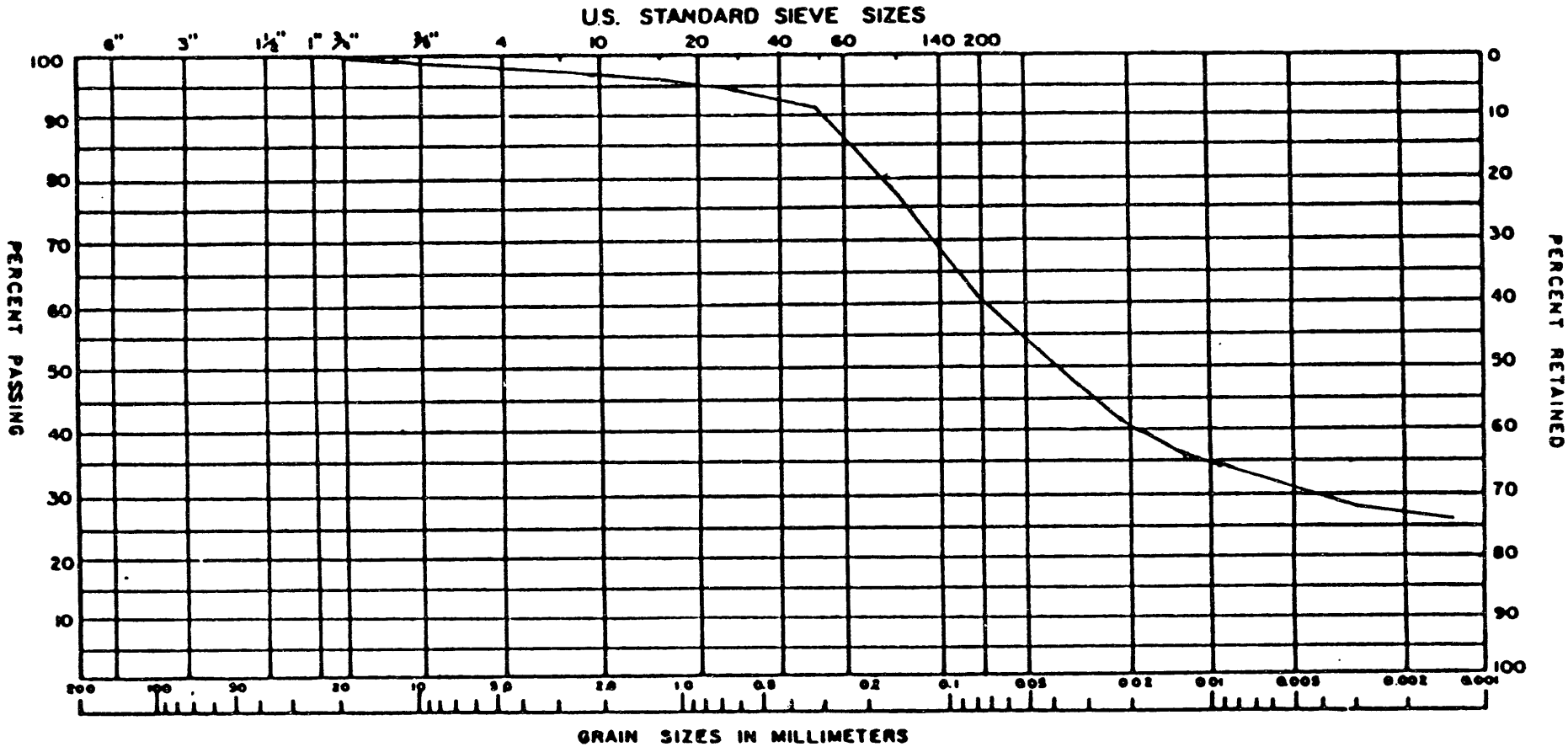
Project: Rifle-RFL-87-01

Job Number: [illegible]

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-2	12½' to 17½'	34	18	2.70	--	1953
CLASSIFICATION						
DISPERSION = 22.5%						

Fig

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-2 at 15 feet

LABORATORY SAMPLE NUMBER: 1954

MOISTURE CONTENT: 9.8 percent

Lambert and Associates

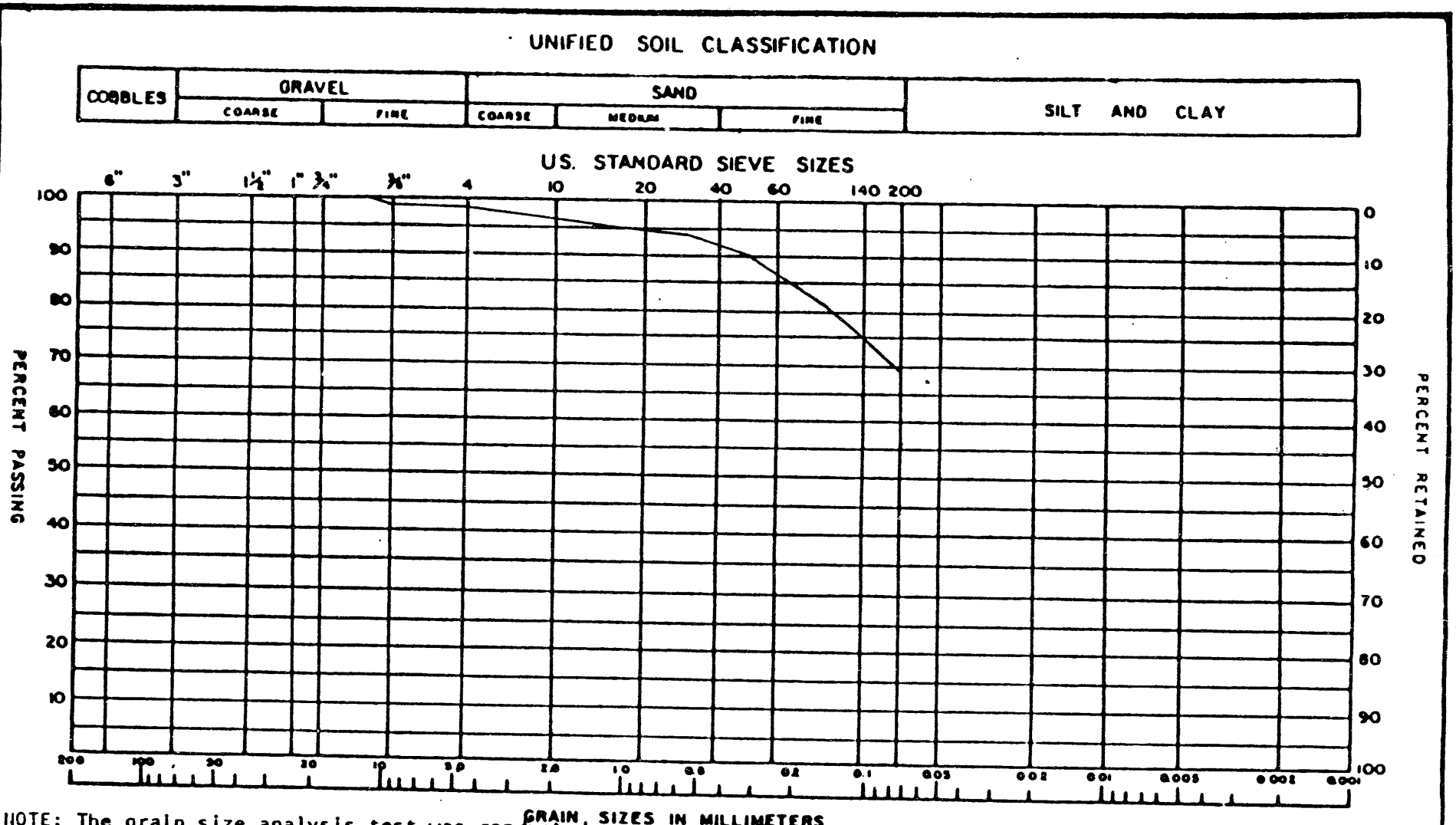
Project No.: M87054GE
Date:
Figure:

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



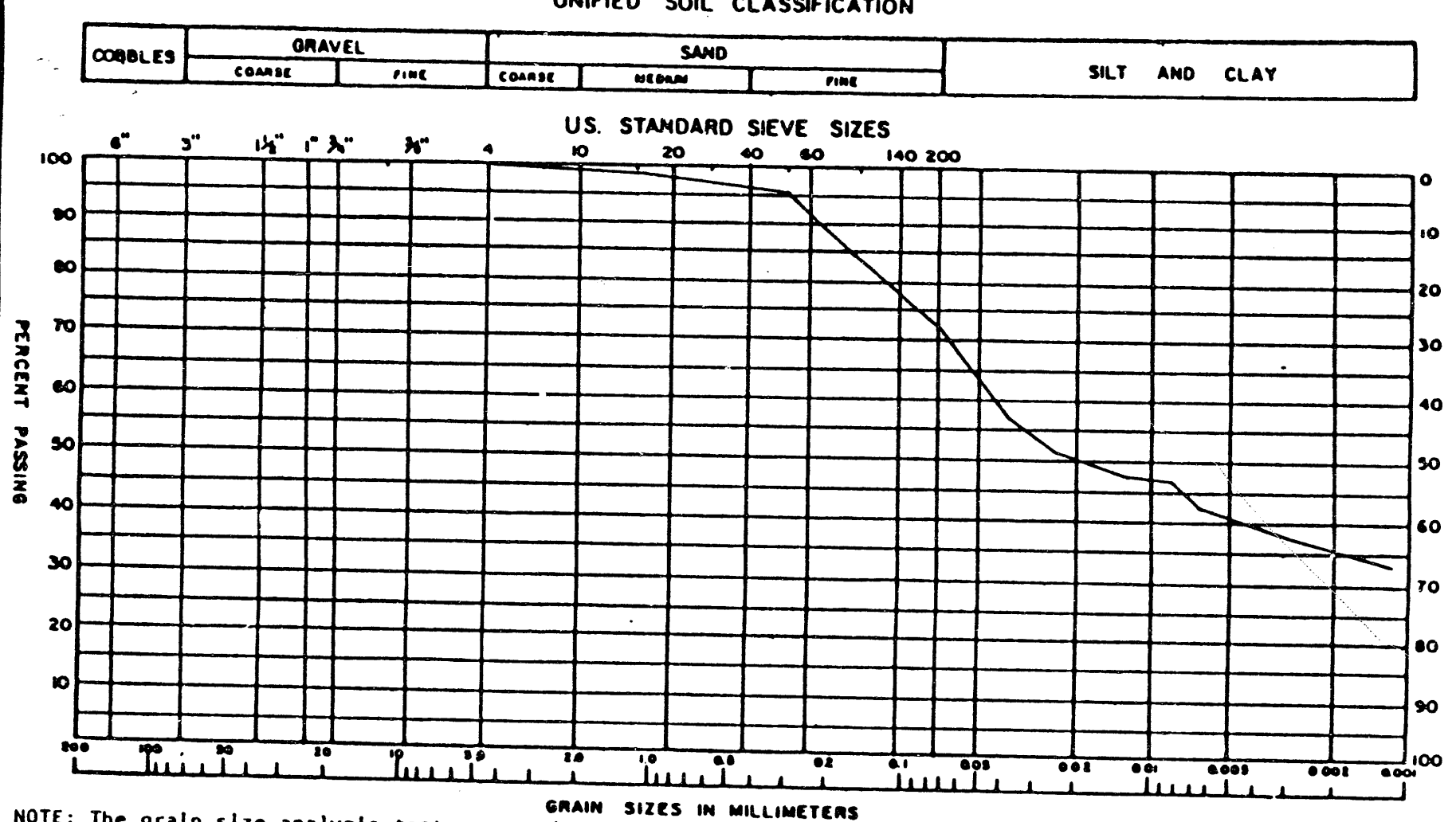
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEB 3	2 1/2	34	18		6.5	1955
CLASSIFICATION	Clay,sandy with some gravel (CL)					

Project: Rifle-PFL-37-01

Job Number: M3705425

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/8 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

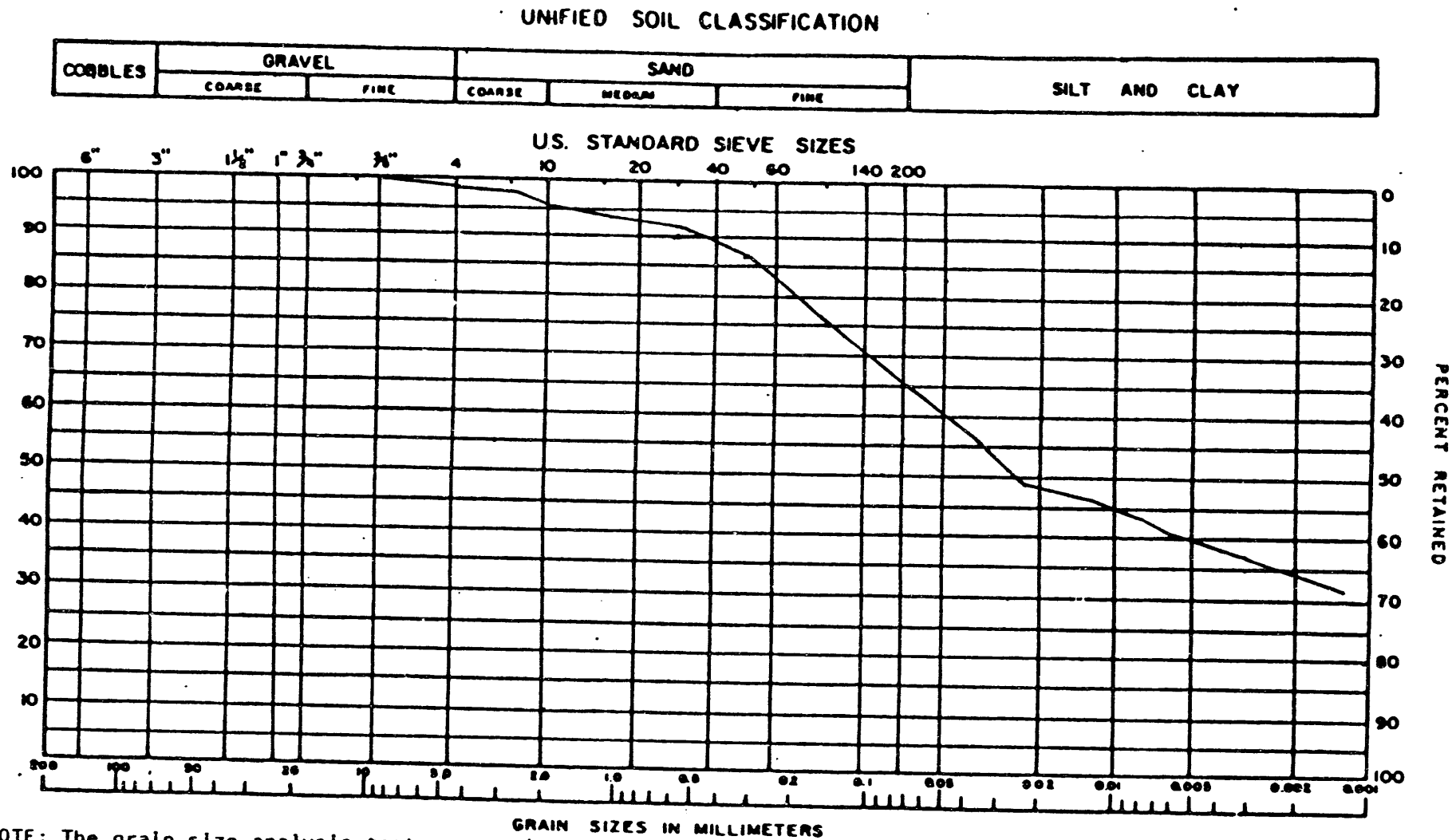
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-4	10'	47	31	--	--	1956
CLASSIFICATION						

Fig.

Project: Rifle-RFL-87-01

Job Number: 13705498

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-4	17 1/2'	--	--	--	8.8	1958
CLASSIFICATION						

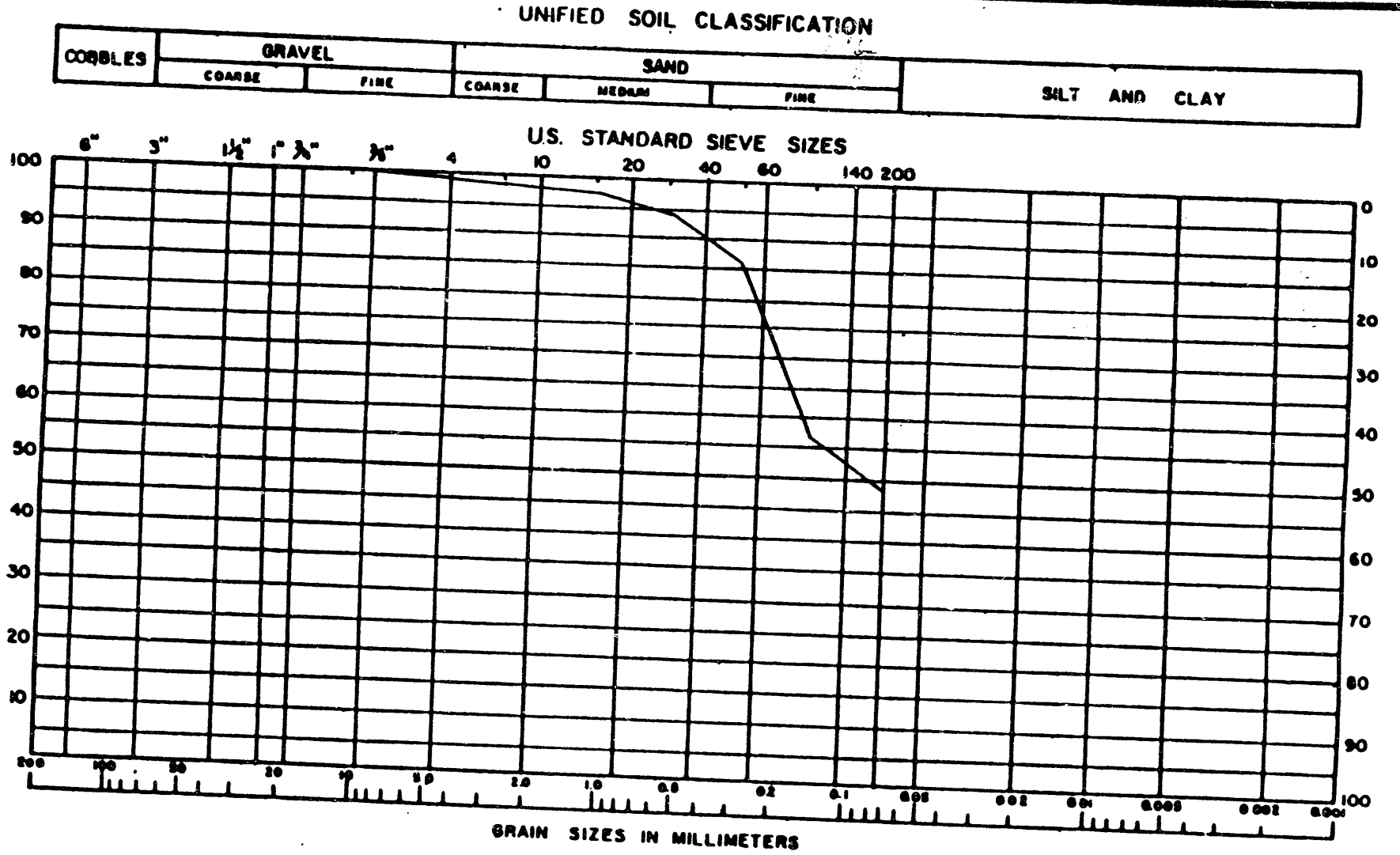
Fig.

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



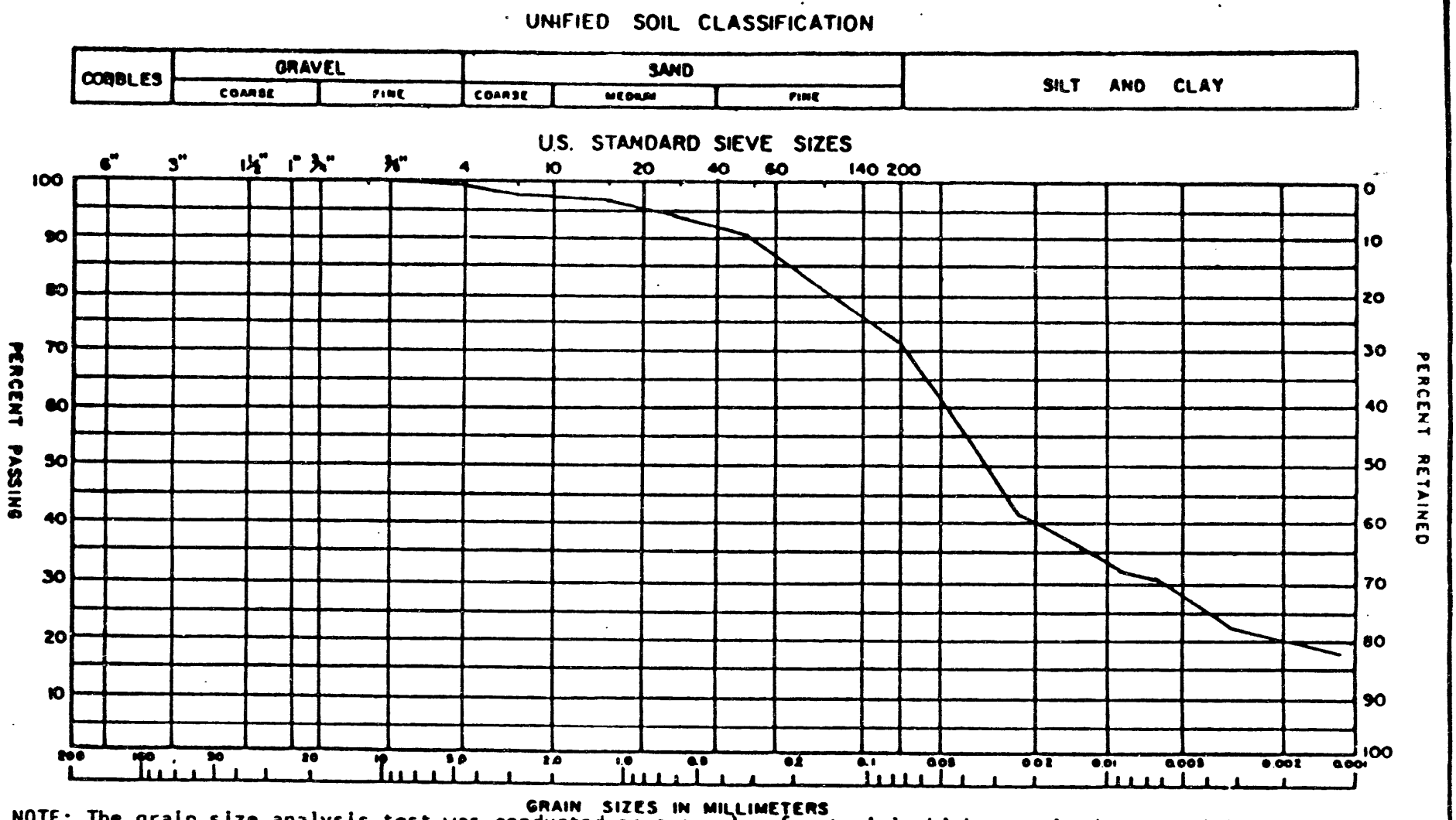
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-4	20 feet	--	--	---	---	2234
CLASSIFICATION						

Project: Rifle-RFL-87-01

Job Number: 197054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

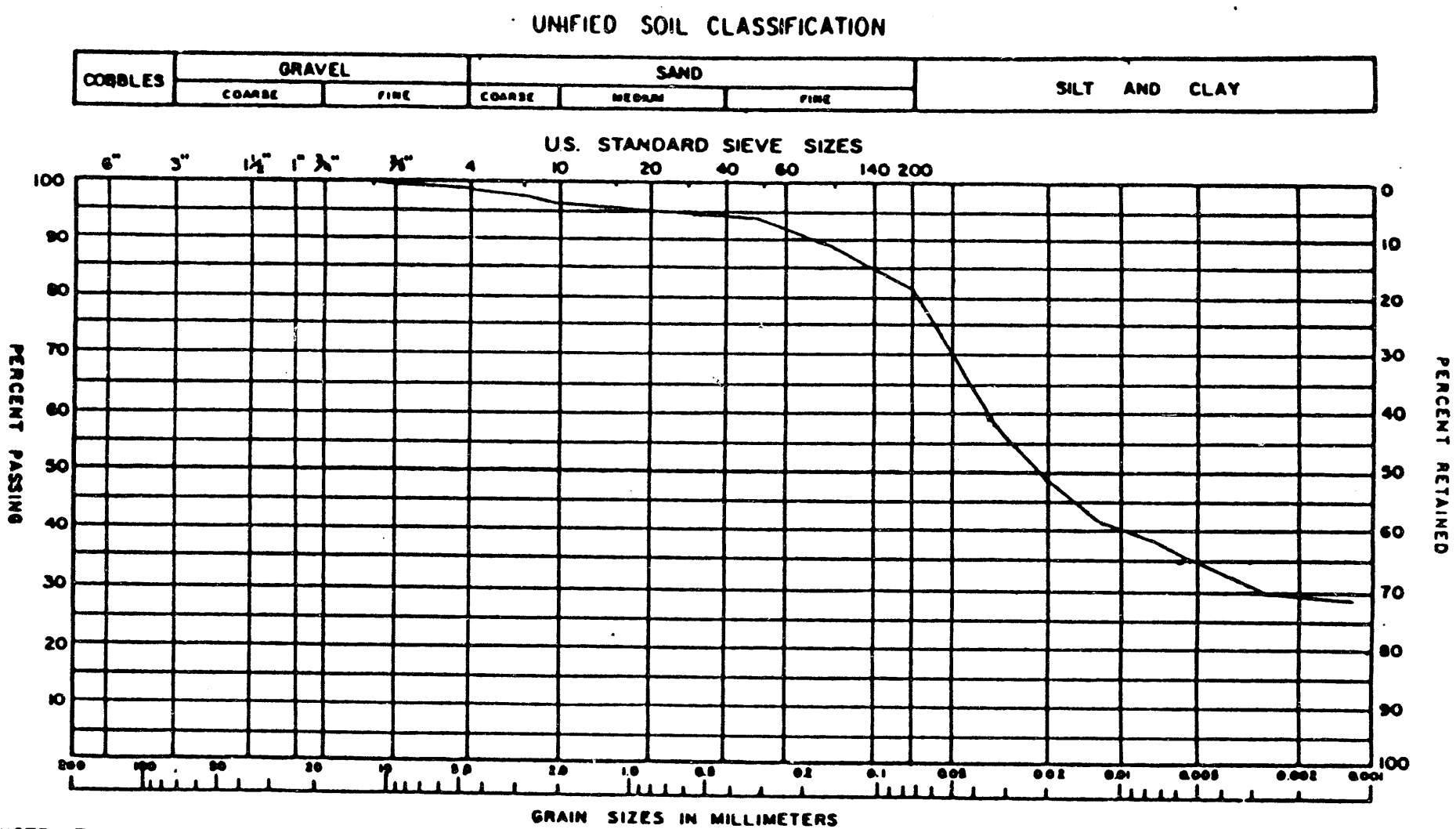


NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-5	21'	--	--	--	--	1960
CLASSIFICATION						

Project: Rifle-RFL-37-01
Job Number: 467054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

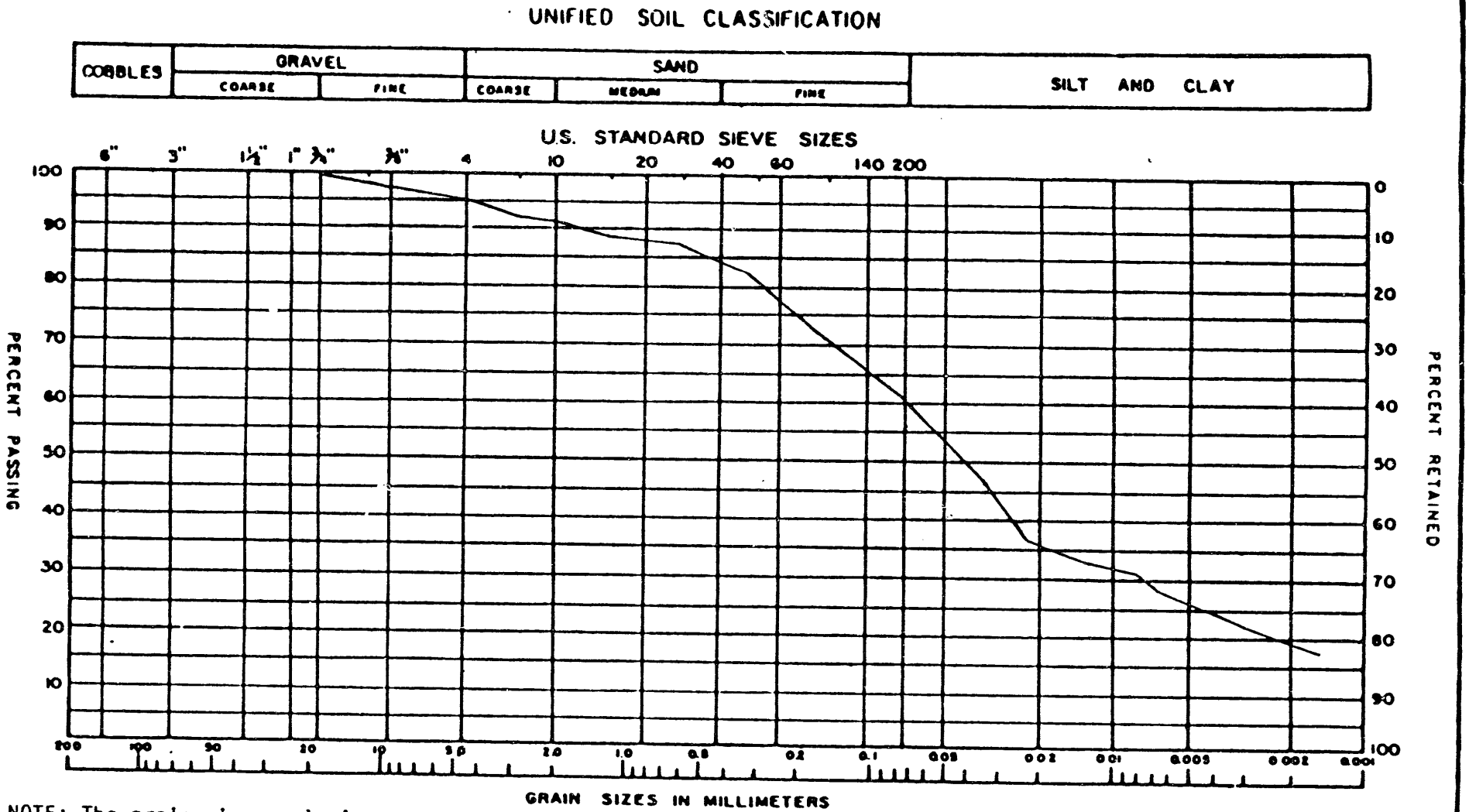
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-5	7½'	39	21	---	9.8	1961
CLASSIFICATION						

Fig

Project: Rifle-RFL-97-01
Job Number: 13703-GE

GRAIN SIZE DISTRIBUTION CURVES

Fig



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-5	10' to 15'	33	19	2.67	--	1962
CLASSIFICATION						

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-8 at 5 Feet

LABORATORY SAMPLE NUMBER: 1964

SAMPLE DESCRIPTION: Clay,sandy,(CL)

INITIAL DRY DENSITY: 105 pcf

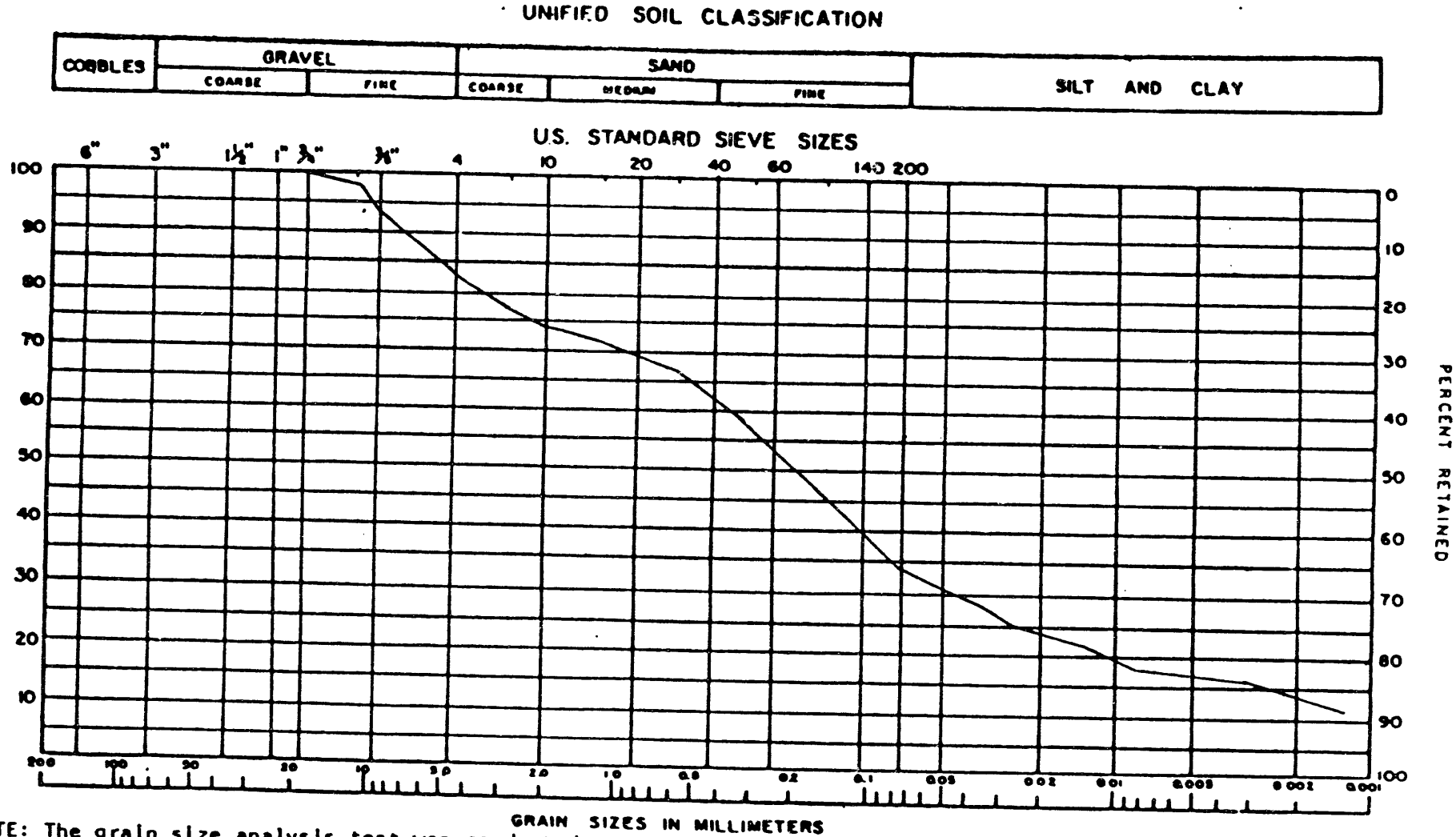
INITIAL MOISTURE CONTENT: 7.1 percent

Project: Rifle-RFL-87-01

Job Number: M3705GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-8	5' to 10'	27	10	2.66	5.6	1965
CLASSIFICATION						
DISPERSION: 29 percent						

Project: Rifle-RFL-87-01

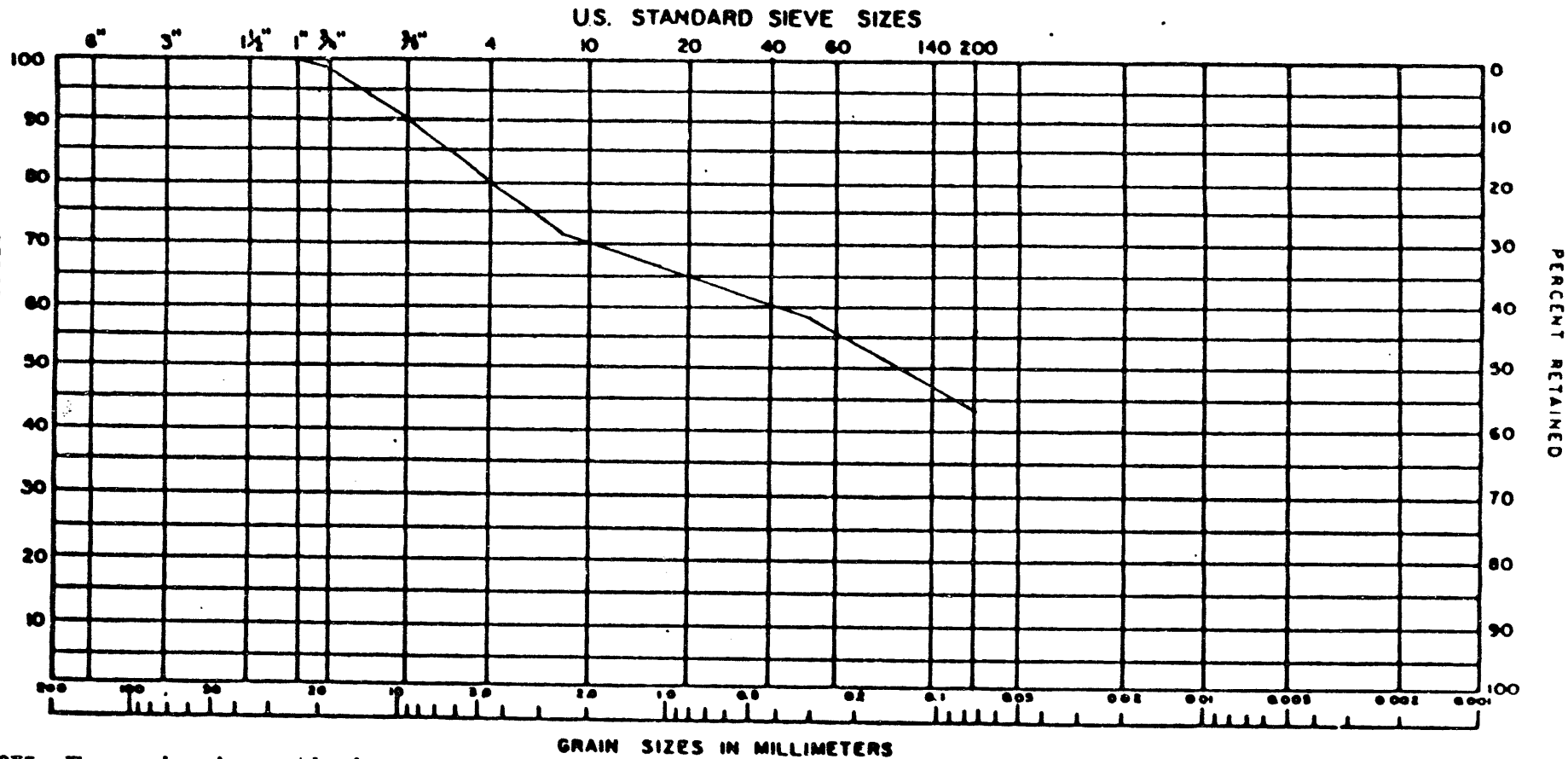
Job Number: M8705 4GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

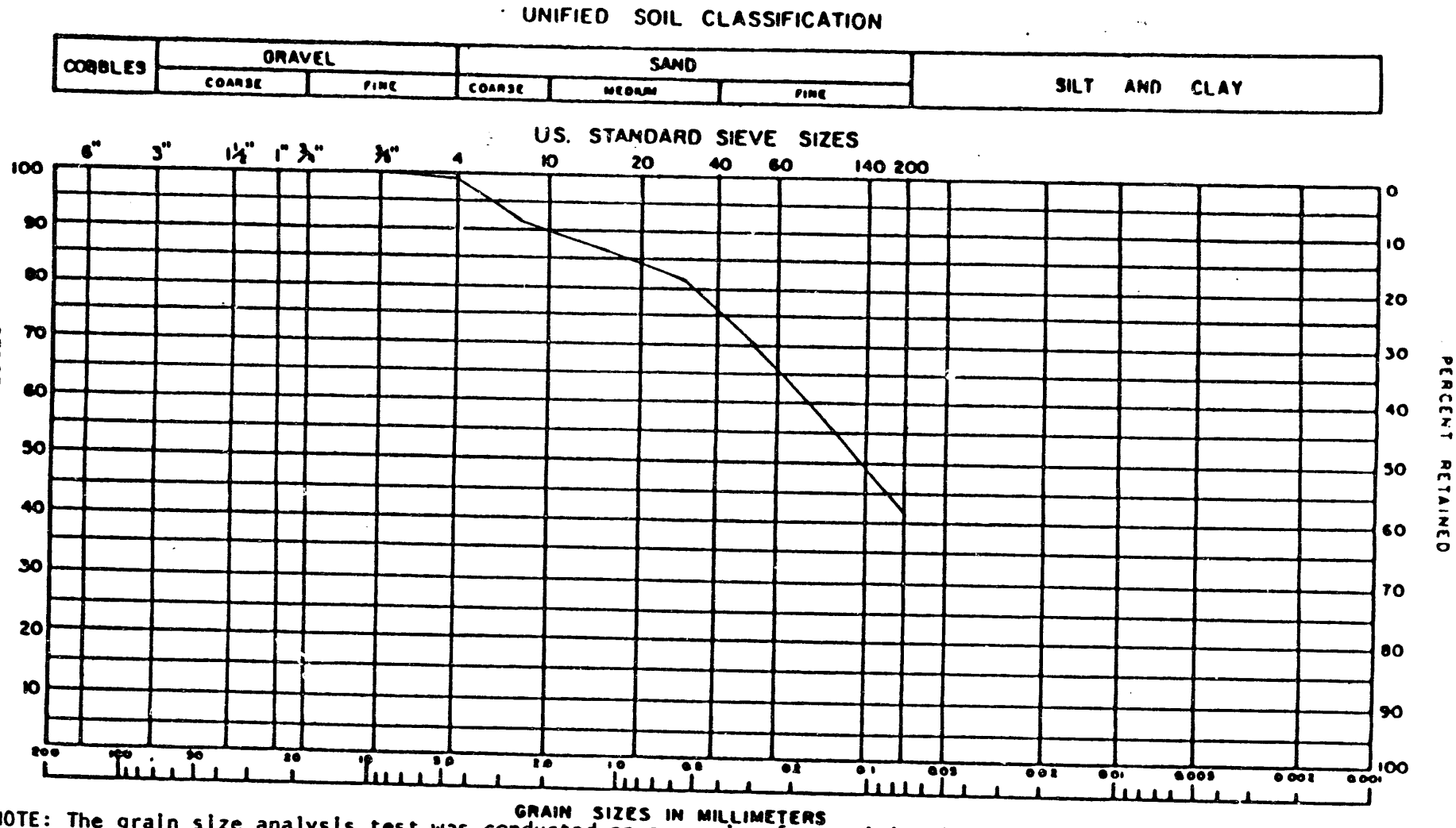
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEB-8	20-23	--	--	2.64	7.0	1966
CLASSIFICATION	Sand, clayey, gravelly, (SC)					

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEB-8	40	28	13	---	4.7	1967
CLASSIFICATION	Sand, very clayey, (SC)					

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-9 at 7 1/2 Feet

LABORATORY SAMPLE NUMBER: 1968

SAMPLE DESCRIPTION: Clay,silty,sandy,some gravel,(CL)

ATTERBERG LIMITS: Liquid Limit = 31
Plastic Limit = 17
Plasticity Index = 14

INITIAL MOISTURE CONTENT: 5.6 percent

Project: Rifle-RFL-87-01

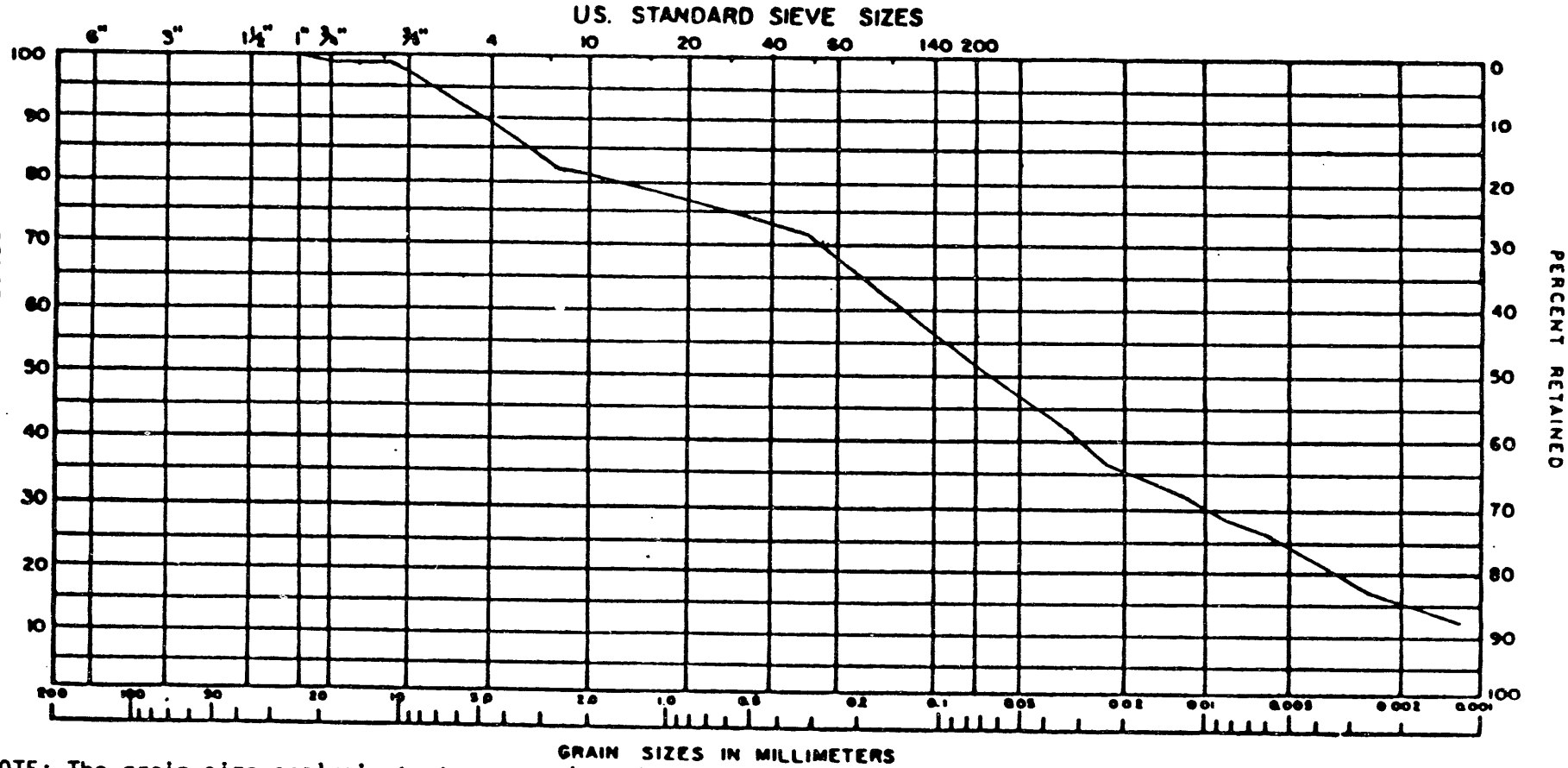
Job Number: 1870540E

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-9	15' to 20'	33	17	--	8.2	1970
CLASSIFICATION						

TEST RESULTS SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-9 at 20 feet

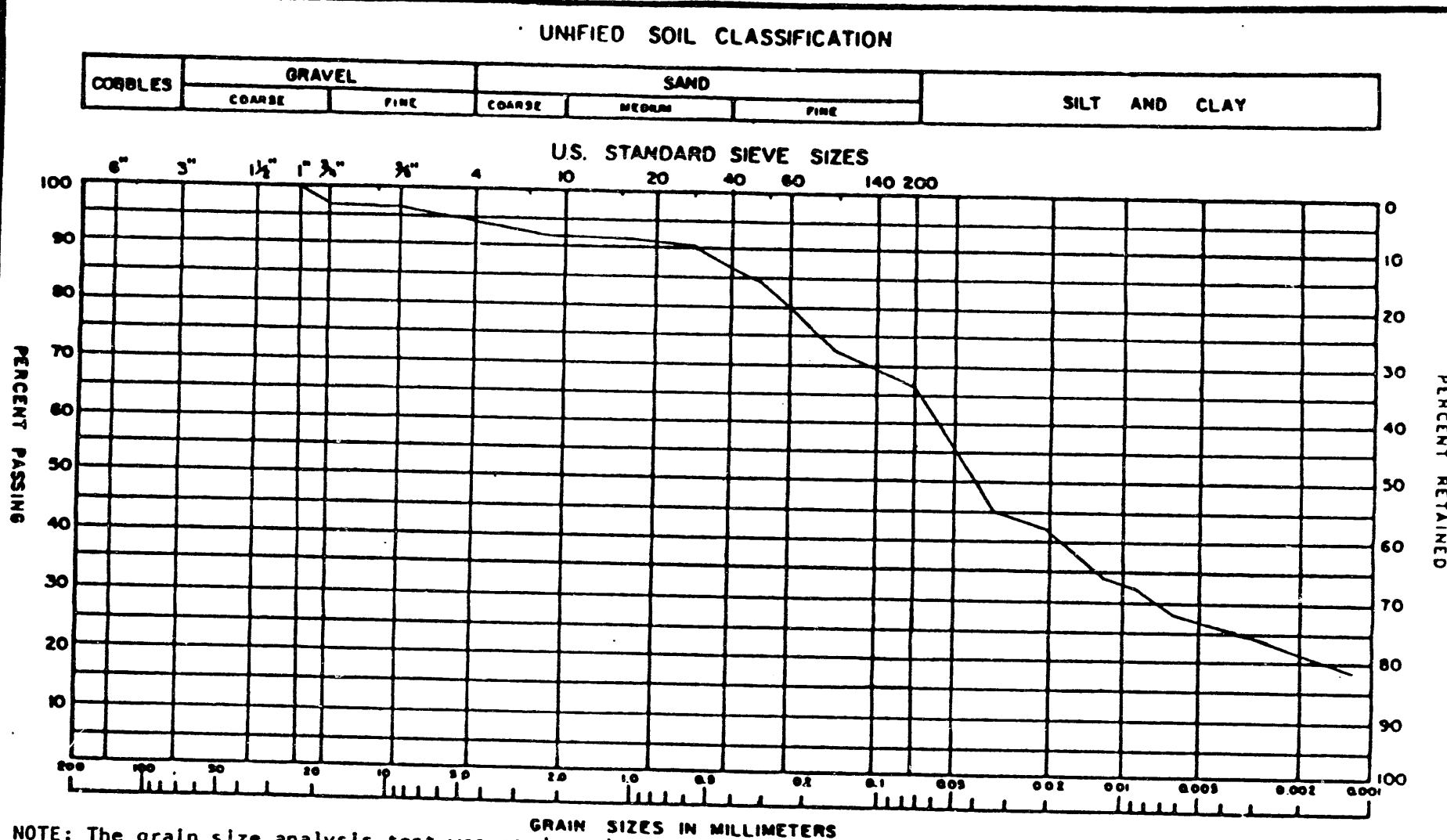
LABORATORY SAMPLE NUMBER: 1971

INITIAL MOISTURE CONTENT: 4.4 percent

Project: Rifle-RFL-87-01

Job Number: H8705456

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-9	30'	--	--	--	--	1972
CLASSIFICATION						

Fig.

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-9 at 34 Feet

LABORATORY SAMPLE NUMBER: 1973

SAMPLE DESCRIPTION: Clay,sandy,gravelly,(CL)

ATTERBERG LIMITS: Liquid Limit = 44
Plastic Limit = 18
Plasticity Index = 25

INITIAL MOISTURE CONTENT: 9.6 percent

Project: Rifle-RFL-87-01

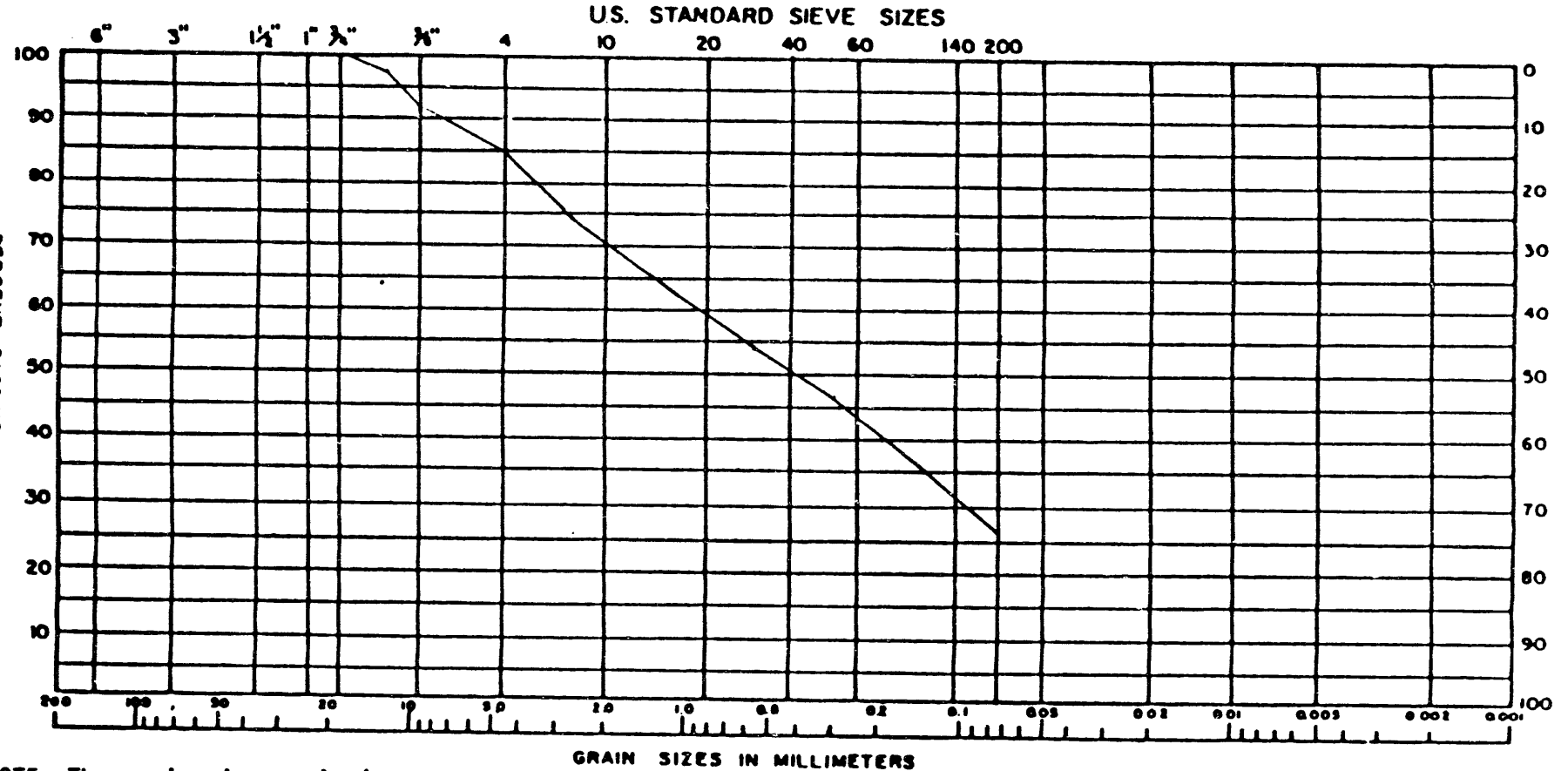
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

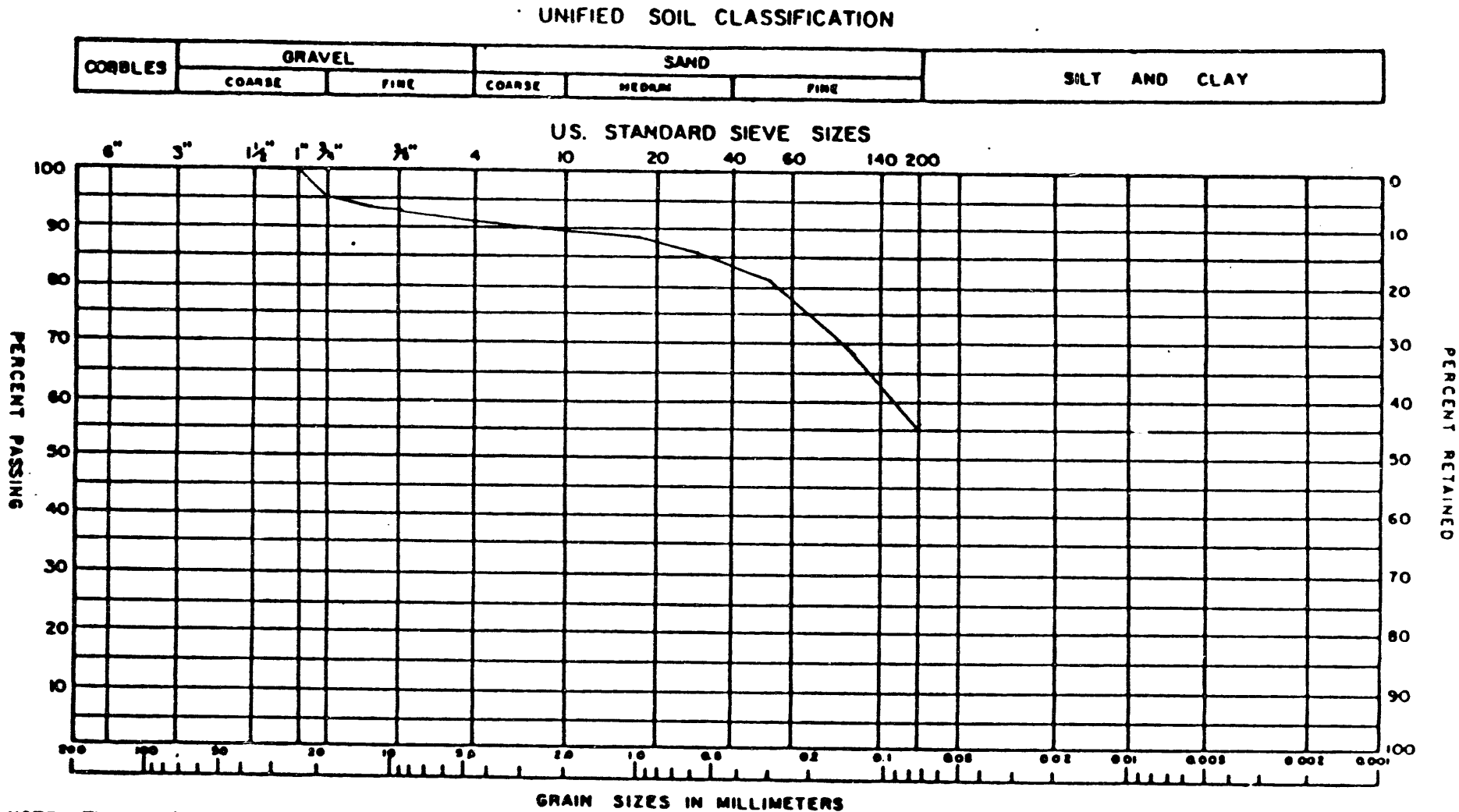
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEB-10	5	--	--	---	7.5	1974
CLASSIFICATION	Sand, silty, gravelly, (SM)					

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



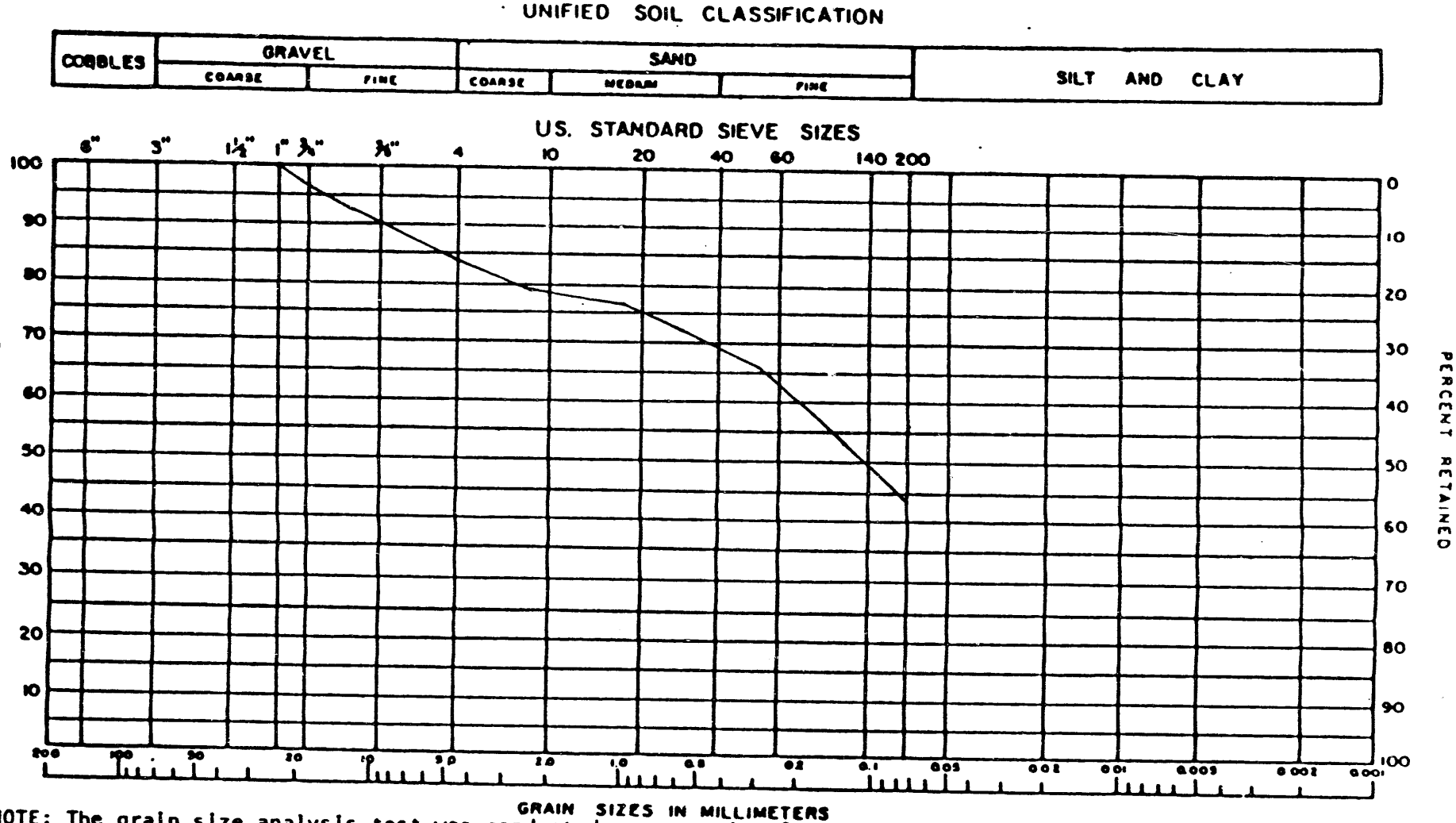
NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEB 10	15	--	--	---	4.8	1975
CLASSIFICATION	Silt, very sandy, gravelly, (ML-SM)					

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

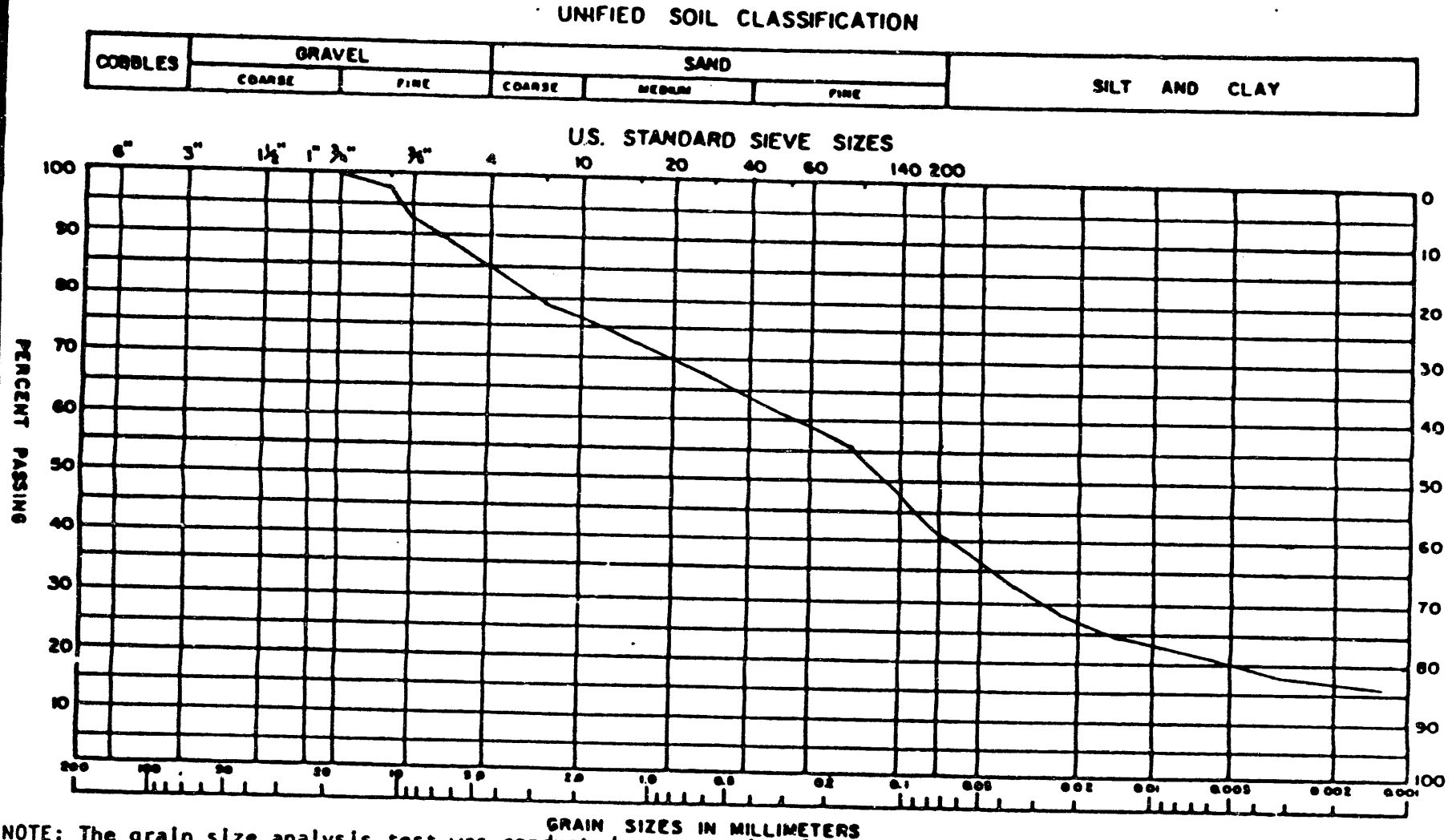
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEB 11	7 1/2	--	--	---	7.8	1976
CLASSIFICATION	Sand, very clayey, gravelly, (SC-CL)					

Fig.

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-11	9' to 14'	33	17	2.67	8.1	1977
CLASSIFICATION						

Fig.

TEST RESULTS SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-11 at 20 feet

LABORATORY SAMPLE NUMBER: 1978

INITIAL MOISTURE CONTENT: 5.2 percent

Project: Rifle-RFL-87-01

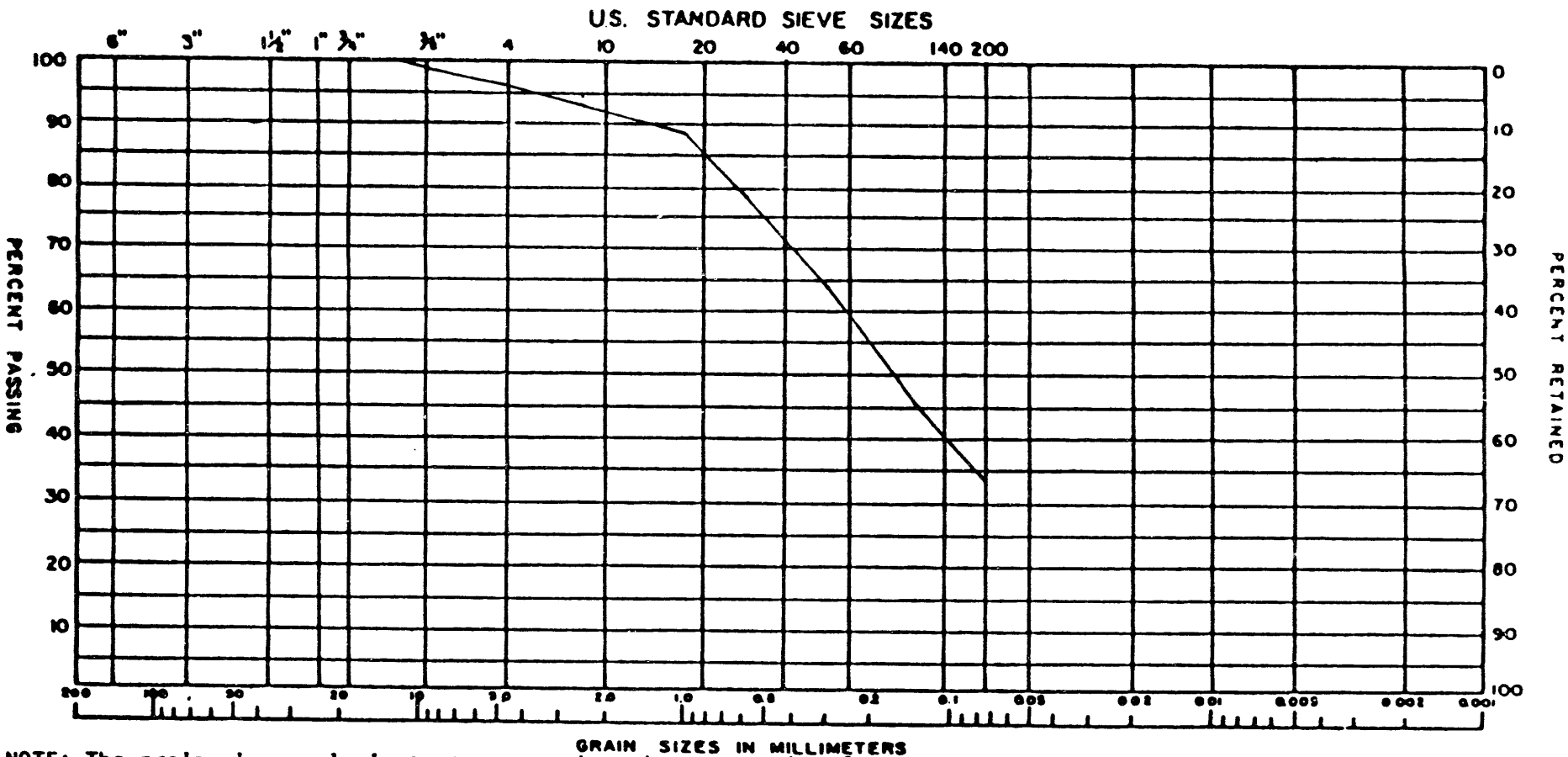
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

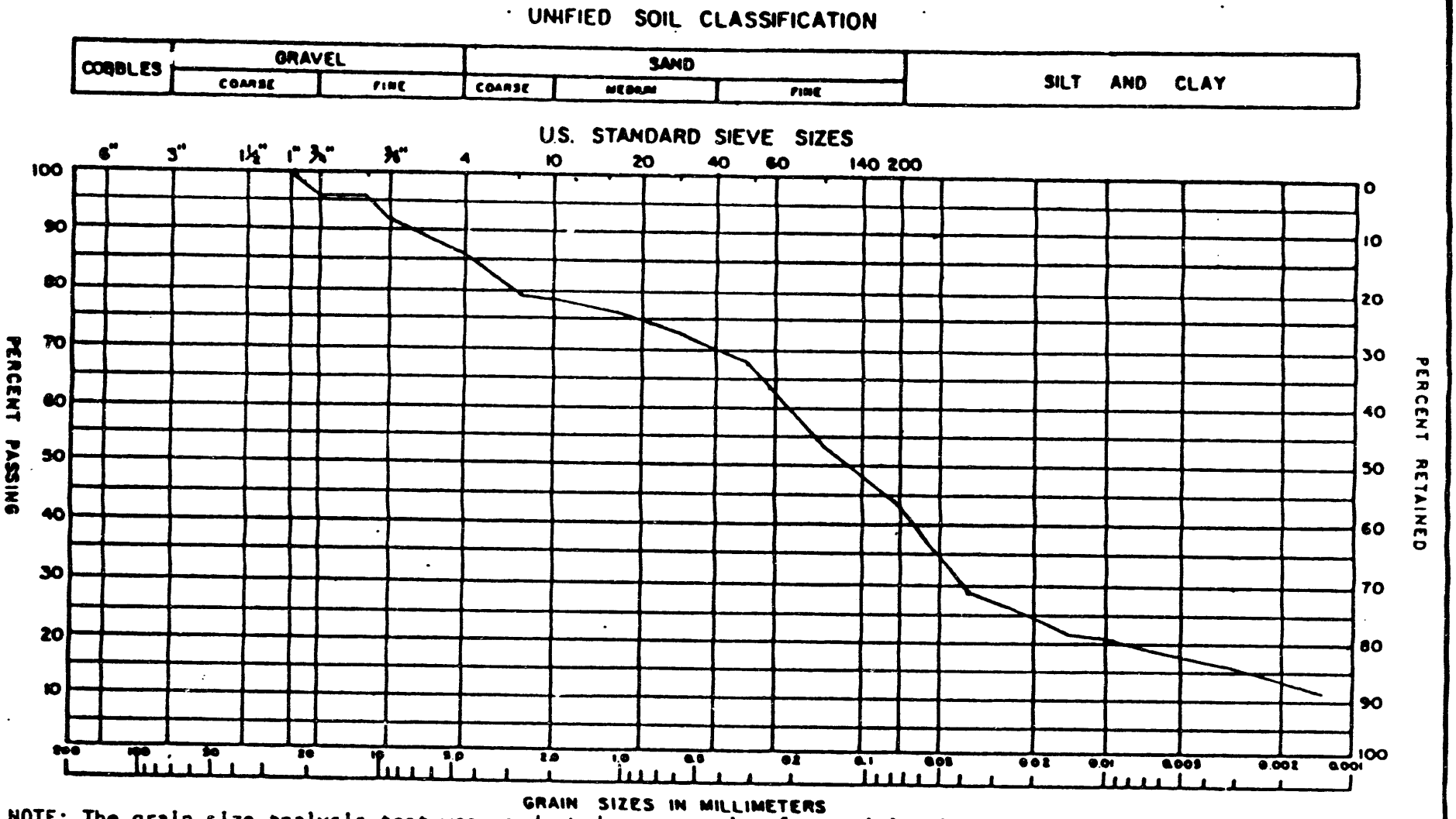
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEB 11	25	~~16~~ 17	9	---	7.3	1979
CLASSIFICATION Sand,clayey,slightly gravelly (SC)						

Project: Rifle-RFL-97-01

Job Number: M8705 4GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-12	2½'	30	11	--	--	1981
CLASSIFICATION						

TEST RESULTS SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-12 at 5 feet

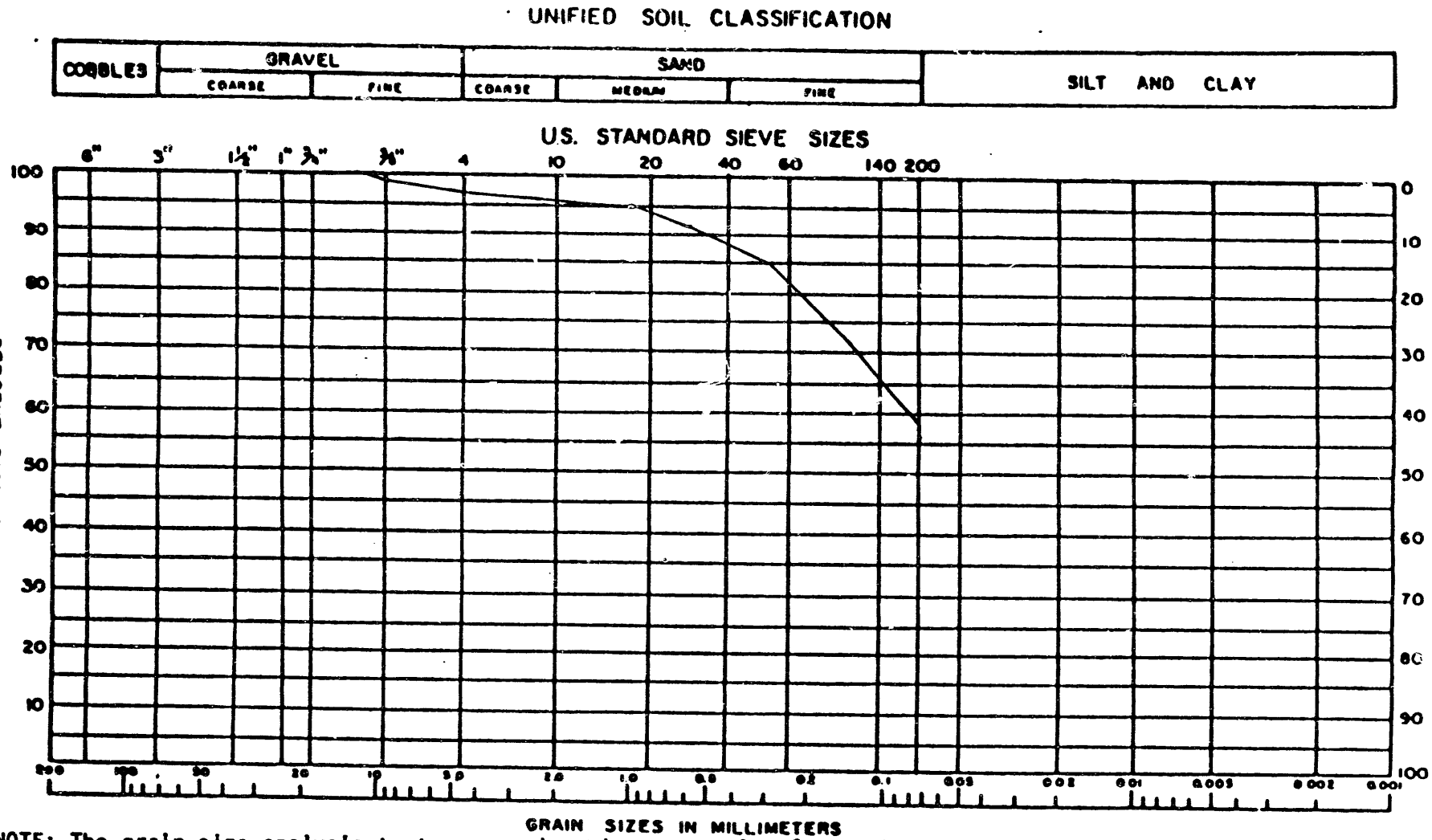
LABORATORY SAMPLE NUMBER: 1982

INITIAL MOISTURE CONTENT: 9.3 percent

Project: Rifle-RFL-87-01
Job Number H87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEB 12	7 1/2	--	--	---	9.8	1983
CLASSIFICATION	Clay, silty, sandy, some scattered gravel, (CL)					

Project: Rifle-RFL-87-01

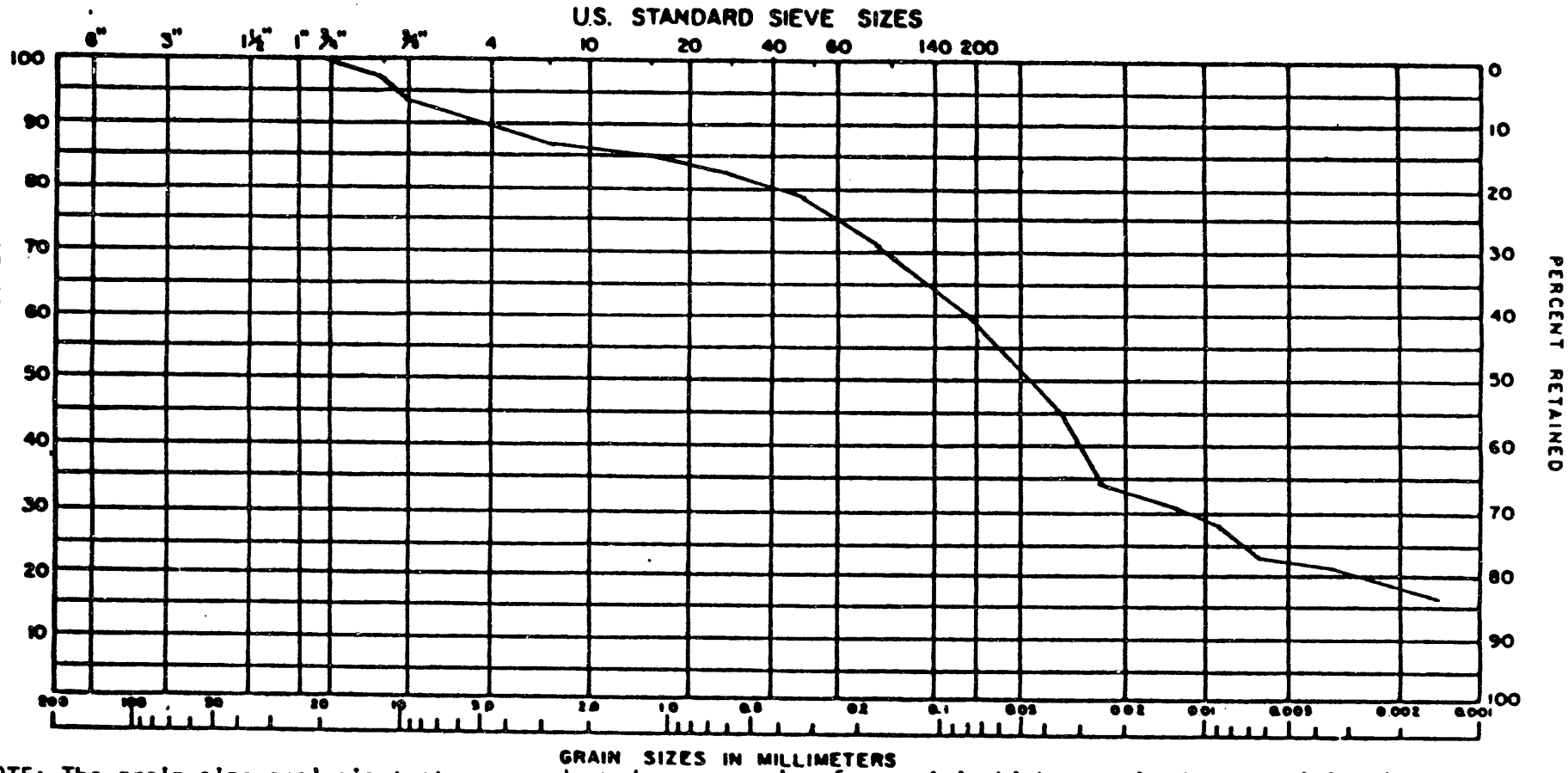
Job Number: M8705456

GRAIN SIZE DISTRIBUTION CURVES

Fig

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MFB-13	2[illegible]	--	--	--	--	1994
CLASSIFICATION						

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-13 at 5 Feet

LABORATORY SAMPLE NUMBER: 1985

SAMPLE DESCRIPTION: Clay,silty,sandy,some scattered gravels,(CL)

ATTERBERG LIMITS: Liquid Limit = 28
Plastic Limit = 15
Plasticity Index = 13

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE MEB-13 at 10 Feet to 13 1/2 Feet

LABORATORY SAMPLE NUMBER: 1986

SAMPLE DESCRIPTION: Clay,silty,sandy,some scattered gravels,(CL)

ATTERBERG LIMITS: Liquid Limit = 32
Plastic Limit = 16
Plasticity Index = 16

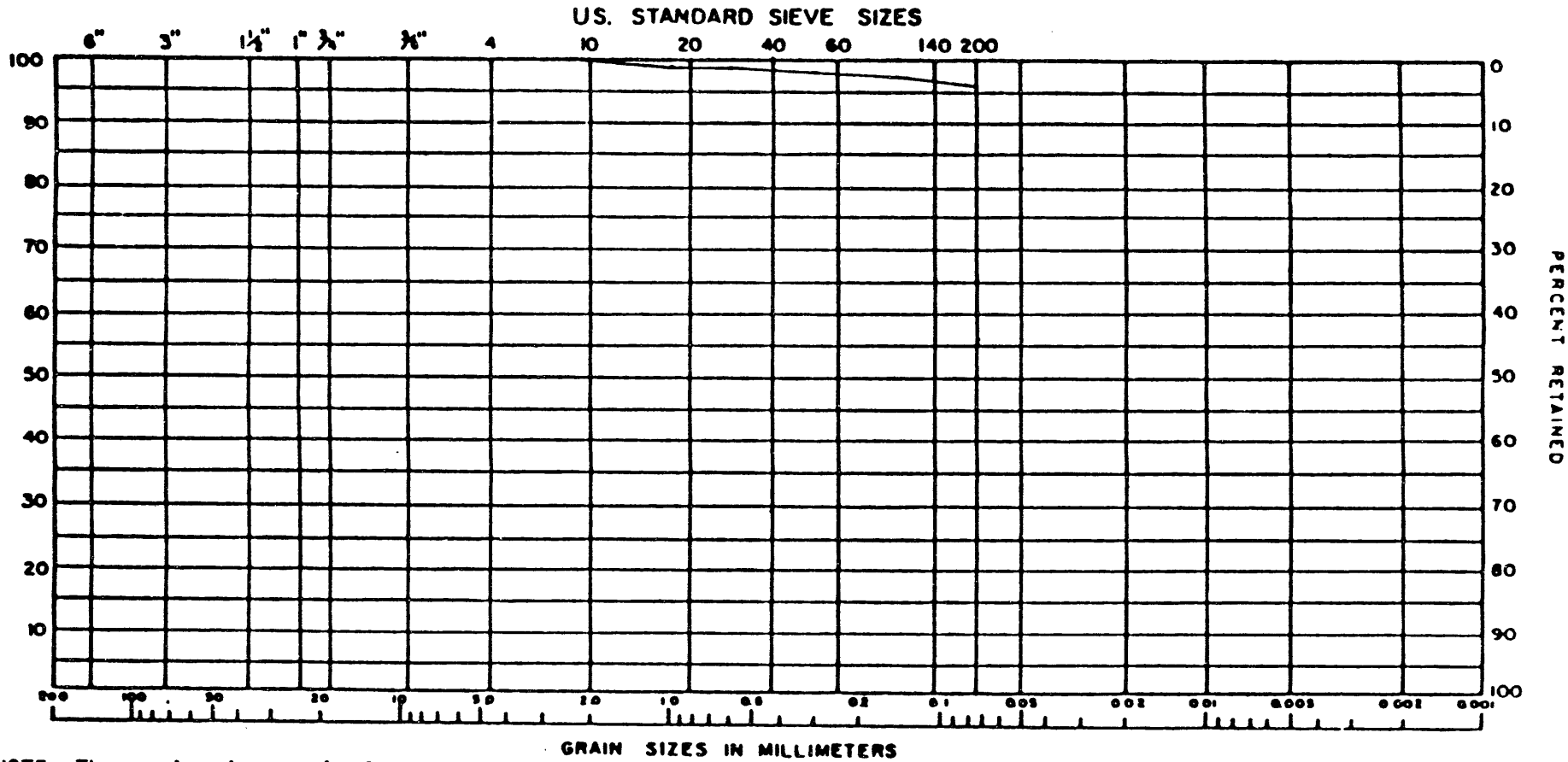
Project: Rifle-RFL-87-01
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

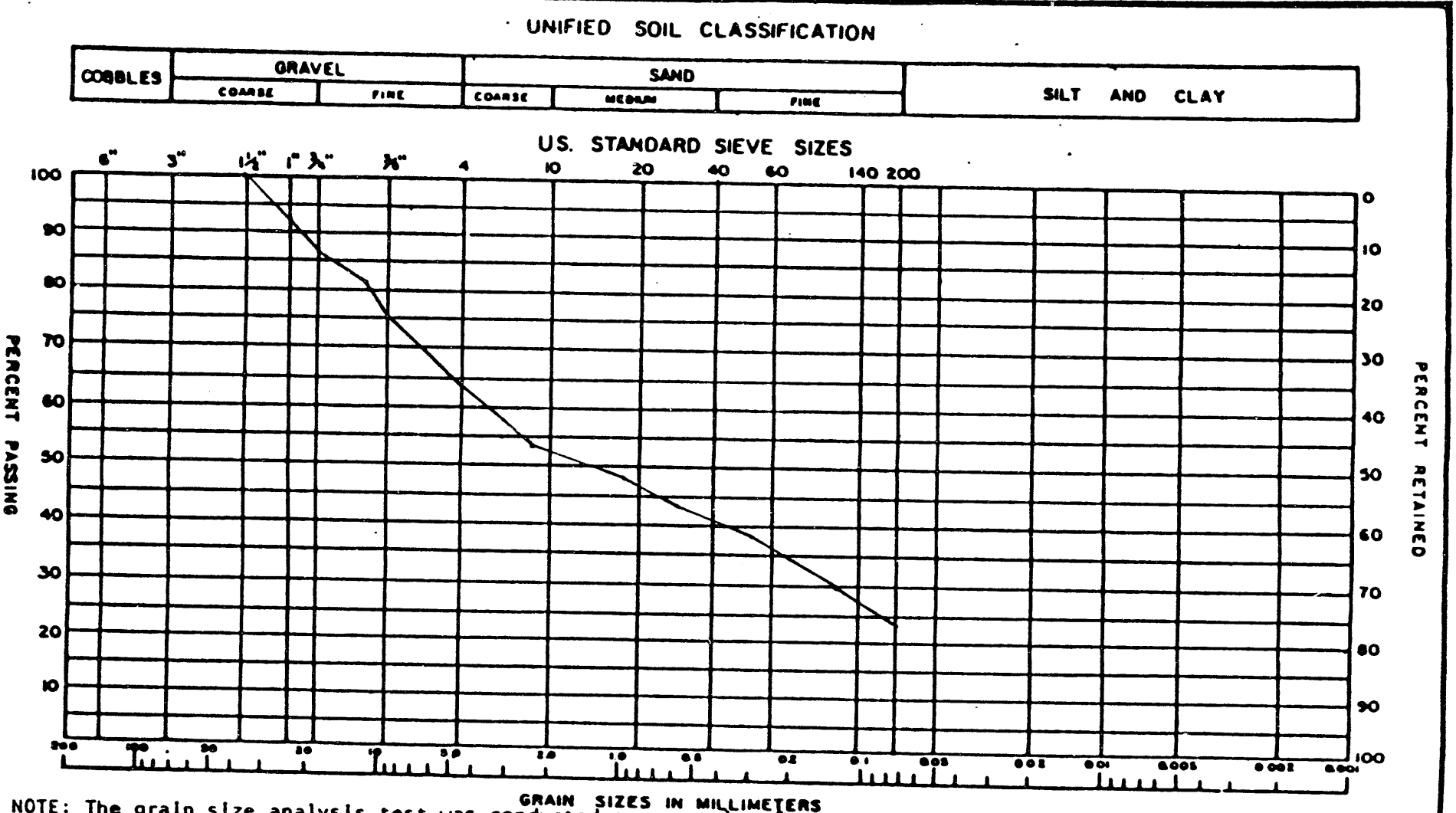
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEB 13	12 1/2	--	--	---	8.1	1987
CLASSIFICATION	Formational material, claystone					

Project: Rifle-RFL-87-01

Job Number: H87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

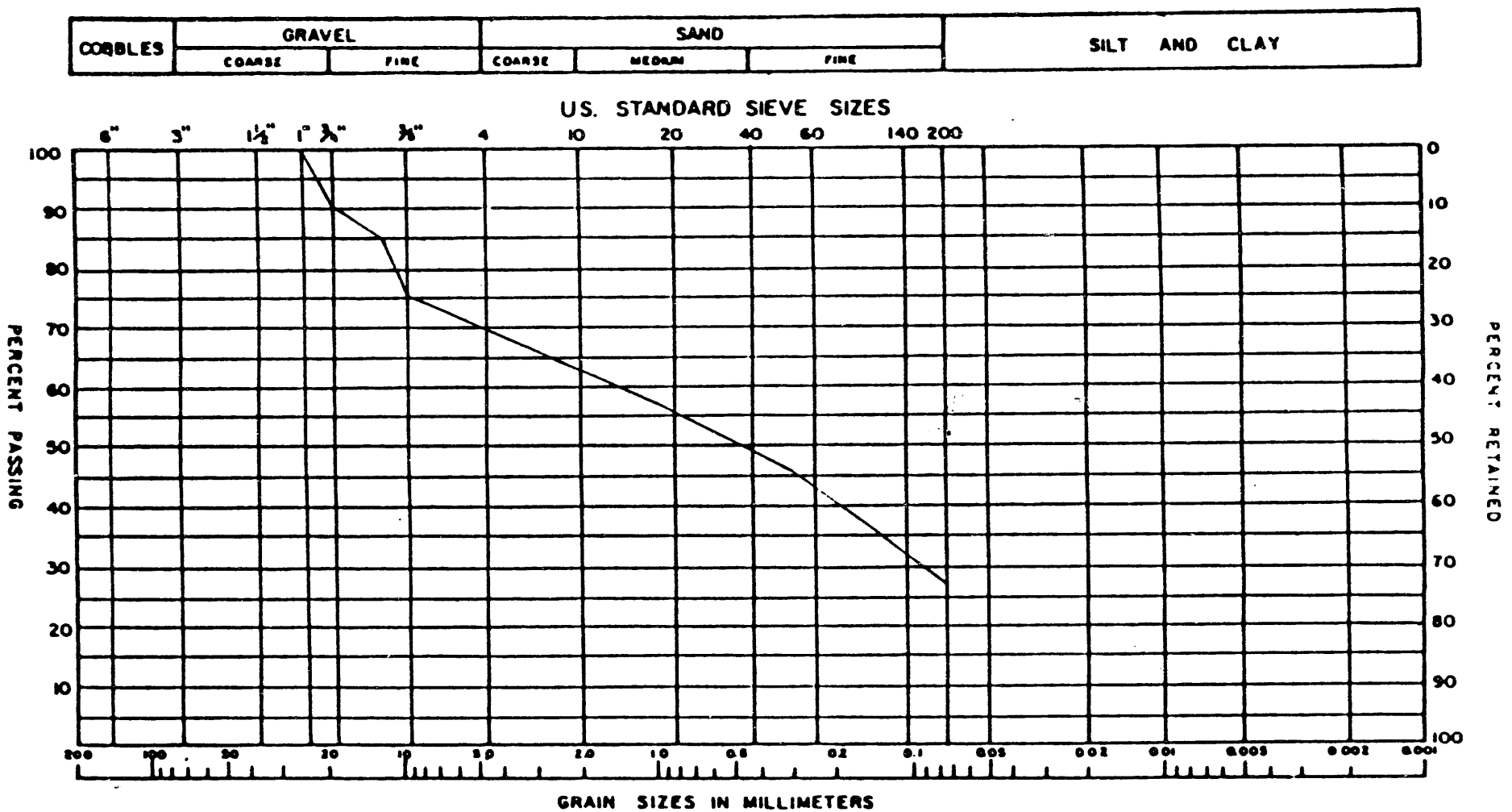


NOTE: The grain size analysis test was conducted on a sample of material which contained no particles sizes larger than 3 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEB 15	4	--	--	---	6.8	1988
CLASSIFICATION	Sand, very gravelly, clayey, (SC-GC)					

Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

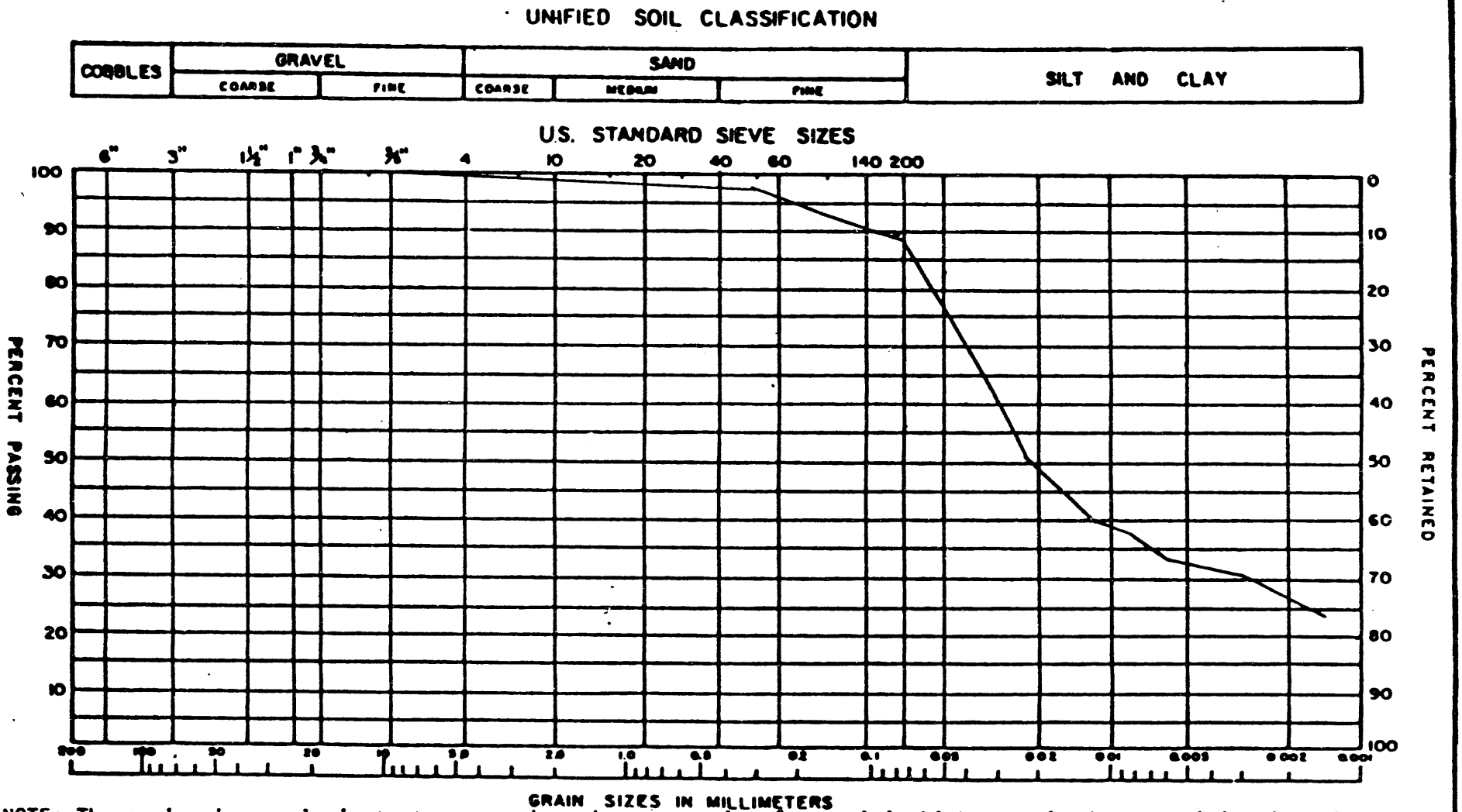
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEB 15	9	--	--	---	5.3	1989
CLASSIFICATION	Sand,gravelly,clayey,(SC)					

Fig

Project: RI file-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MET-1	2½'	--	--	--	--	1990
CLASSIFICATION						

Fig:

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: ME-1 at 5 Feet

LABORATORY SAMPLE NUMBER: 1991

SAMPLE DESCRIPTION: Clay,sandy,silty,(CL)

ATTERBERG LIMITS: Liquid Limit = 45
Plastic Limit = 19
Plasticity Index = 26

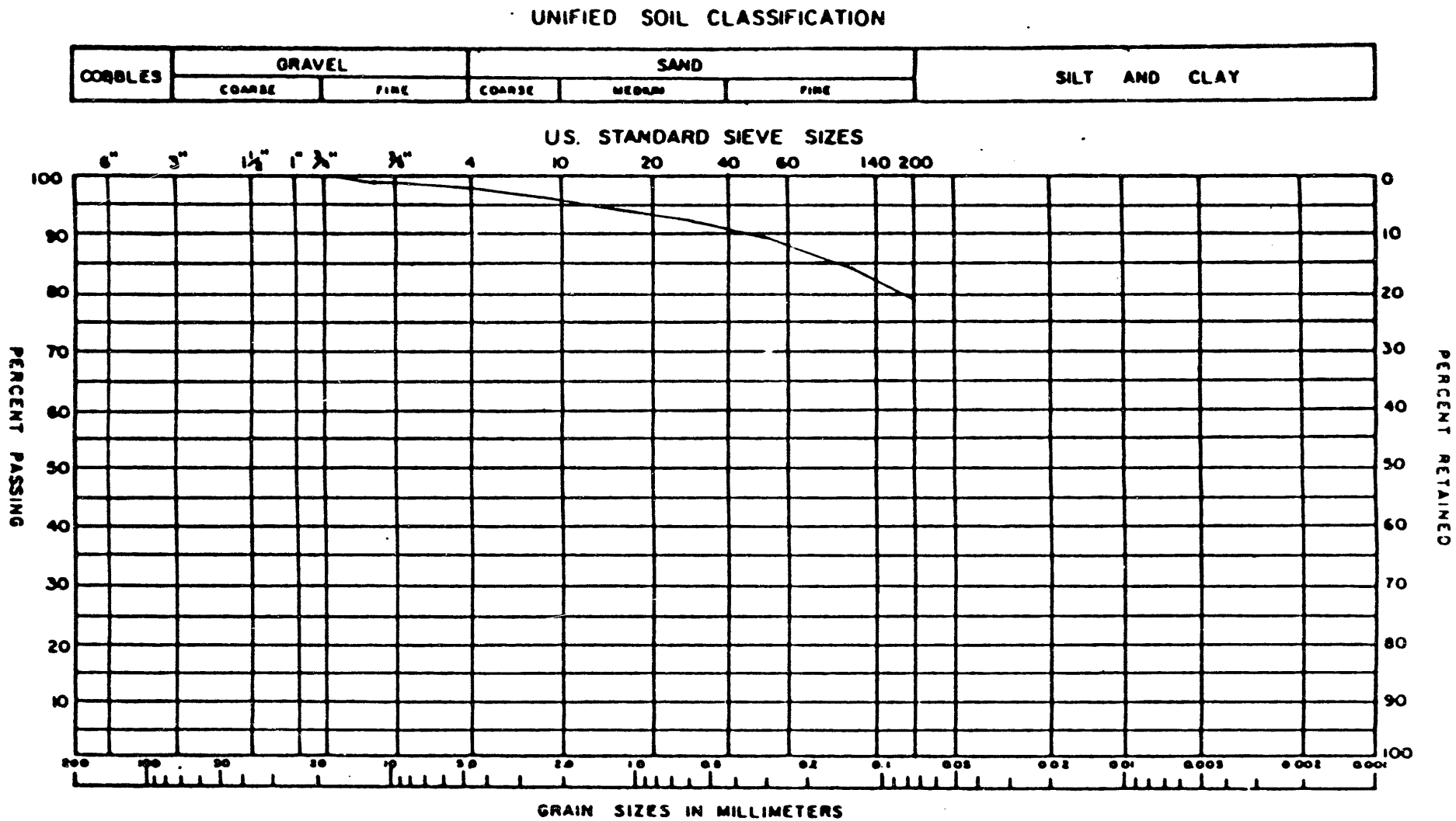
Lambert and Associates

Project No.:	ME-054GE
Date:	
Figure:	

Project: Rifle-RFL-87-01

GRAIN SIZE DISTRIBUTION CURVES

Fig



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

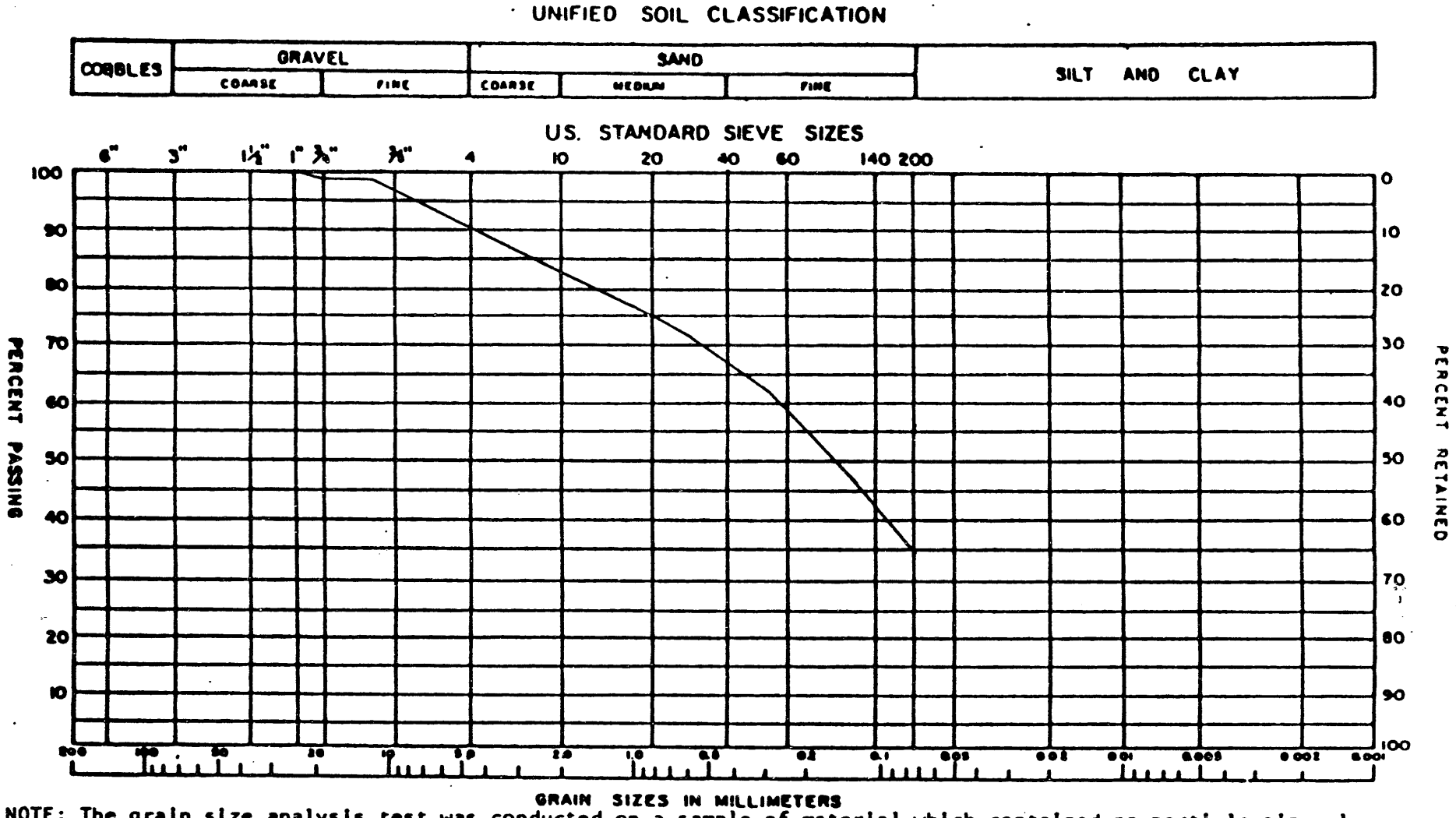
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MET 1	7 1/2				9.3	1992
CLASSIFICATION	Clay, sandy, (CL)					

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

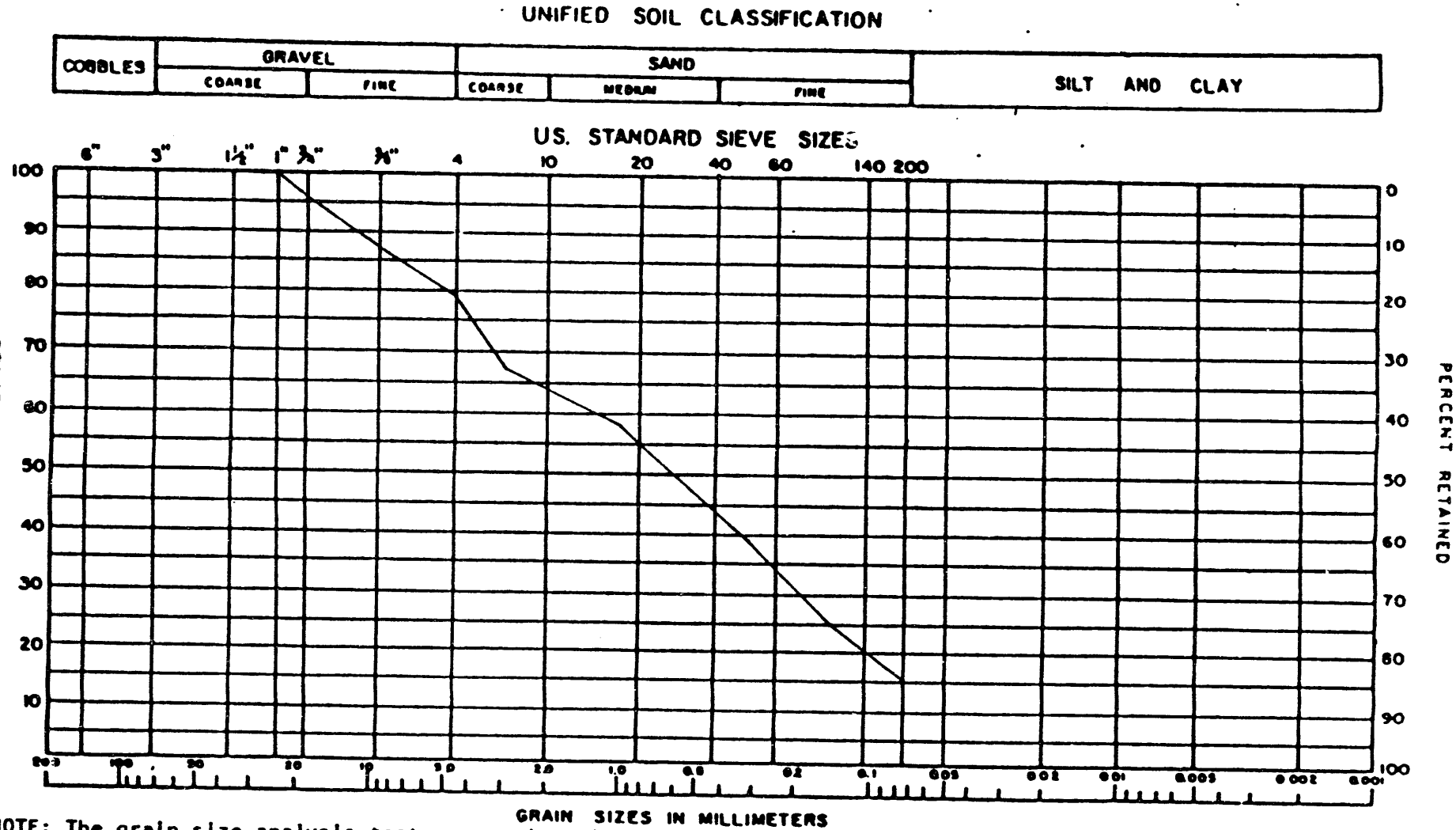
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MET 1	12	--	--	---	7.1	1993
CLASSIFICATION	Sand, clayey, some gravel, (SC)					

Project: Rifle-RFL-87-01

Job Number H87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig.



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MET 4	2 1/2	--	--	---	7.1	1994
CLASSIFICATION	Sand, gravelly, clayey, (SC)					

Project: Rifle-RFL-87-01

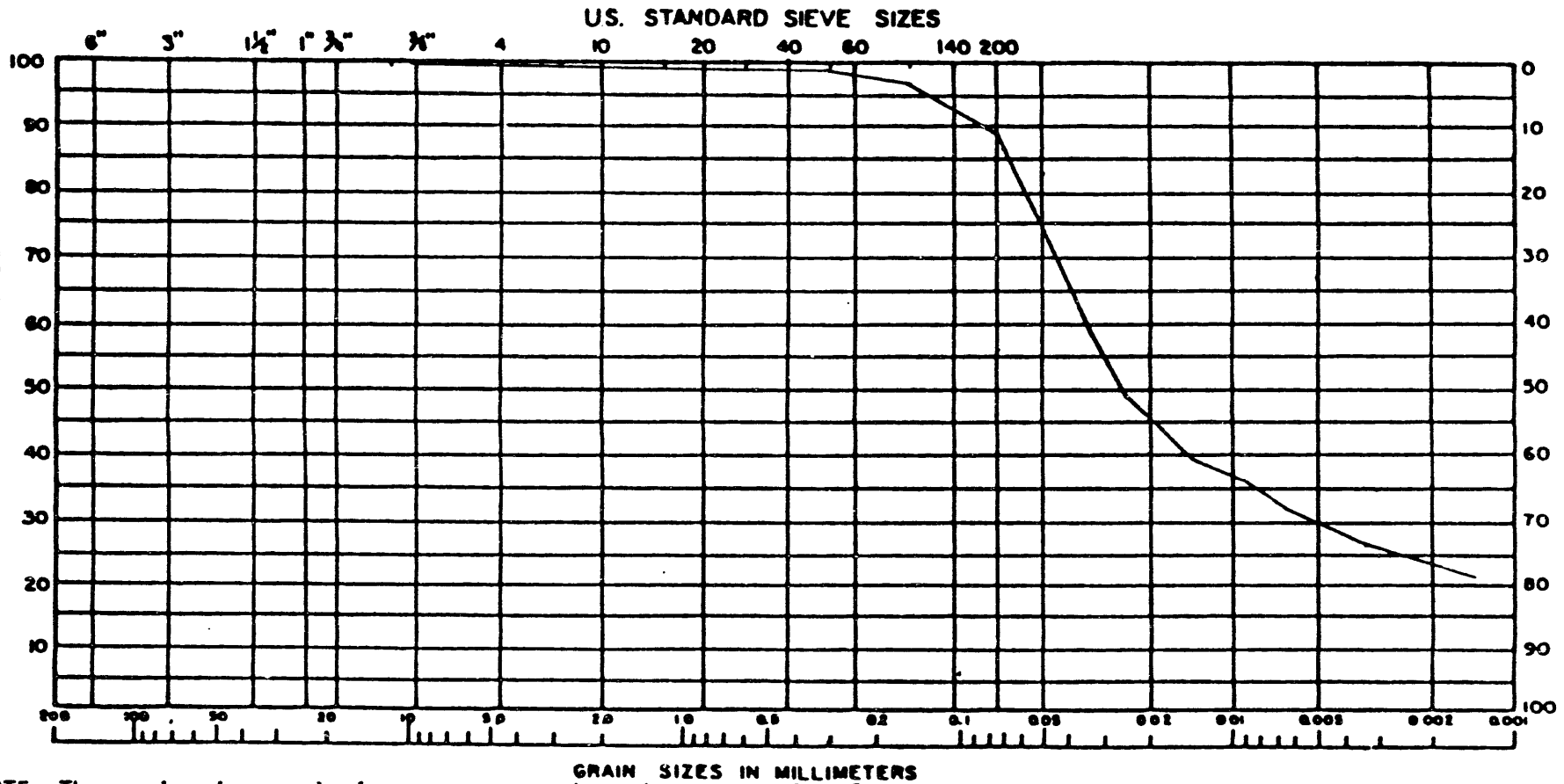
Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MET-5	2½'	--	--	--	--	1995
CLASSIFICATION						

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MET-5 at 8 Feet

LABORATORY SAMPLE NUMBER: 1996

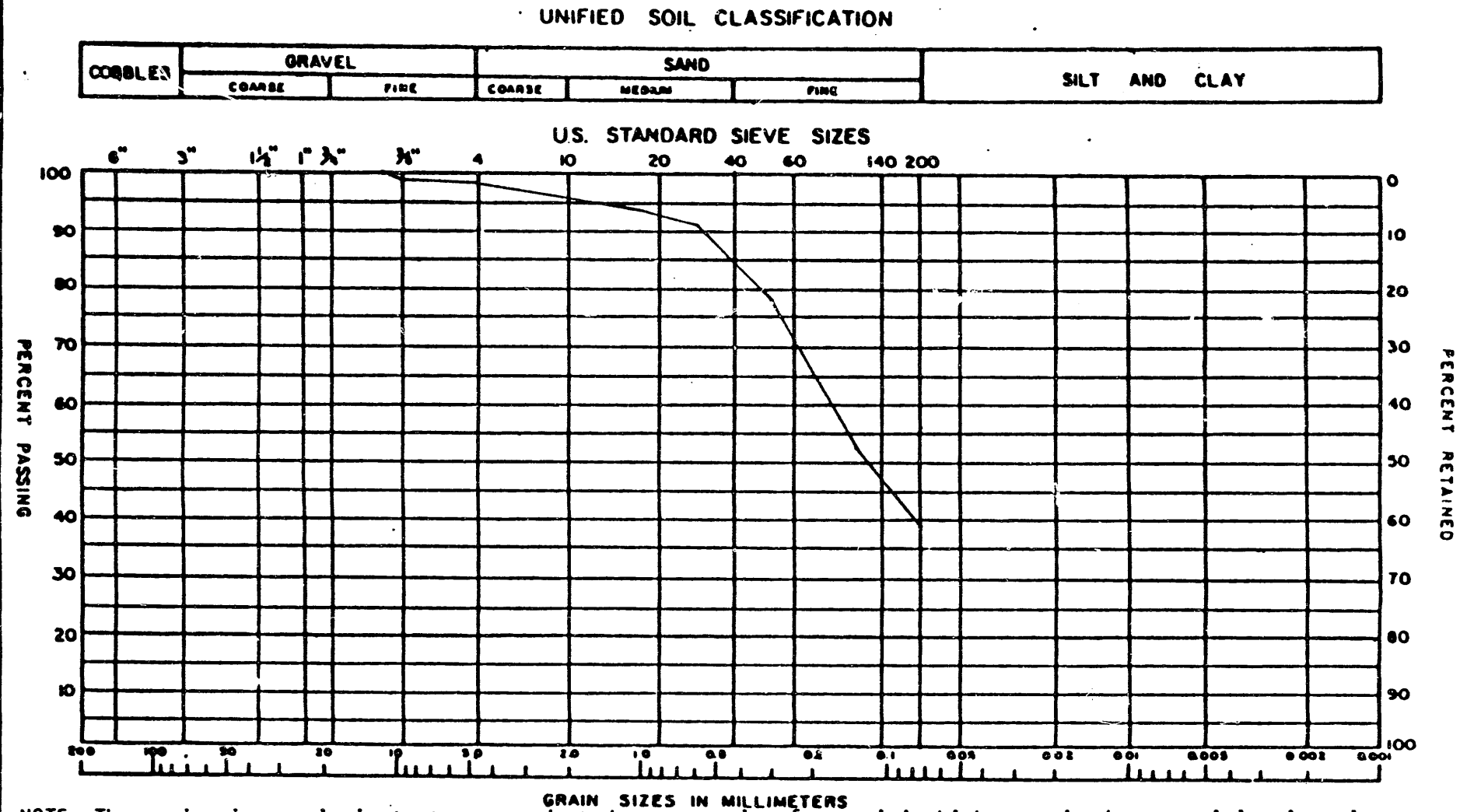
SAMPLE DESCRIPTION: Clay,sandy,(CL)

ATTERBERG LIMITS: Liquid Limit = 34
Plastic Limit = 16
Plasticity Index = 18

Project: Rifle-RFL-87-01

Job Number M97054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MET 5	10	--	--	---	9.8	1997
CLASSIFICATION	Sand, clayey, (SC)					

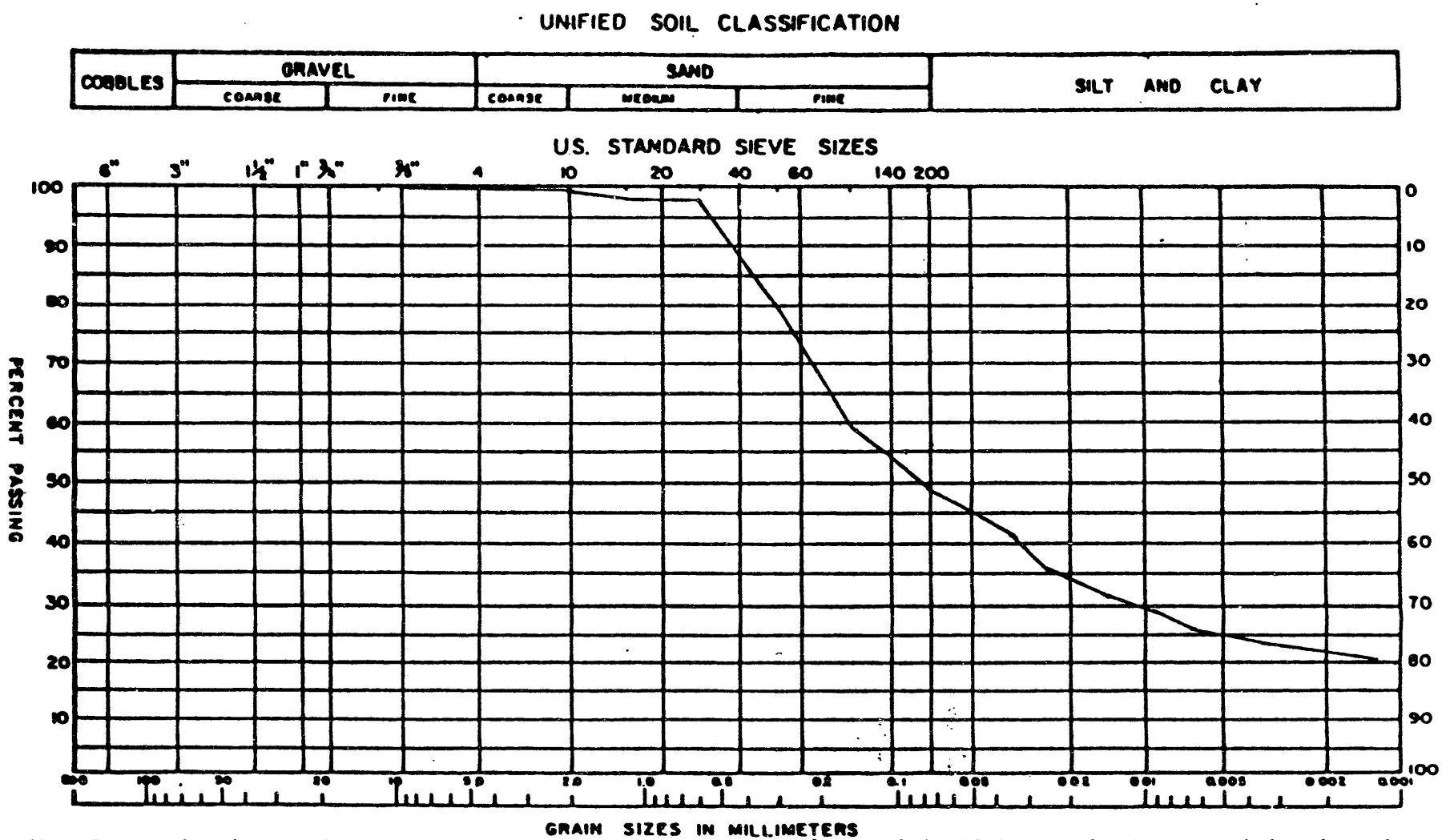
Fig.

Project: Rifle-RFL-87-91

Job Number: H87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

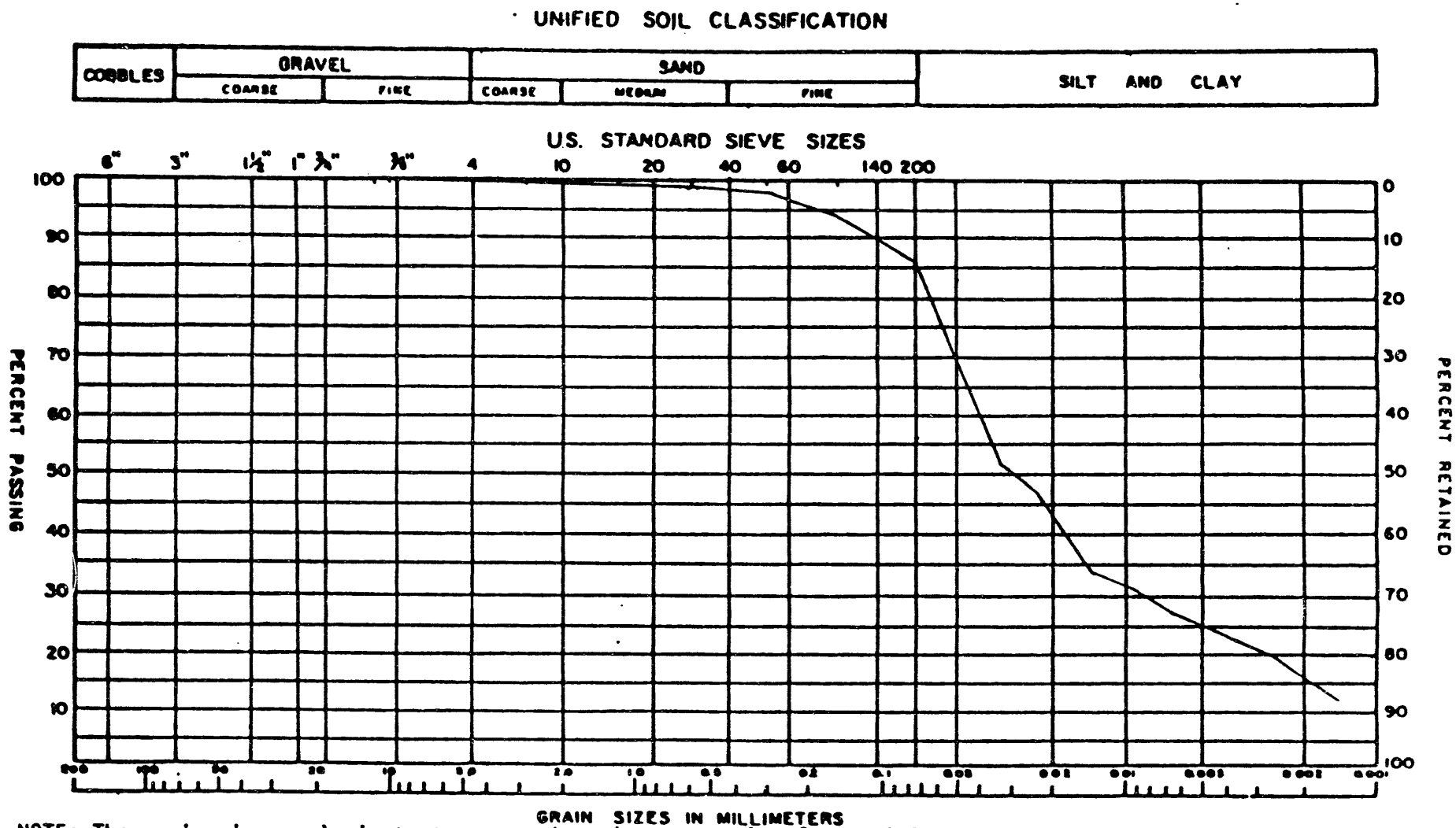
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MET-5	11½'	36	20	2.68	--	1998
CLASSIFICATION						
DISPERSION: 12 percent						

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 3/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

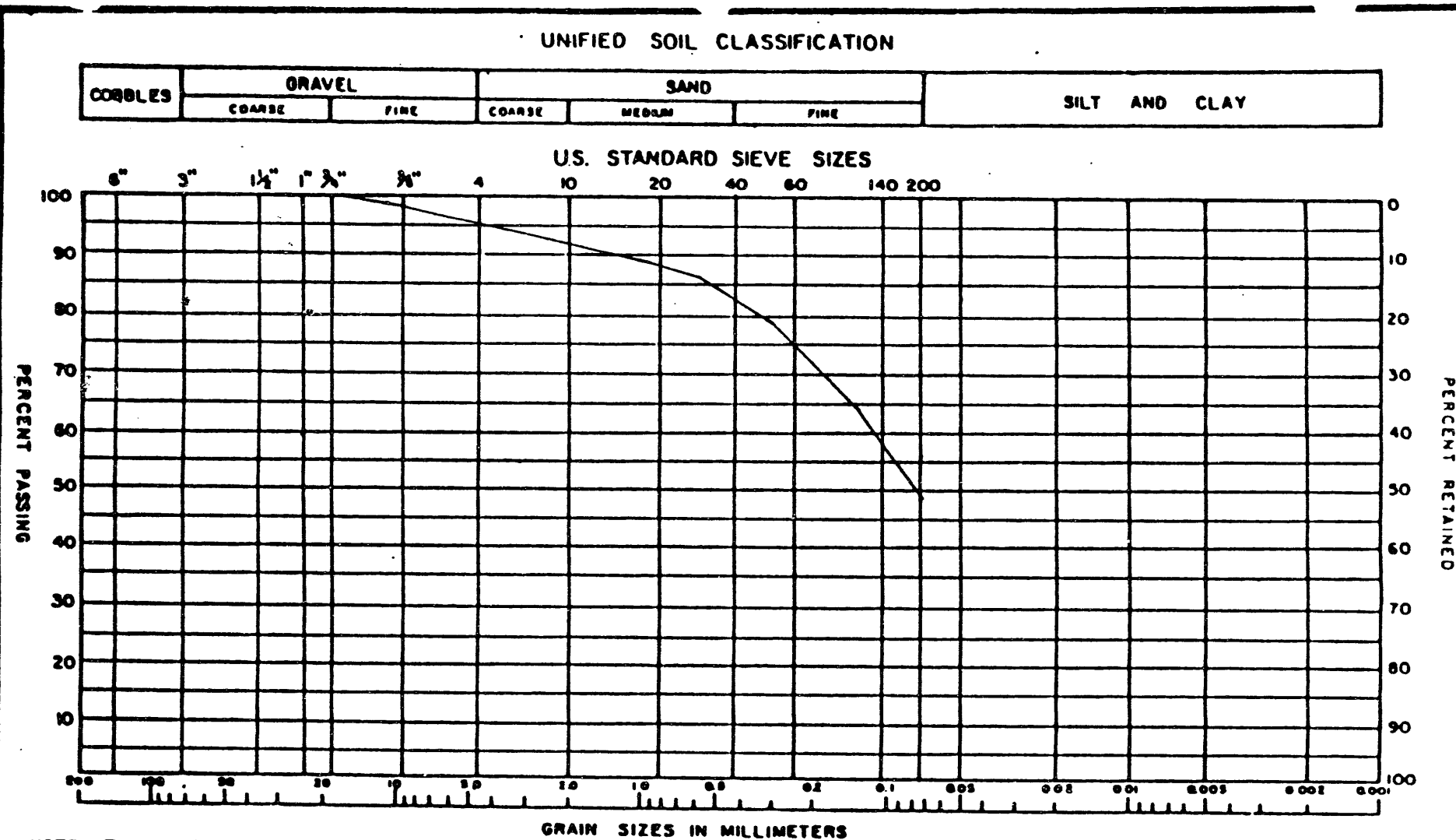
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MET-7	5'	--	--	--	7.9	2000
CLASSIFICATION						

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MET-8B	2 1/2	33	14	2.66	8.2	2001
CLASSIFICATION	Sand, very clayey, silty, slightly gravelly, (SC-CL)					

Project: Rifle-RFL-87-01

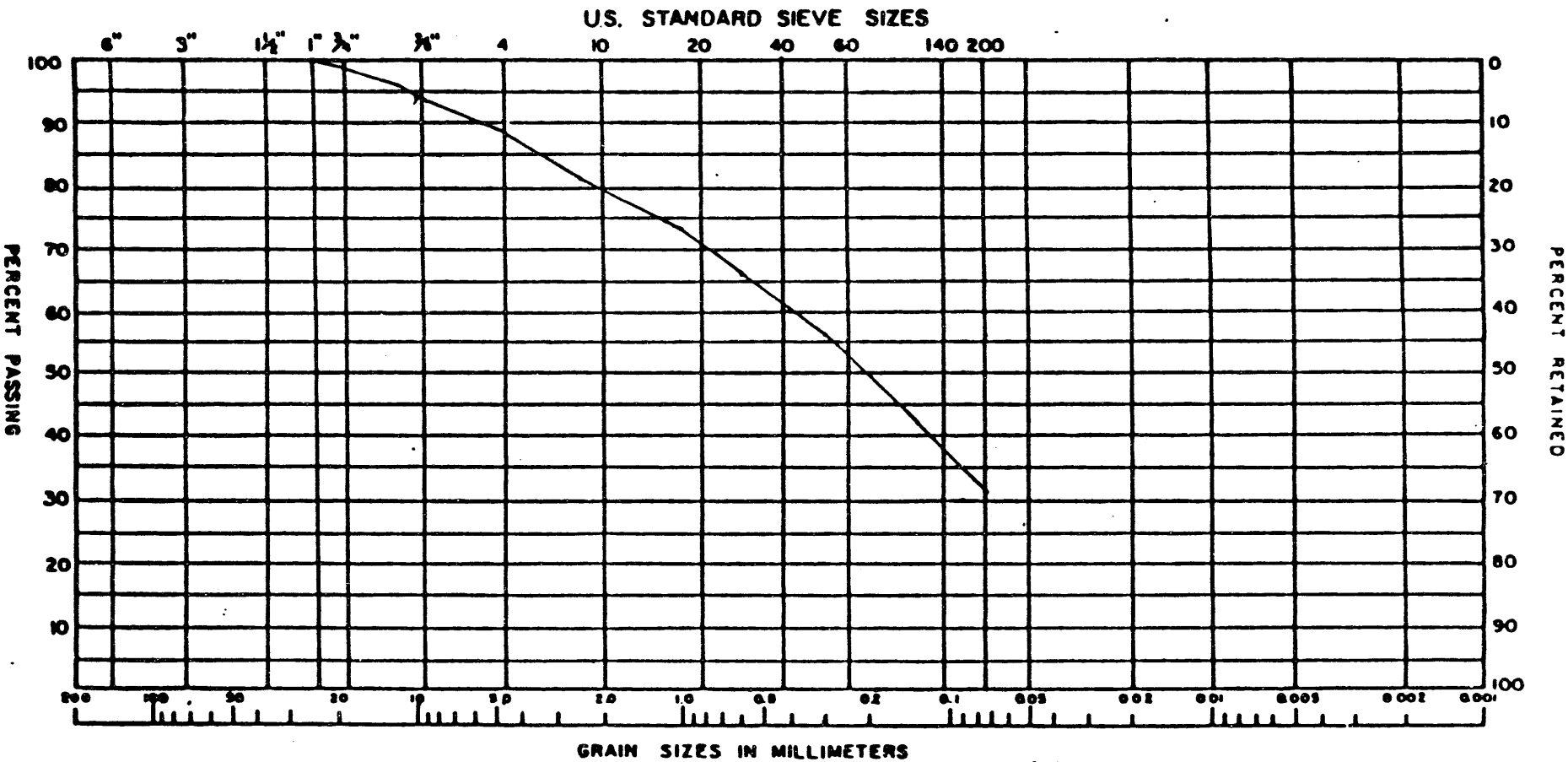
MA7054GF

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

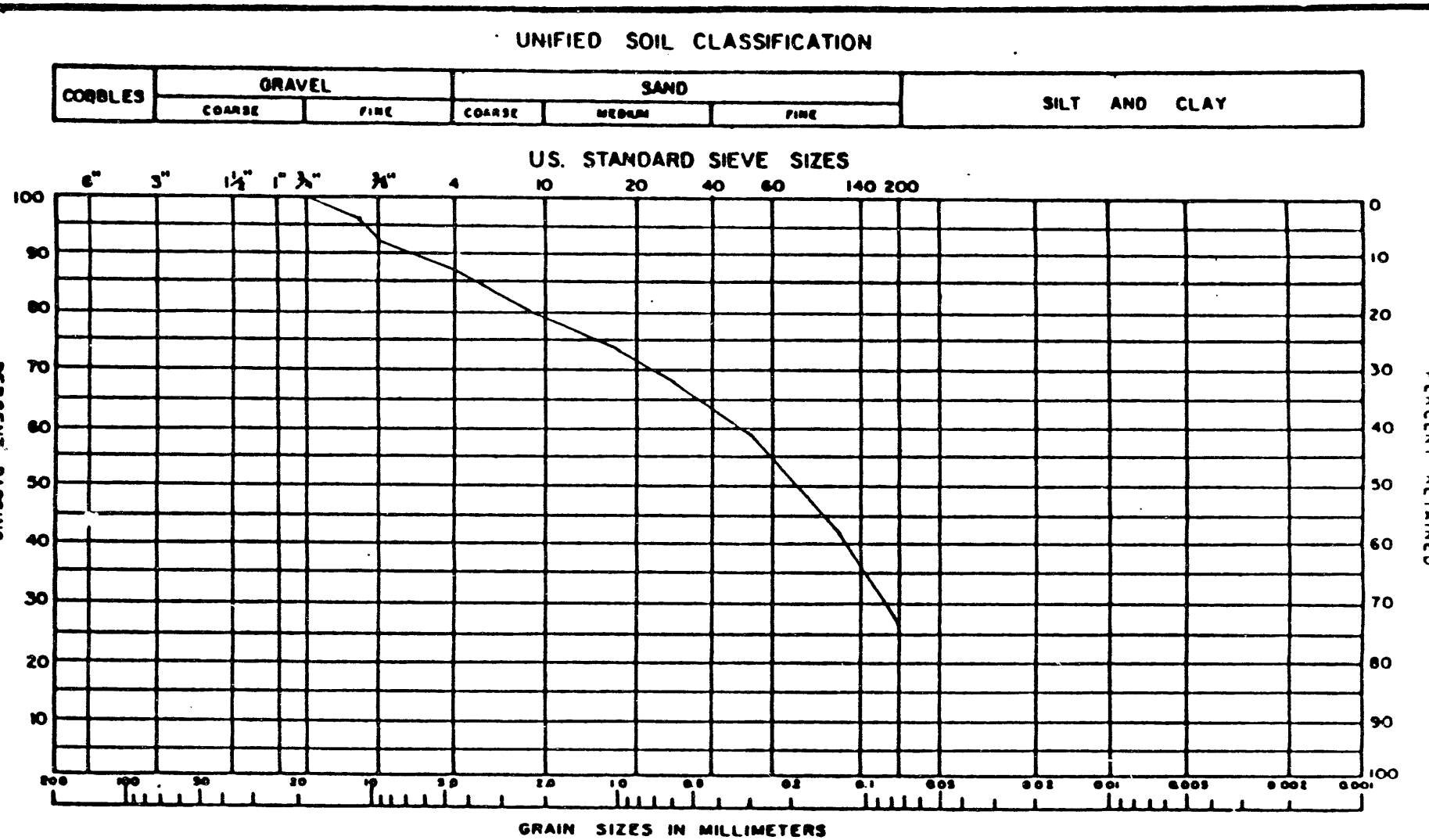
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MET-9	5	--	--	---	11.5	2002
CLASSIFICATION	Sand,clayey,slightly gravelly,(SC)					

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MET 11	2 1/2	--	--	---	---	2003
CLASSIFICATION	Sand, gravelly, clayey, (SC)					

TEST RESULTS SHEET

PROJECT: RFL-87-01

TEST HOLE: MET-11 at 7 1/2 feet

LABORATORY SAMPLE NUMBER: 2004

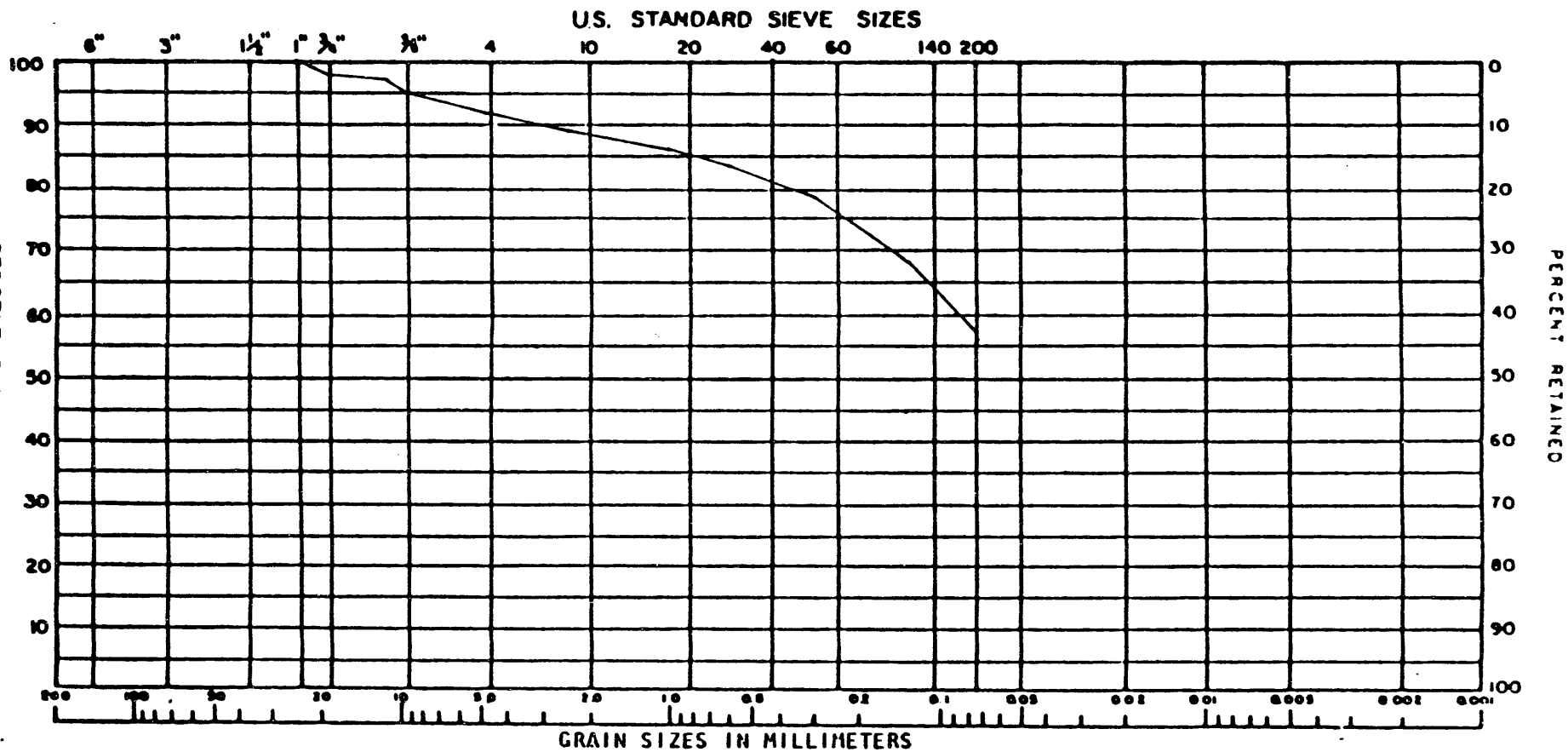
INITIAL MOISTURE CONTENT: 12.7 percent

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MET-11	7 1/2	--	--	2.66	12.0	2005
CLASSIFICATION	Clay, sandy, slightly gravelly, (CL)					

Project: Rifle-RFL-87-01

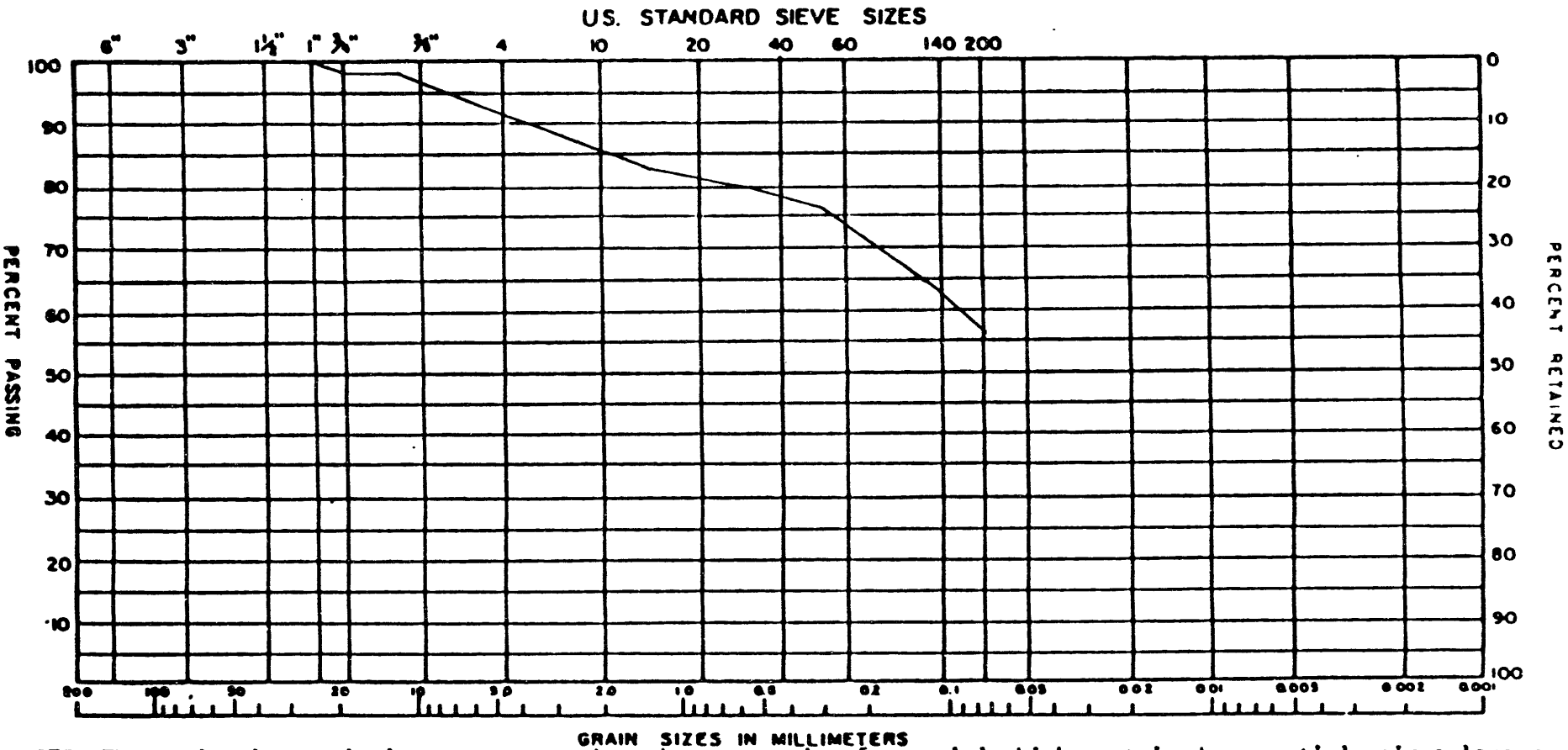
M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

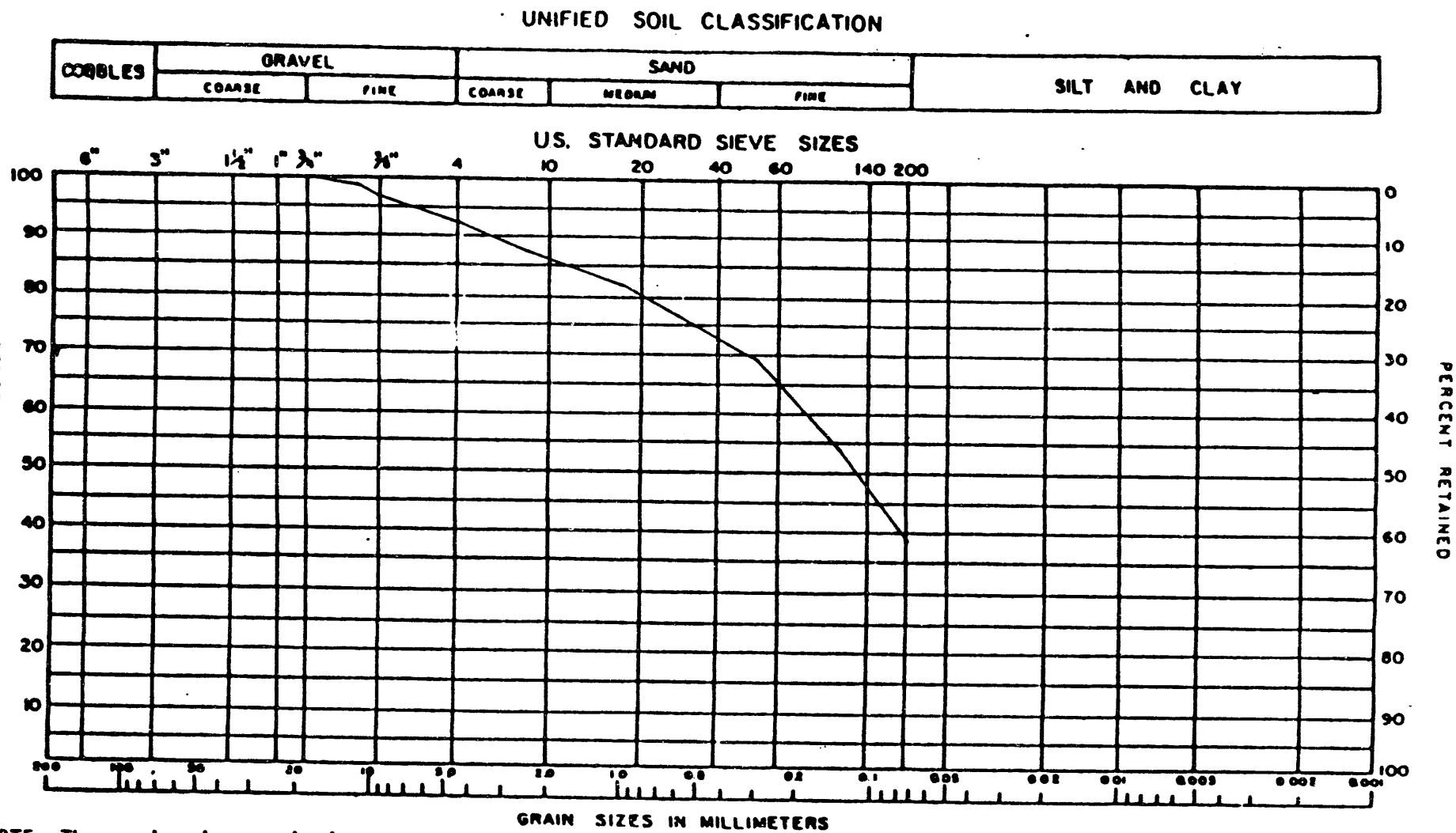
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MET-12	Surface	--	--	---	7.8	2006
CLASSIFICATION	Clay, sandy, slightly gravelly, (CL)					

Project: Rifle-RFL-87-01

Job Number: M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MET-12	1-2	--	--	2.69	8.9	2007
CLASSIFICATION	Sand, clayey, slightly gravelly, (SC)					

Project: Rifle-RFL-87-01

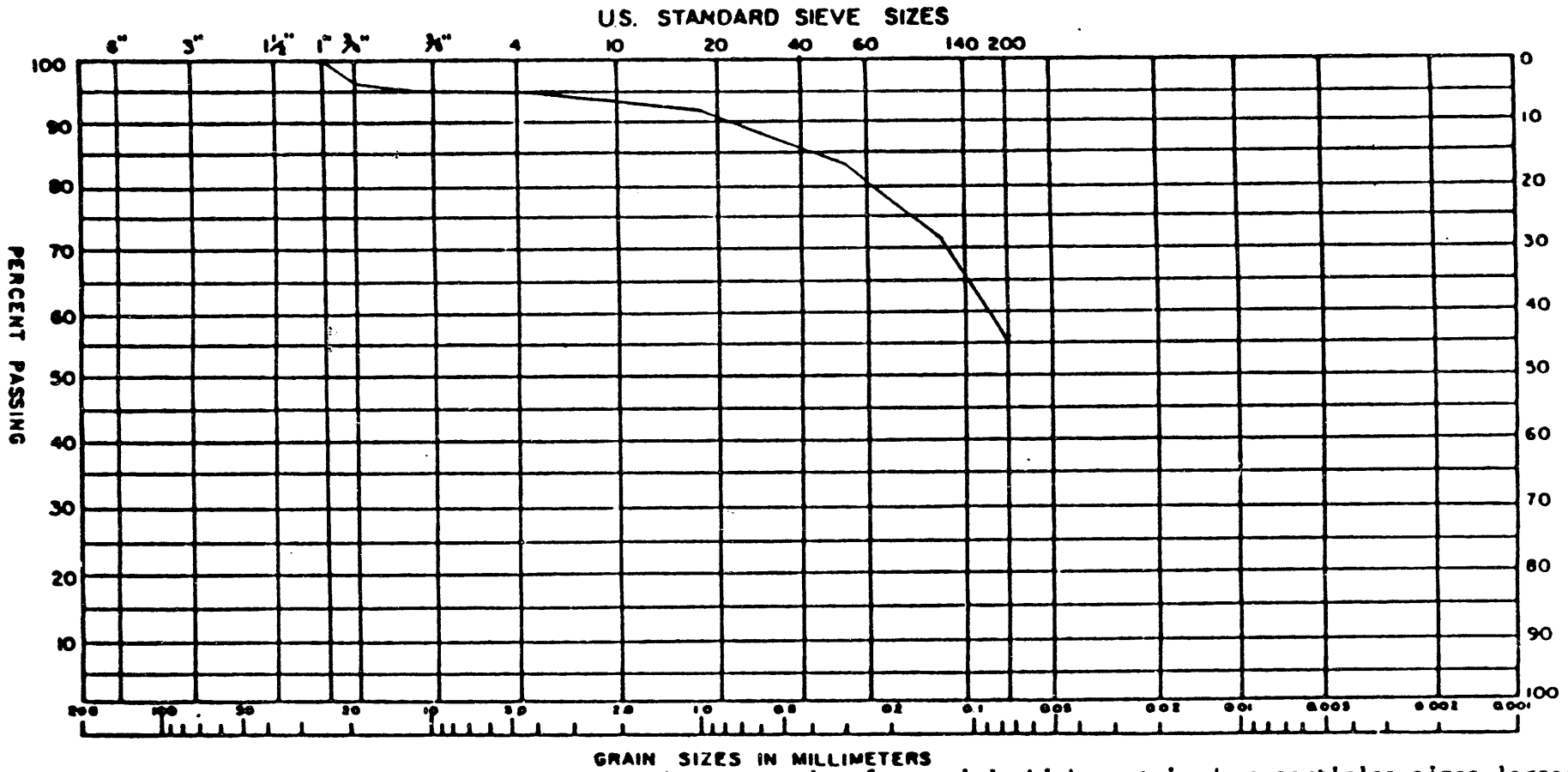
Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig:

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



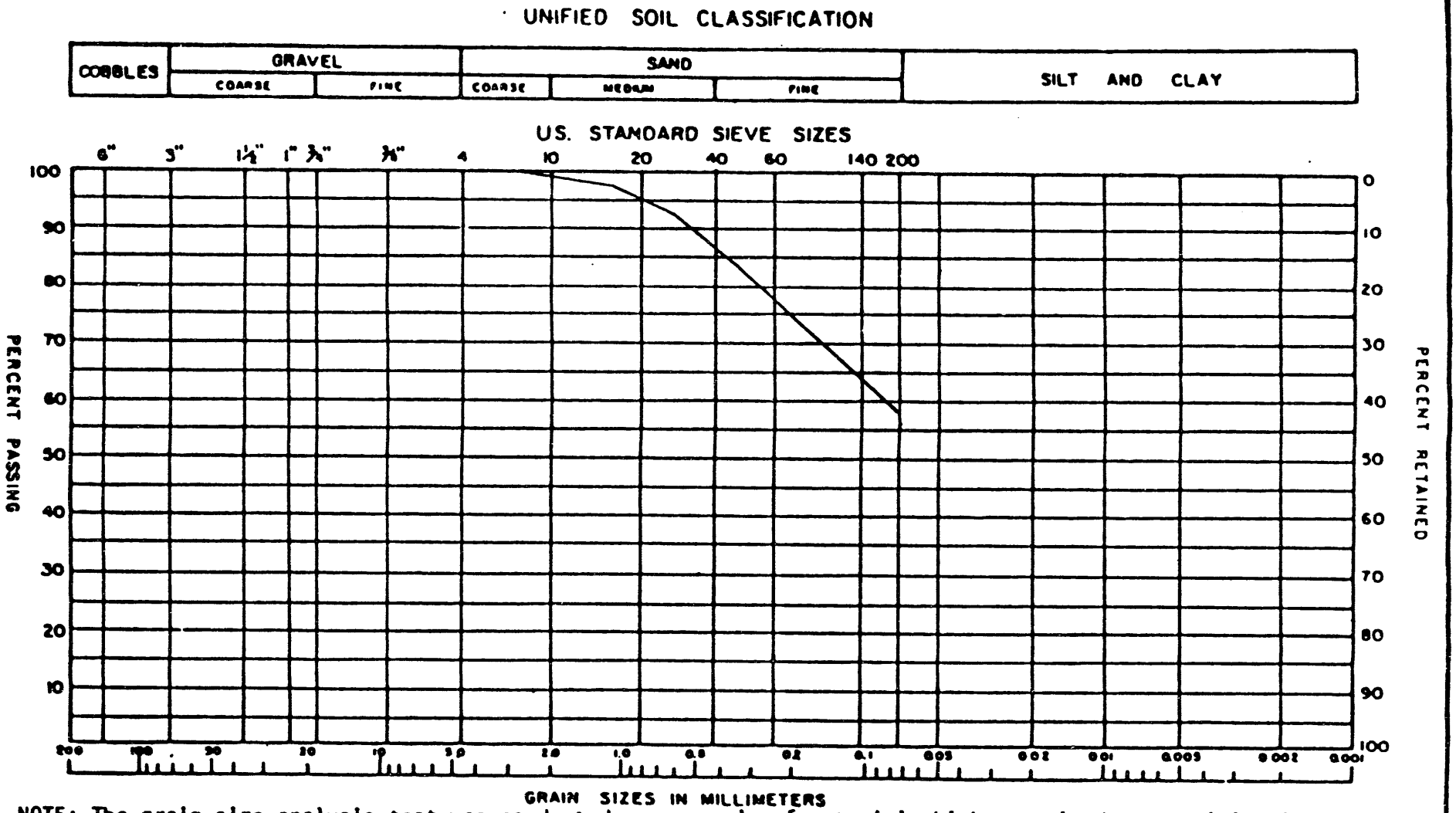
NOTE: The grain size analysis test was conducted on a sample of material which contained no particles sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LAB NUMBER
MEBT 14	2 1/2	--	--	---	8.9	2008
CLASSIFICATION	Clay, very sandy, slightly gravelly, (CL-SC)					

Project: Rifle-RFL-87-01

Job Number M87054GE

GRAIN SIZE DISTRIBUTION CURVES



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1/4 inch. The in situ soils may contain particles larger than indicated by the grain size analysis test.

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
Estes Gulch	Turnoff	--	--	--	1.9	2150
CLASSIFICATION	Silt,sandy (ML)					

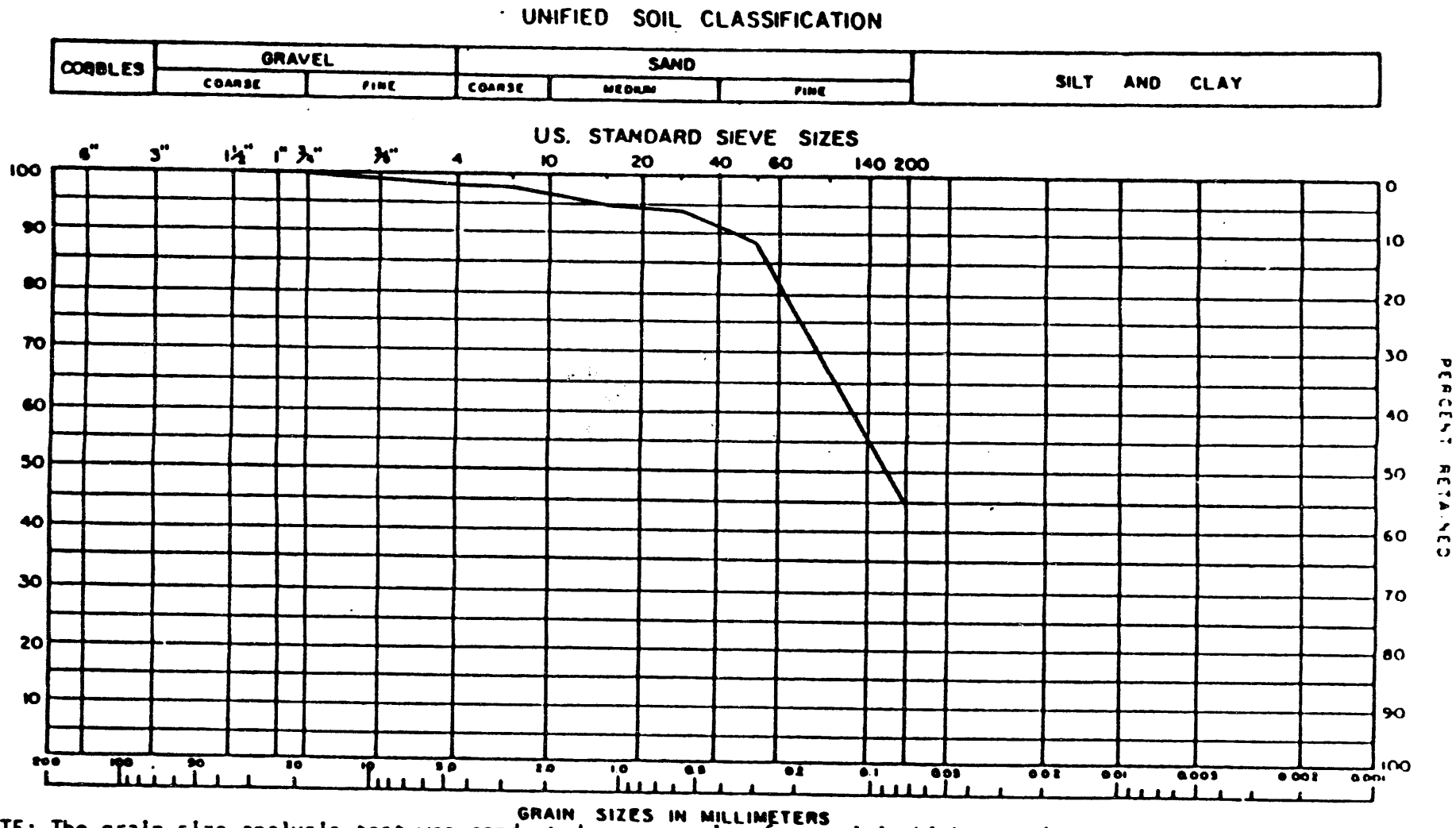
Fig

Project: Rifle-RFL-87-01

Job Number 1570546E

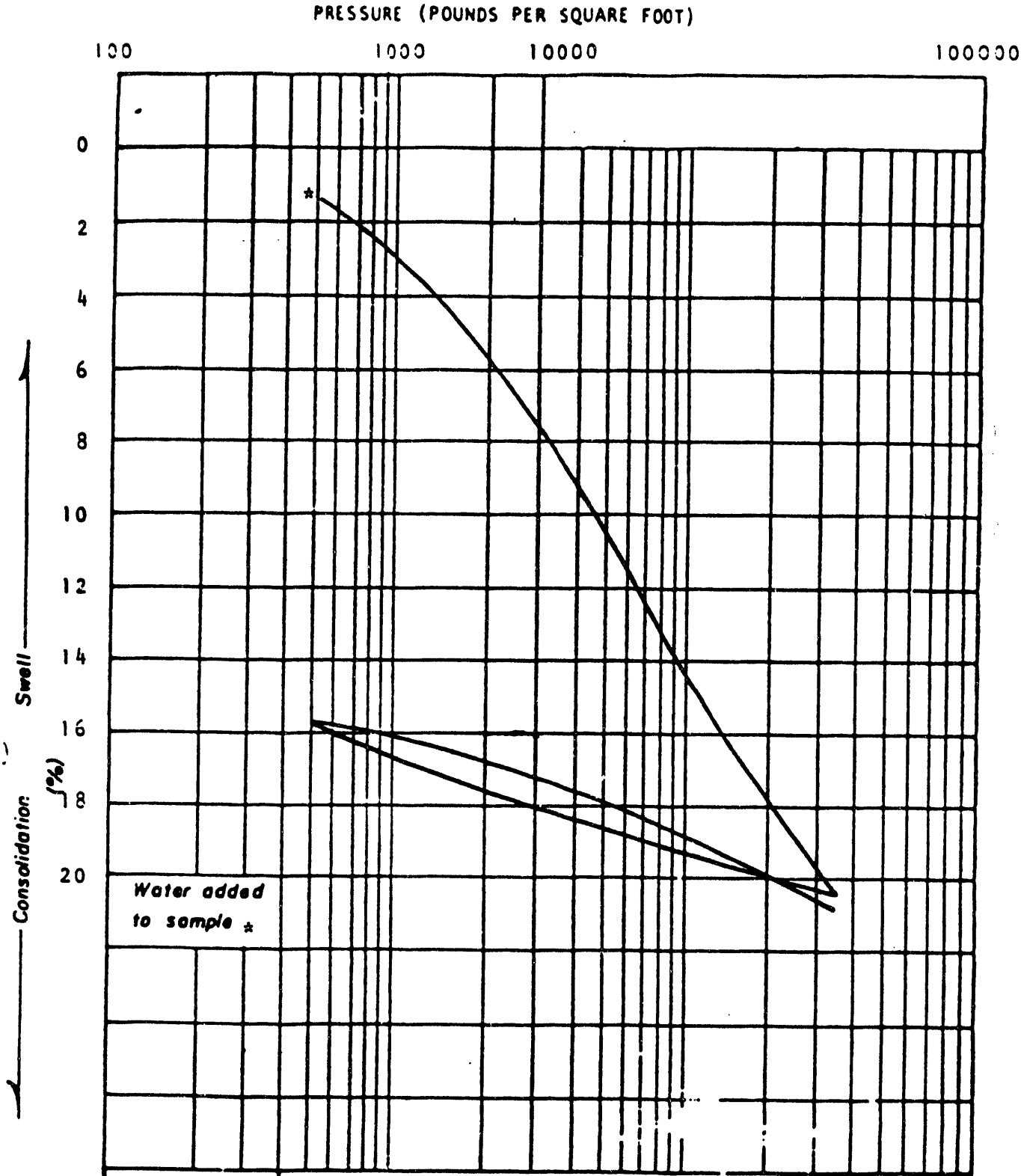
GRAIN SIZE DISTRIBUTION CURVES

Fig



NOTE: The grain size analysis test was conducted on a sample of material which contained no particle sizes larger than 1 1/2 inches. The in situ soils may contain particles larger than indicated by the grain size analysis test.

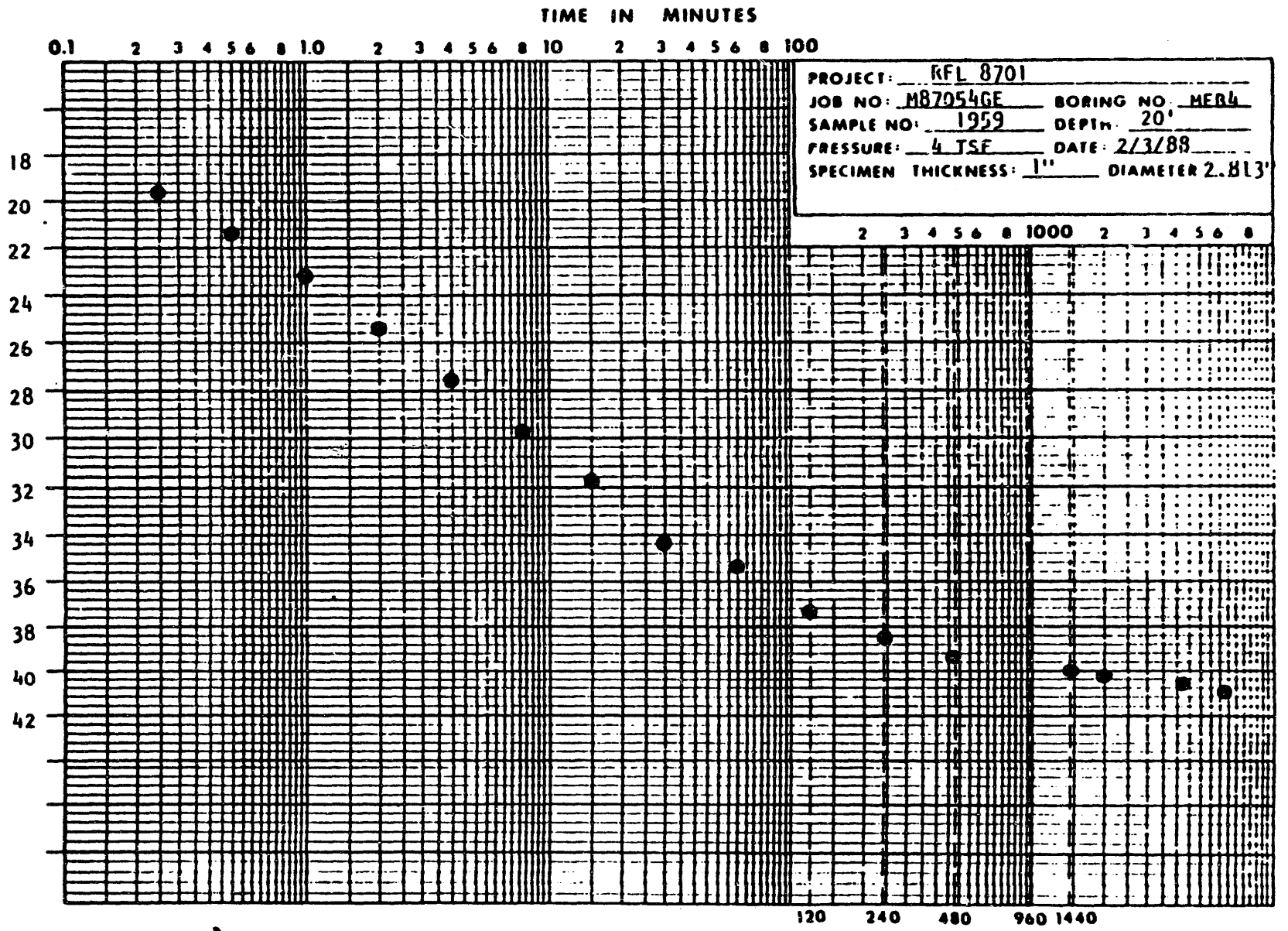
TEST HOLE NO.	DEPTH SAMPLE NO.	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
Estes Gulch Turnoff	2	--	--	--	4.3	2151
CLASSIFICATION						



Boring No. M-E34 Depth 20 ft.	SUMMARY OF TEST RESULTS				
	Moisture Content (%)	Dry Density (P.C.F.)	Height (in.)	Diameter (in.)	Swell Pressure (P.S.F.)
Initial	6.8	110	1"	2.813	
Final	14.5	140	--	2.813	--
Soil Description					

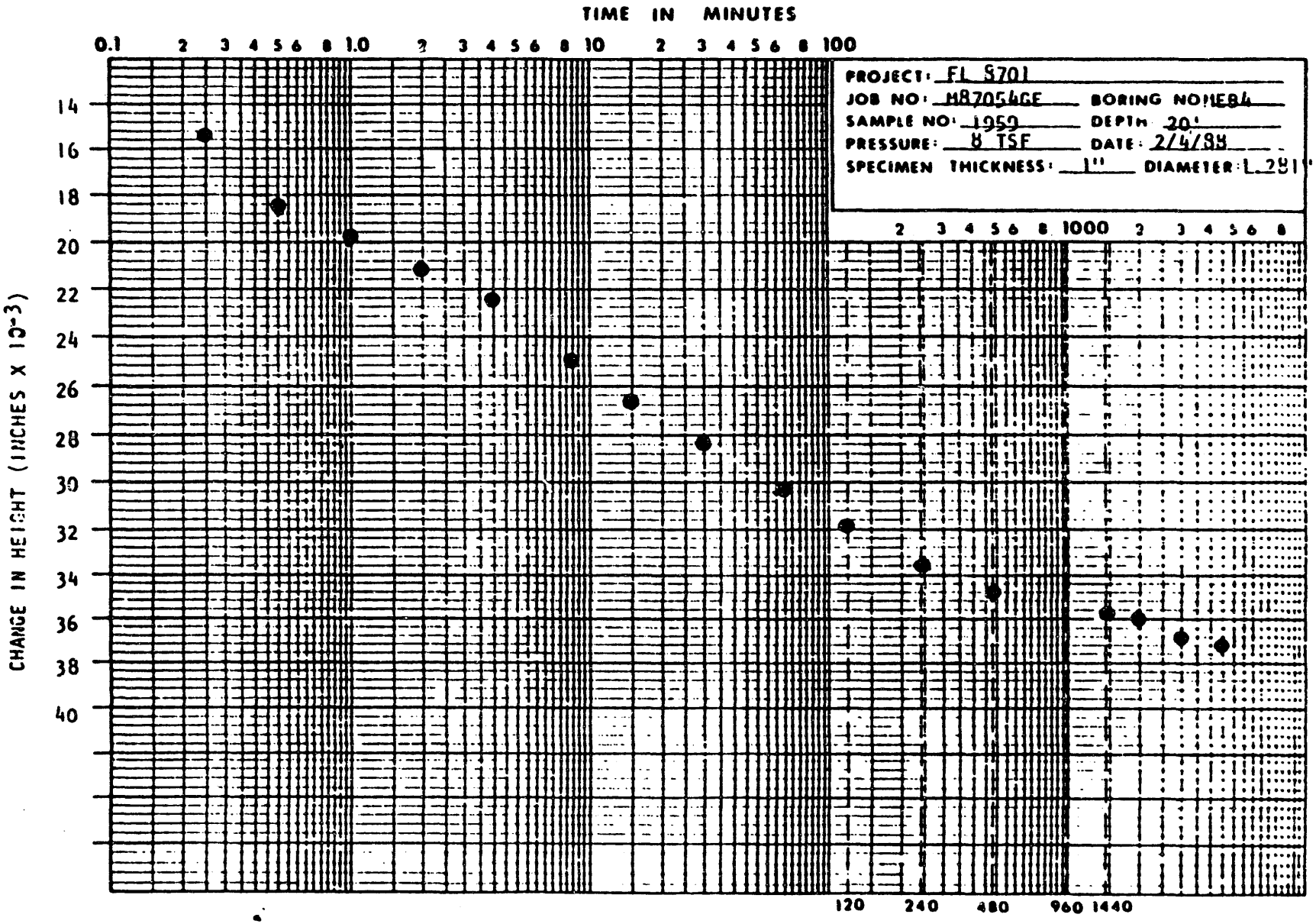
LABORATORY SAMPLE NUMBER: 1959

SWELL - CONSOLIDATION TEST	Project No.: M87054GE
Lambert and Associates	Date:
	Figure:



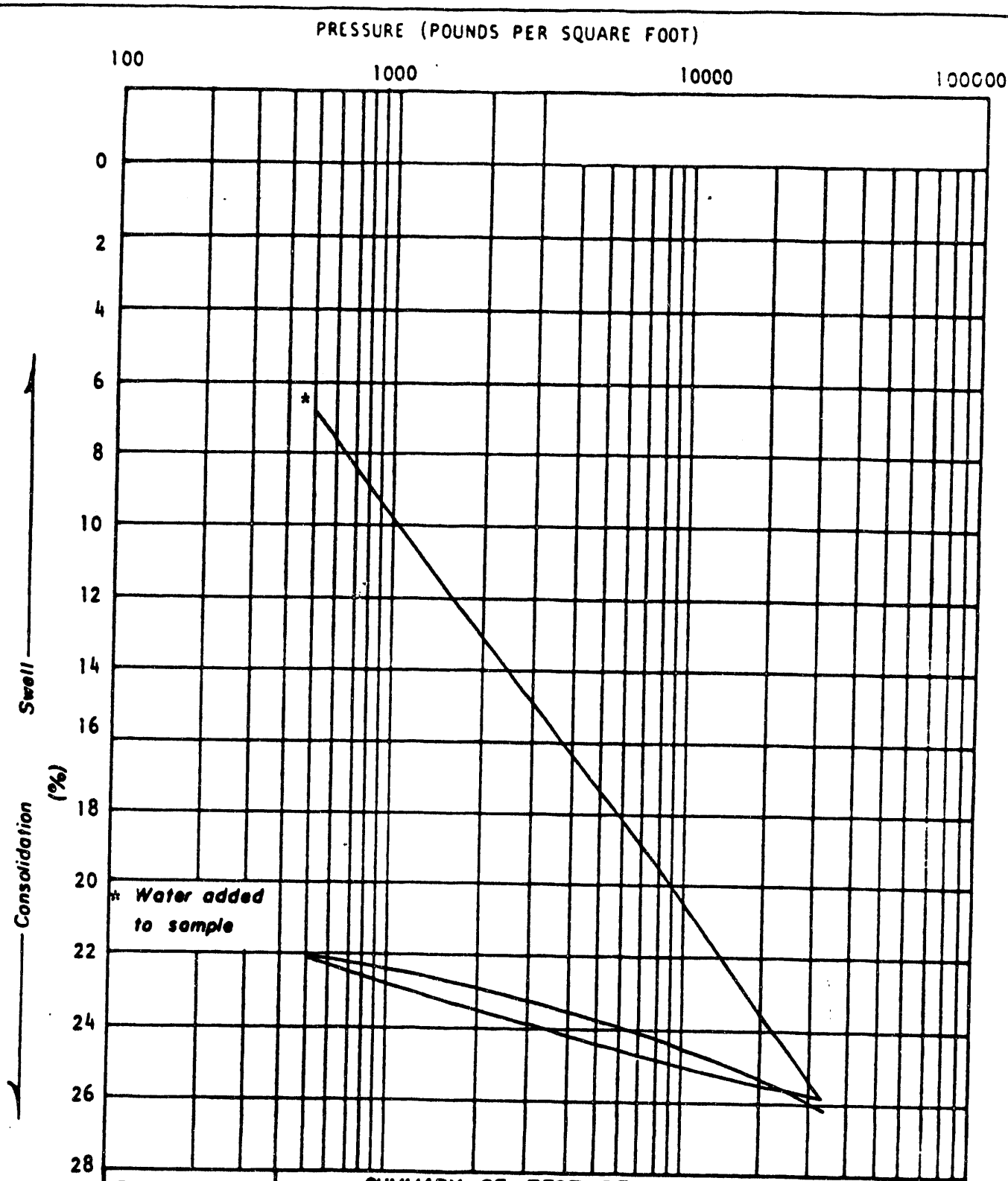
Lambert and Associates

Project No.: M3705-35
Date:



Lambert and Associates

Project No.: M87054GE
Date:
Figure:



Boring No. MEB5 Depth 15'	SUMMARY OF TEST RESULTS				
	Moisture Content (%)	Dry Density (P.C.F.)	Height (in.)	Diameter (in.)	Swell Pressure (P.S.F.)
Initial	6.1	102	1.0	2.8125	
Final	14.6	137	.7381	2.8125	
Soil Description					

LABORATORY SAMPLE NUMBER: 1903

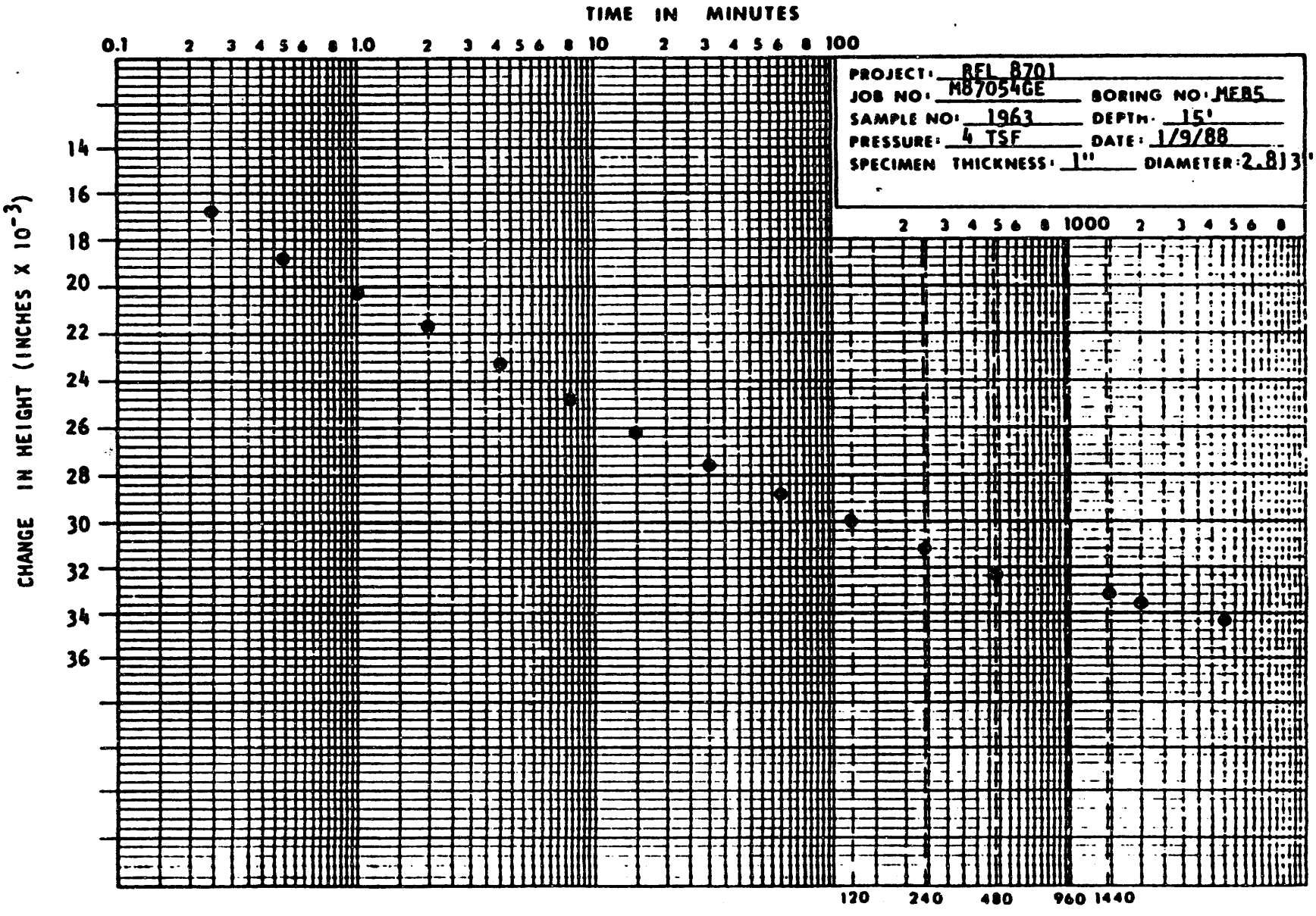
SWELL - CONSOLIDATION TEST

Lambert and Associates

Project No.: M87054E

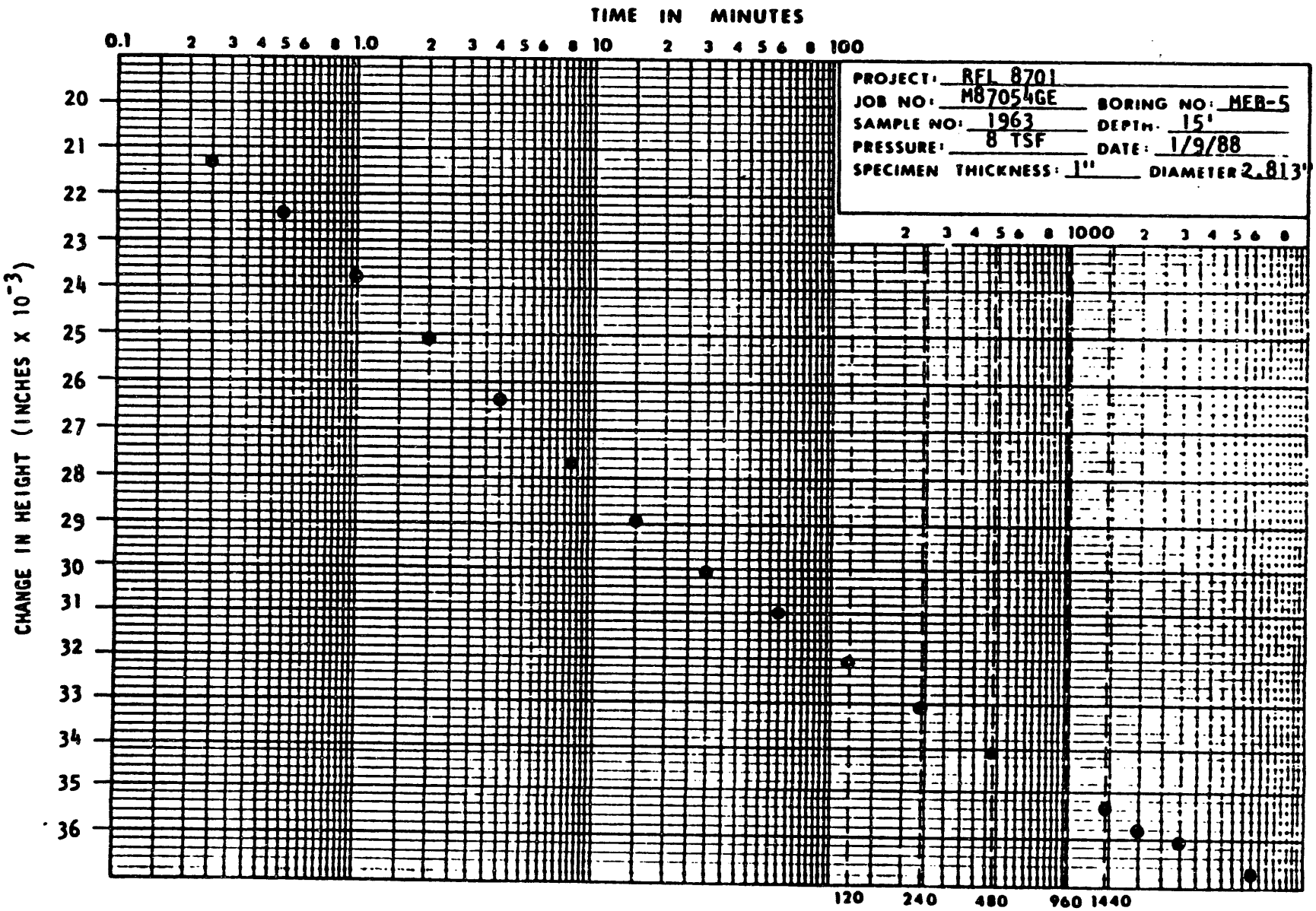
Date:

Figure:



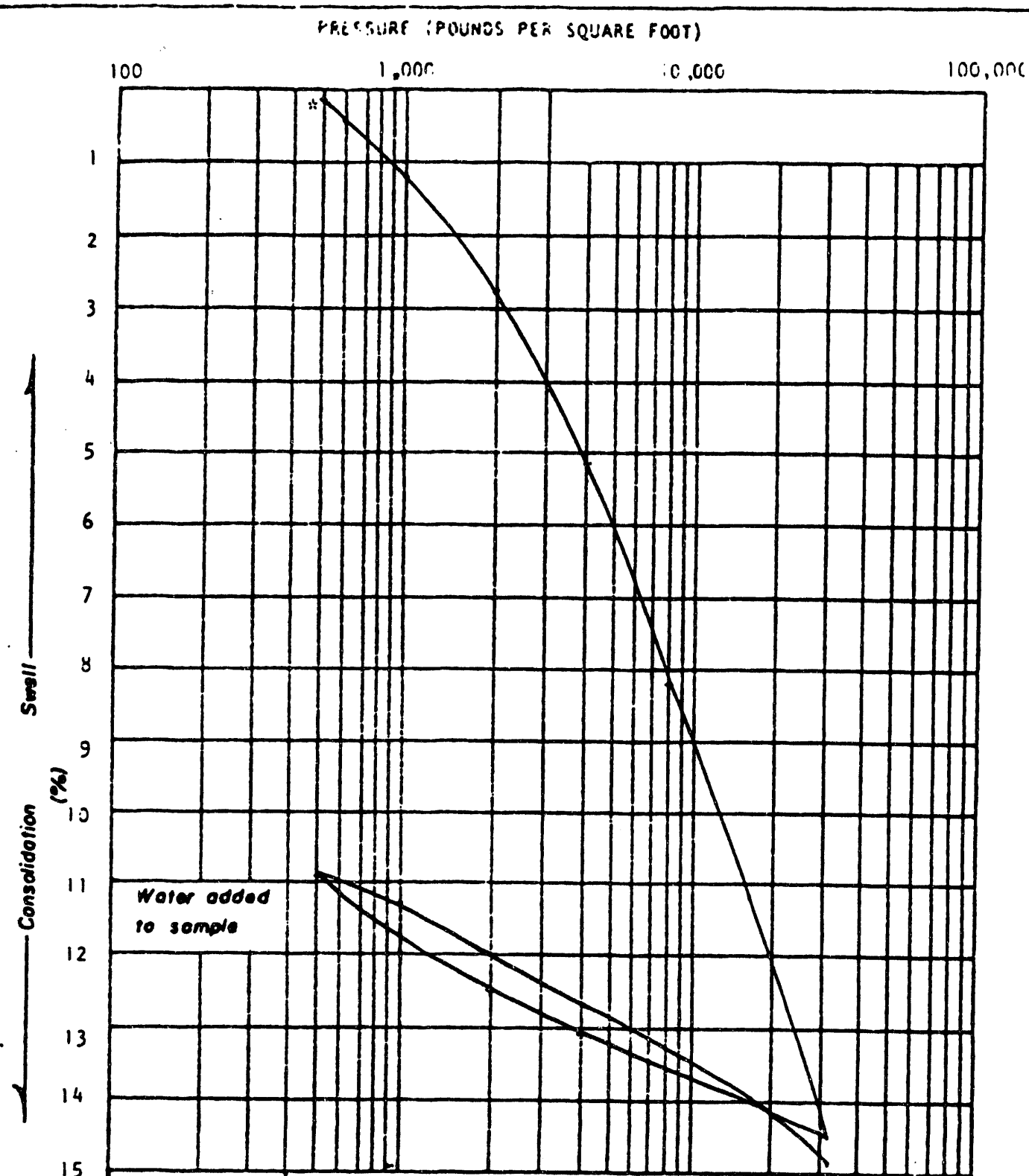
Lambert and Associates

Project No.: M87054GE
Date:
Figure:



Lambert and Associates

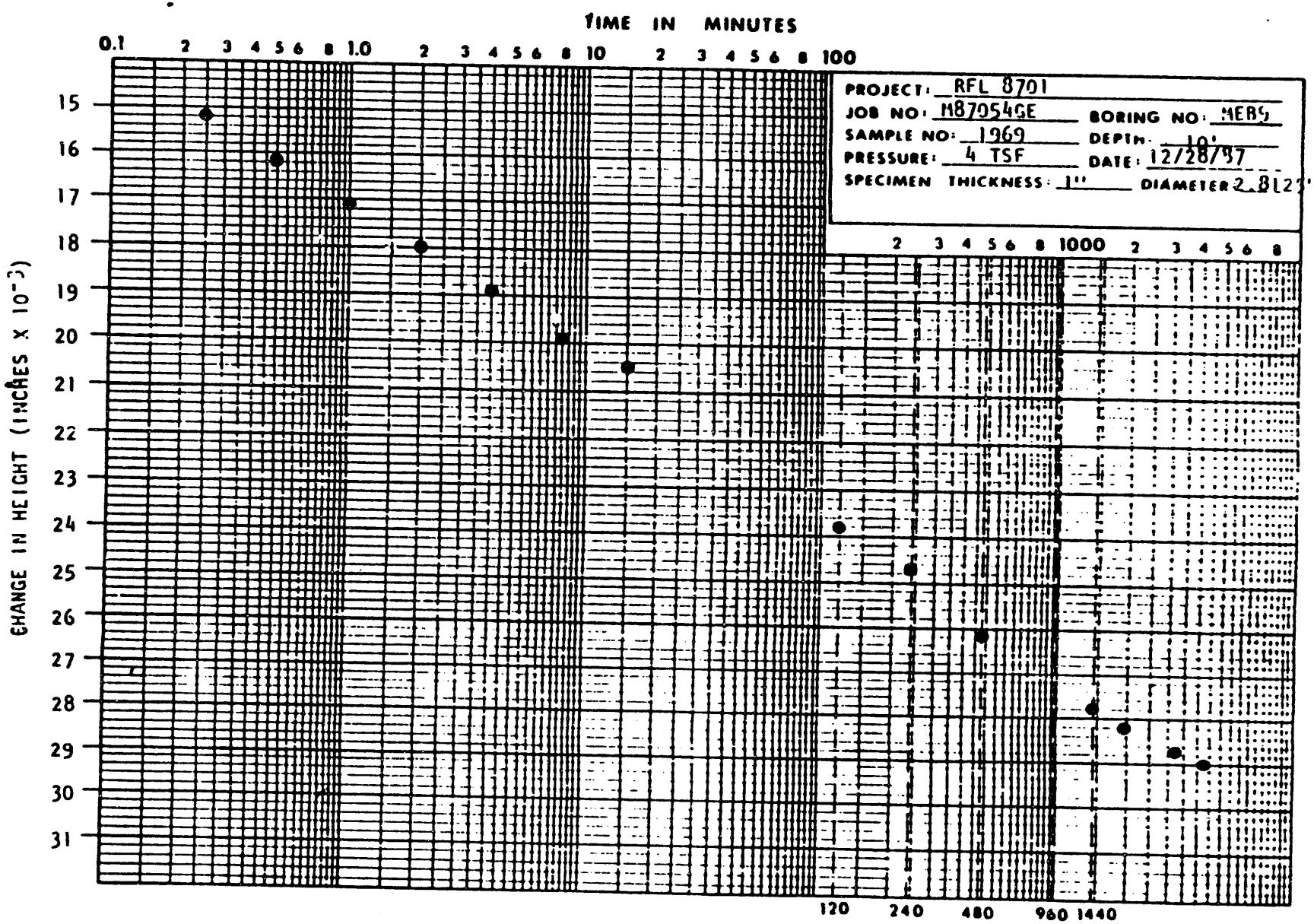
Project No.: M87054GE
Date:
Figure:



Boring No. MEB9	SUMMARY OF TEST RESULTS				
Depth 10 ft.	Moisture Content (%)	Dry Density (P.C.F.)	Height (in.)	Diameter (in.)	Swell Pressure (P.S.F.)
Initial	4.5	113	1.0	2.8125	--
Final	15.5	133	.851	2.8125	
Soil Description					

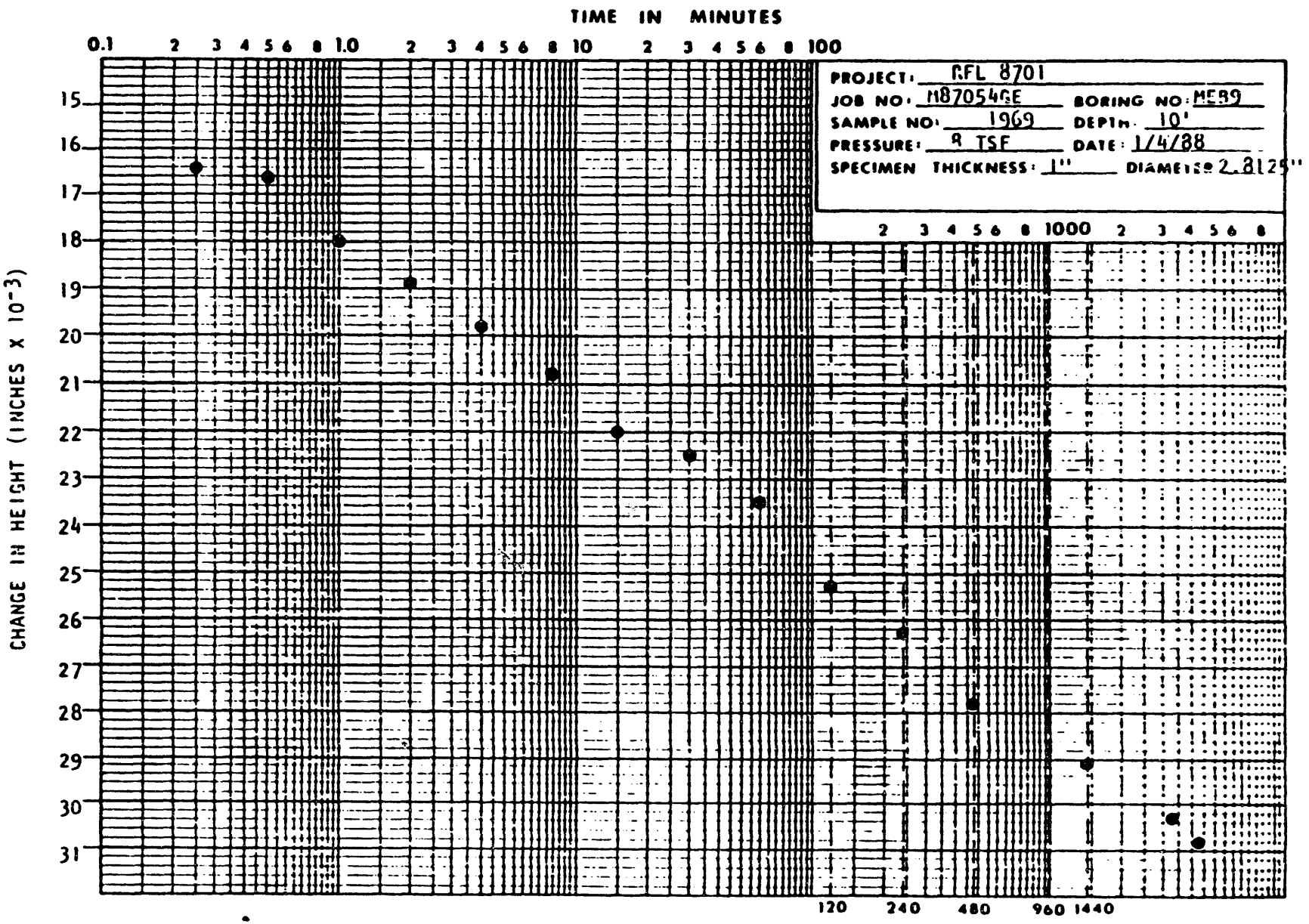
LABORATORY SAMPLE NUMBER: 1969

SWELL - CONSOLIDATION TEST	Project No.: M87054GE
Lambert and Associates	Date:
	Figure:



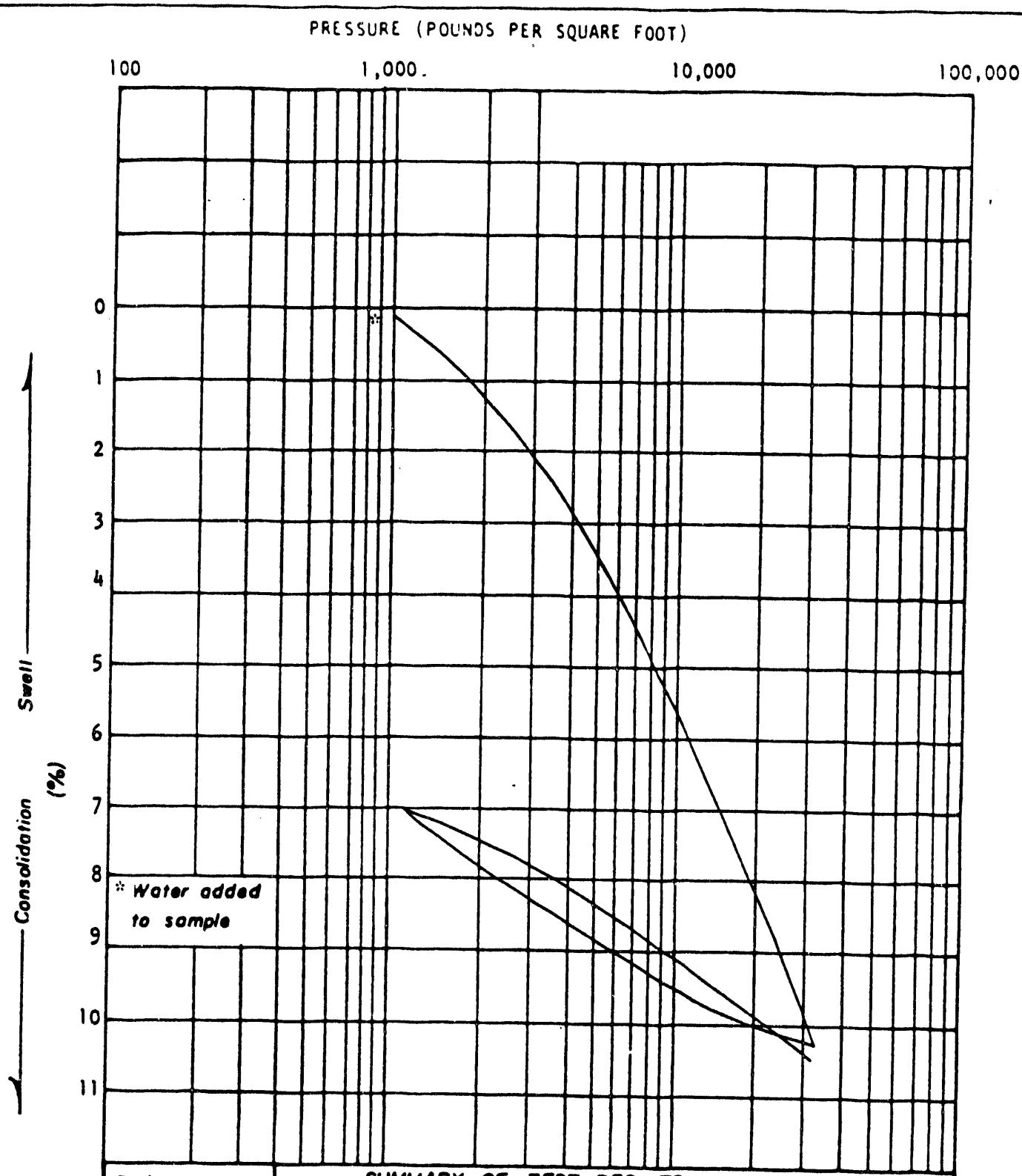
Lambert and Associates

Project No.: M87054GE
Date:
Figure:



Lambert and Associates

Project No.: M87054GE
Date:
Figure:



Boring No. MEB11 Depth 27½'	SUMMARY OF TEST RESULTS				
	Moisture Content (%)	Dry Density (P.C.F.)	Height (in.)	Diameter (in.)	Swell Pressure (P.S.F.)
Initial	7.4	117	1.0	2.5	
Final	14.3	127	.896	2.5	
Soil Description					

LABORATORY SAMPLE NUMBER: 1980

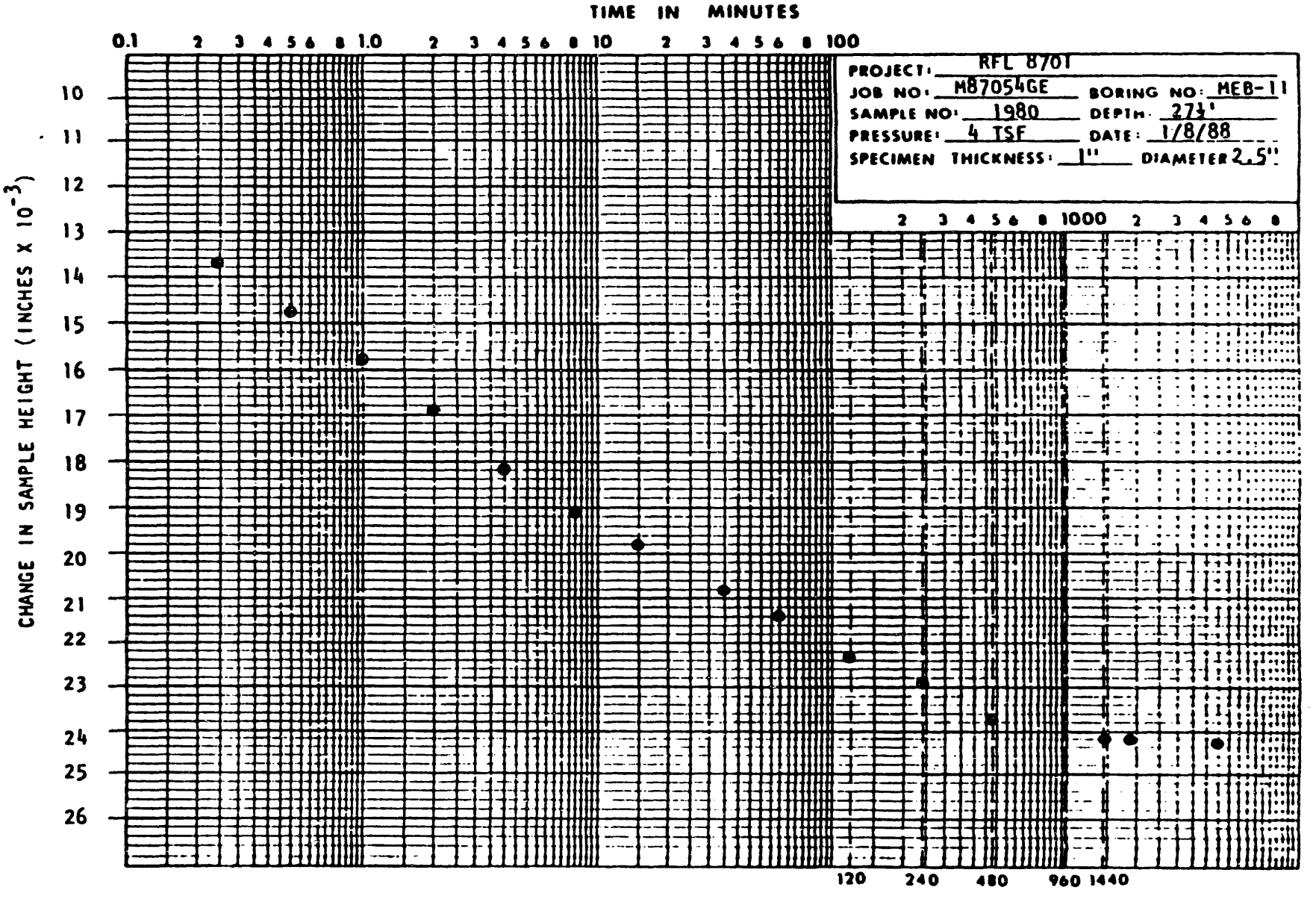
SWELL - CONSOLIDATION TEST

Lambert and Associates

Project No.: M87054GE

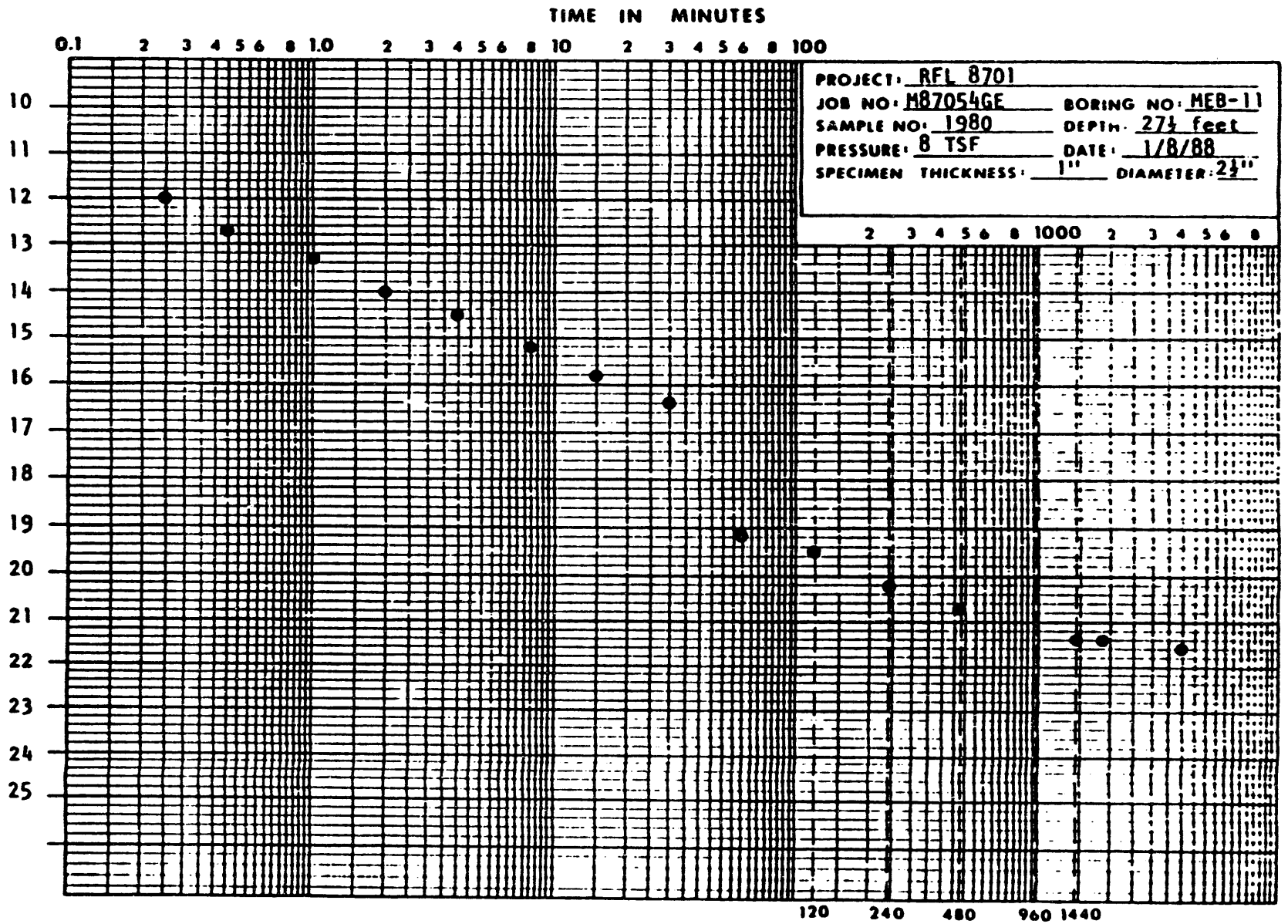
Date:

Figure:



Lambert and Associates

Project No.: M87054GE
Date:
Figure:

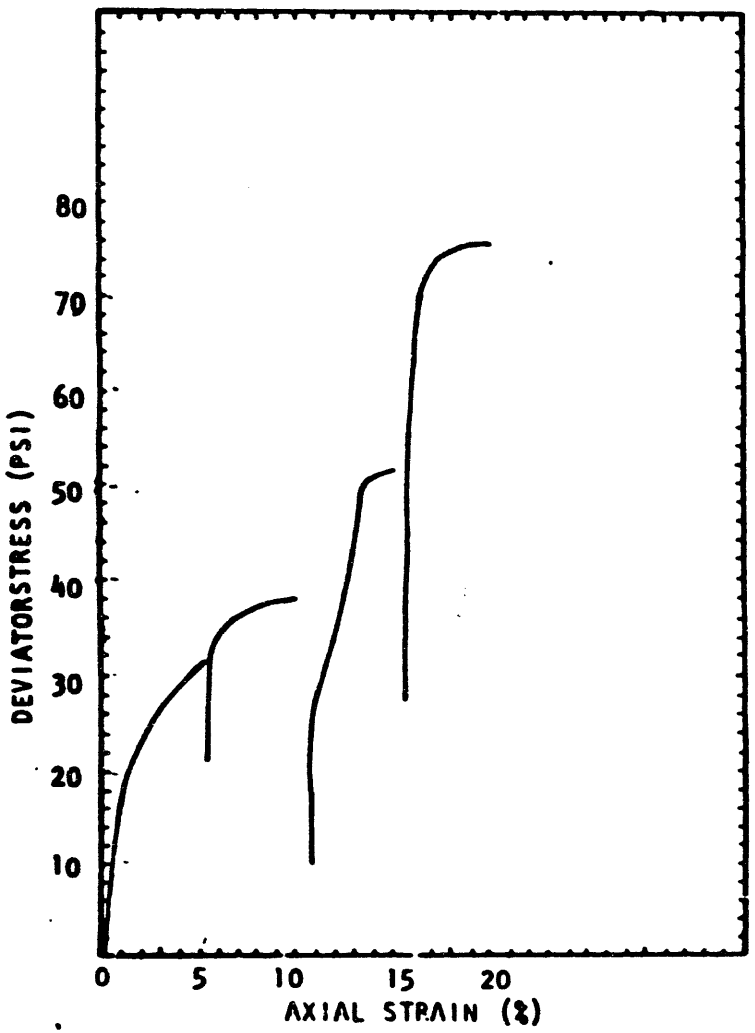


Lambert and Associates

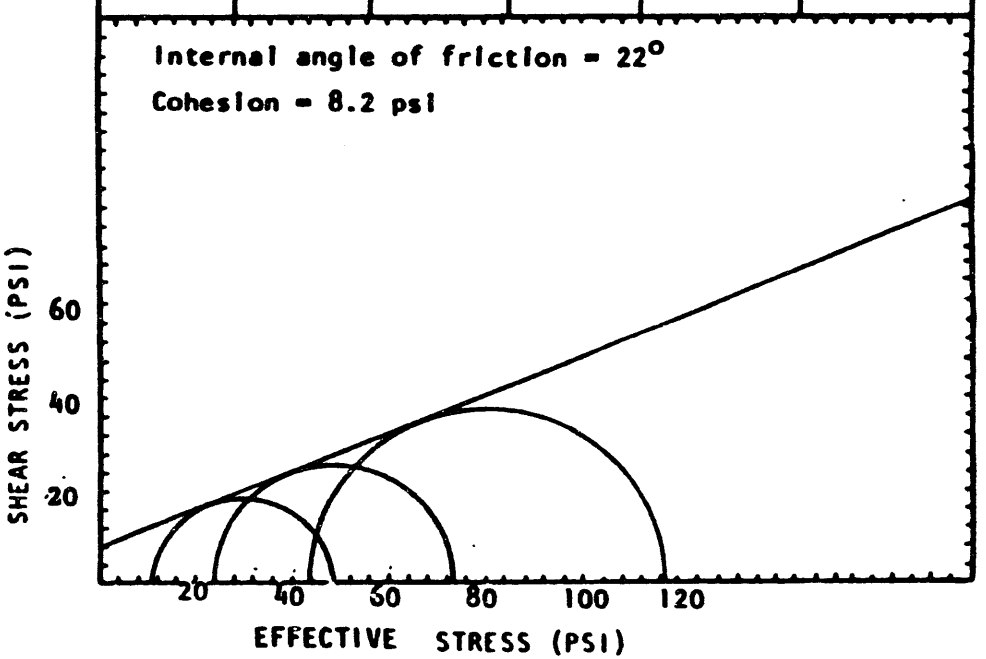
Project No: M87054GE
Date:
Figure:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



Stage	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	6.5	111	26	38	16
2	--	-	36	51.1	14
3	--	-	54	75.7	12



LABORATORY SAMPLE NUMBER: 1959

TEST HOLE: MEB-4 at 20 feet

SAMPLE DESCRIPTION:

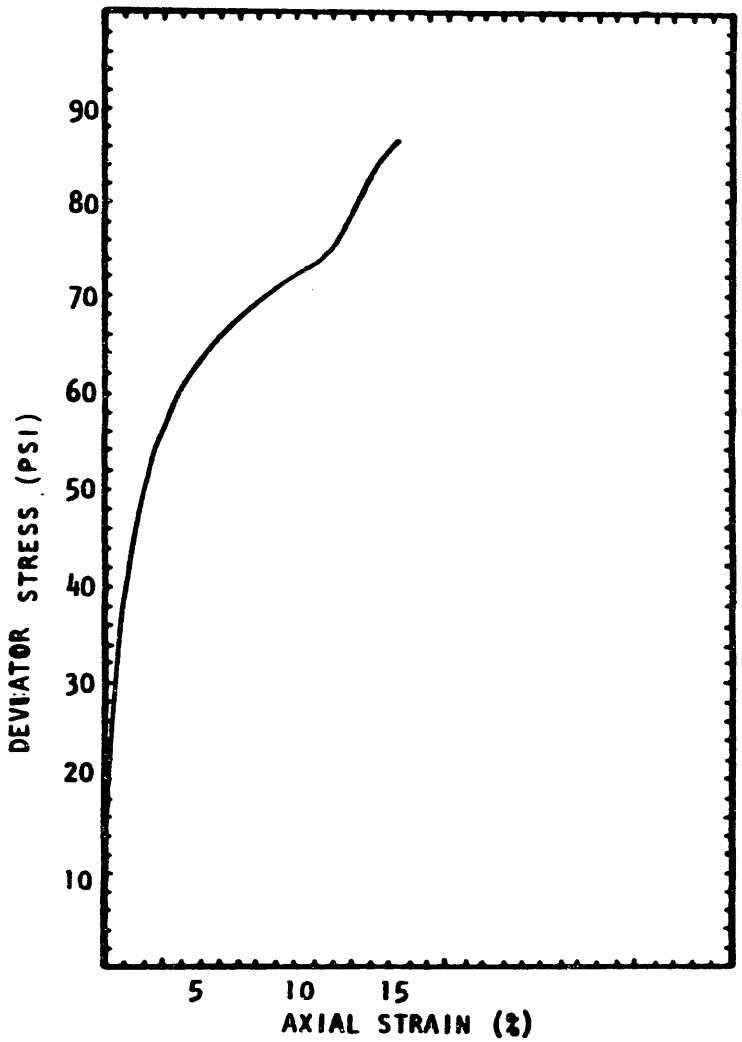
SAMPLE TESTED: Consolidated Undrained

Project No.: H8705 4GE

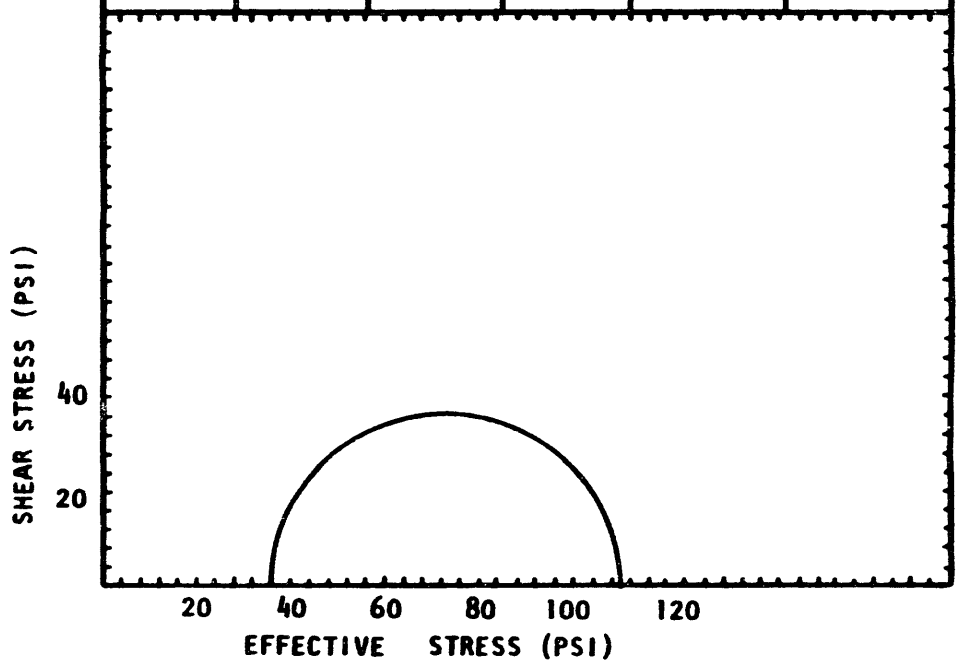
Date:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	5.9	112.8	60	74.0	24



LABORATORY SAMPLE NUMBER: 1959

TEST HOLE: MEB 4 at 20 feet

SAMPLE DESCRIPTION:

TYPE OF TEST: Consolidated, undrained

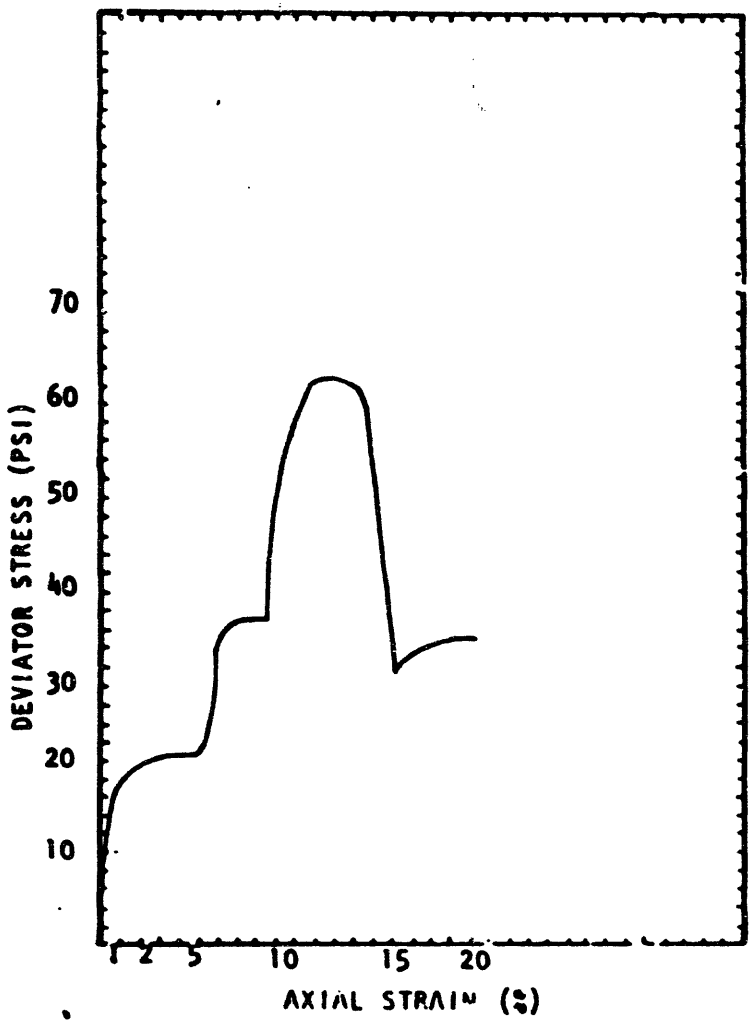
Project No.: M87054GE

Date:

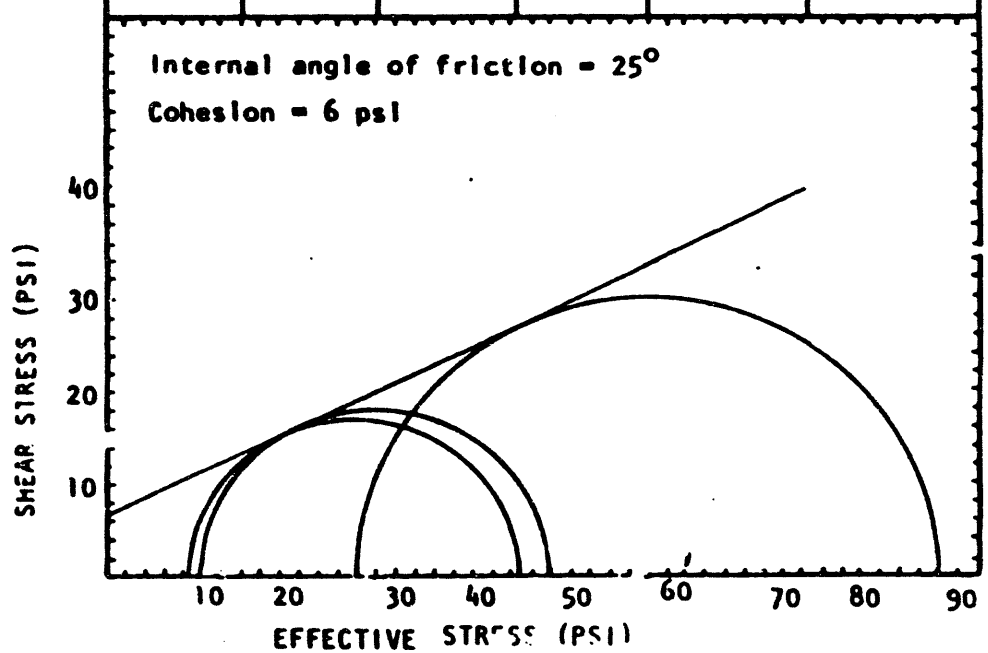
Page:

Lambert and Associates

TRIAXIAL COMPRESSION TEST



Stage	Initial Moisture Content (%)	Initial Dry Density (PCF)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSI)
1	4.5	113	64	35.9	53
2	--	-	96	60.4	69
3	--	-	28	32.9	18



LABORATORY SAMPLE NUMBER: 1969

TEST HOLE: MEB 9 at 10 Feet

SAMPLE DESCRIPTION:

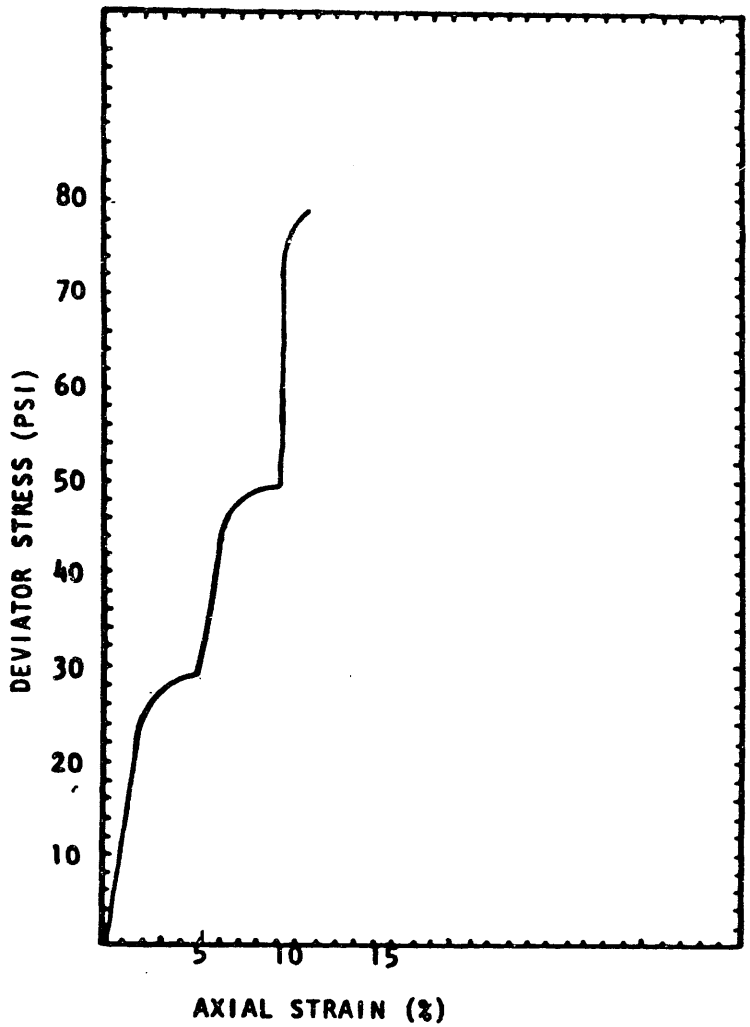
TYPE OF TEST: Unconsolidated Undrained

Project No.: HB70542E
Date:

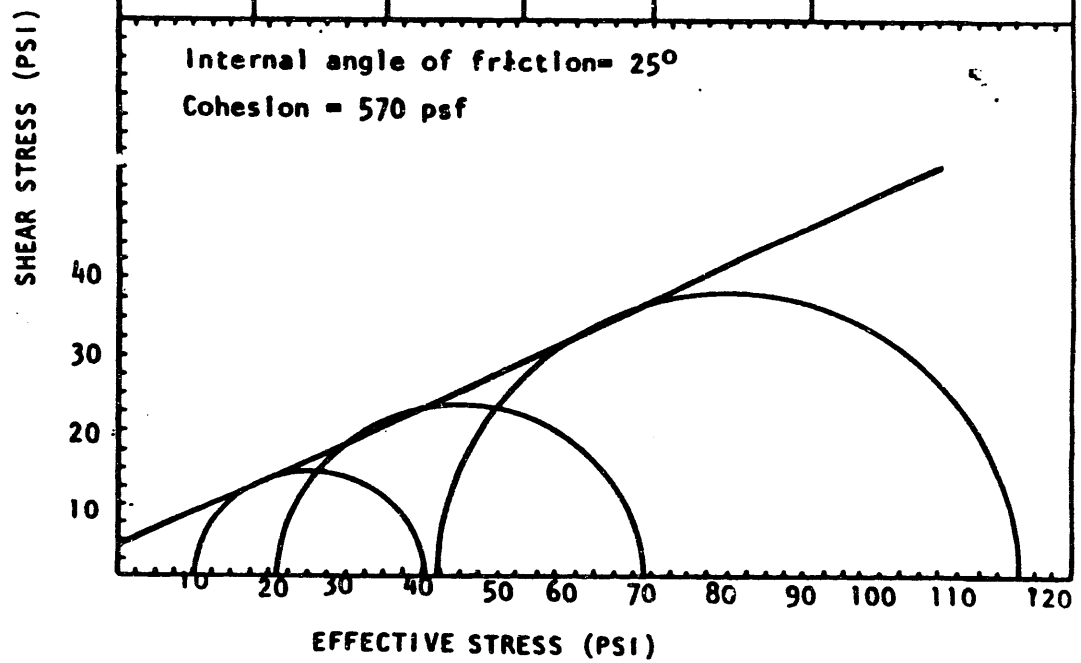
Lamhart and Associates

Project No.: M87054GF
Date:

TRIAXIAL COMPRESSION TEST



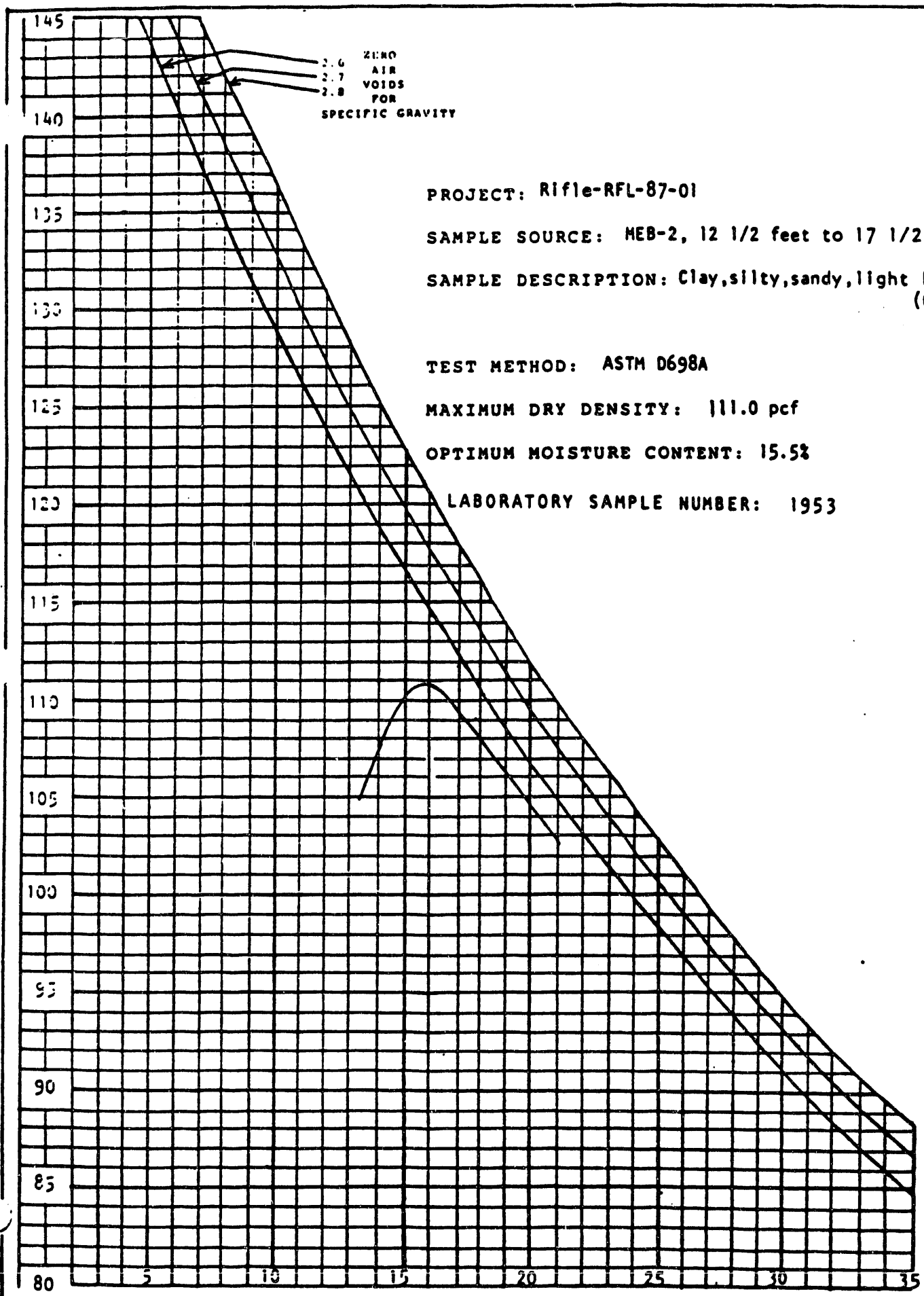
Stage Number	Initial moisture Content (%)	Initial Dry Density (pcf)	Confining Pressure (PSI)	Deviator Stress (PSI)	Pore Pressure (PSF)
1	7.4	117.0	27	29.1	16
2	7.4	117.0	37	48.9	16
3	7.4	117.0	56	76.4	14



Test Hole: MEB-11 at 27 1/2 feet

Type of Test: Consolidated Undrained

LABORATORY SAMPLE NUMBER: 1980



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MEB-2, 12 1/2 feet to 17 1/2 feet

SAMPLE DESCRIPTION: Clay,silty,sandy,light brown (CL)

TEST METHOD: ASTM D698A

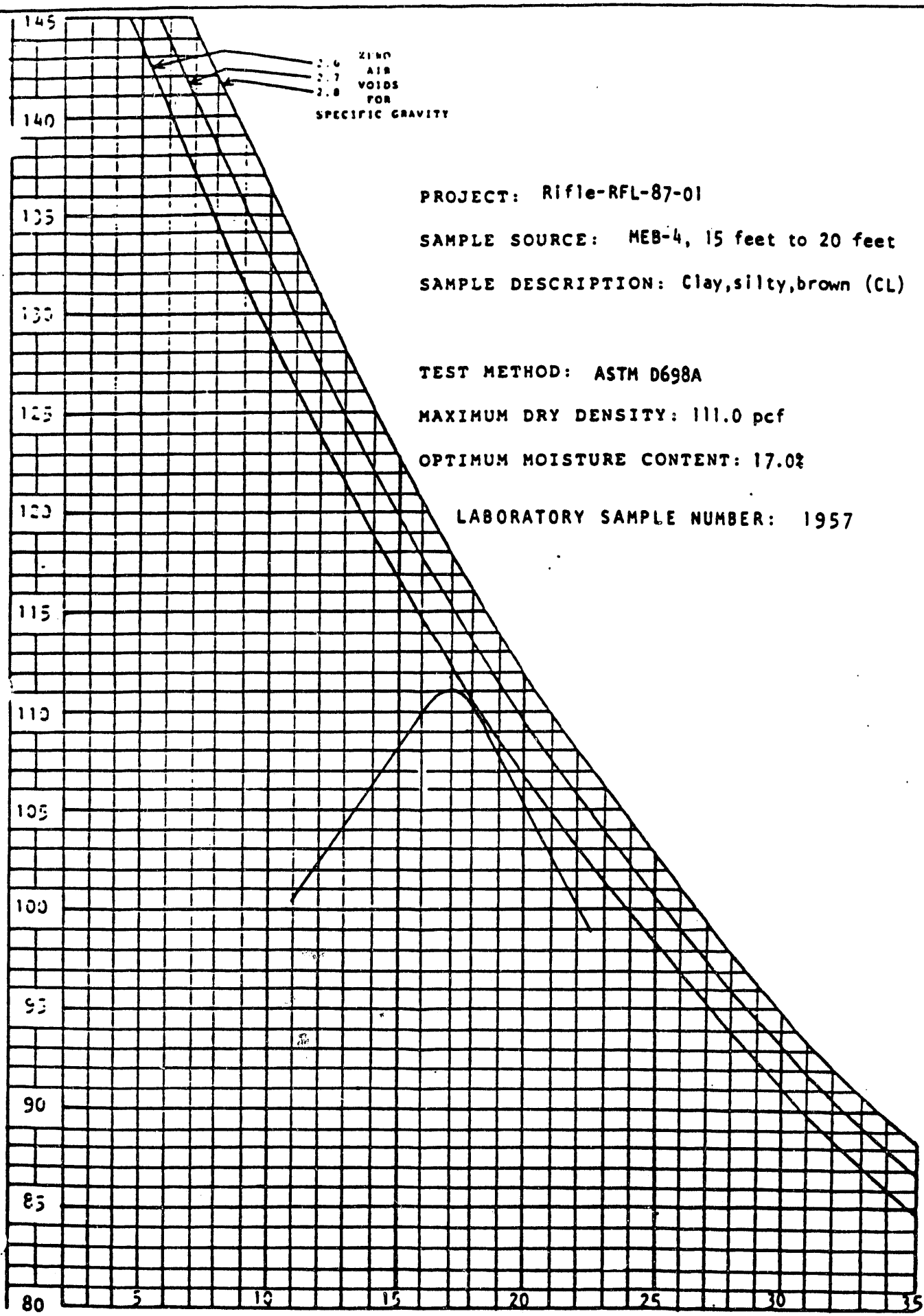
MAXIMUM DRY DENSITY: 111.0 pcf

OPTIMUM MOISTURE CONTENT: 15.5%

LABORATORY SAMPLE NUMBER: 1953

Lambert and Associates

Project No.:	M87054GE
Date:	12/4/87
Figure:	



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MEB-4, 15 feet to 20 feet

SAMPLE DESCRIPTION: Clay,silty,brown (CL)

TEST METHOD: ASTM D698A

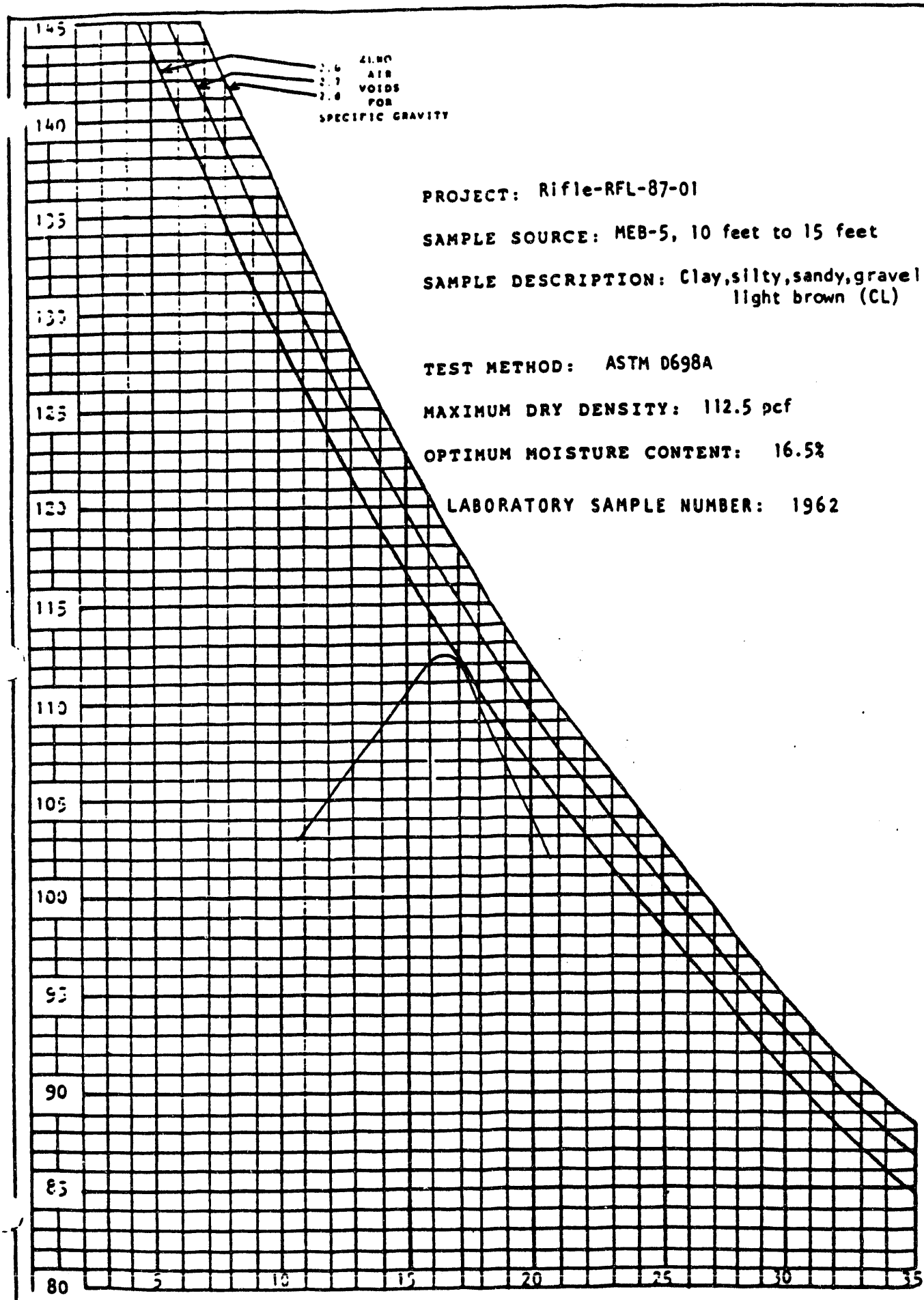
MAXIMUM DRY DENSITY: 111.0 pcf

OPTIMUM MOISTURE CONTENT: 17.0%

LABORATORY SAMPLE NUMBER: 1957

Lambert and Associates

Project No.:	M87054GE
Date:	12/4/87
Figure:	



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MEB-5, 10 feet to 15 feet

SAMPLE DESCRIPTION: Clay,silty,sandy,gravelly, light brown (CL)

TEST METHOD: ASTM D698A

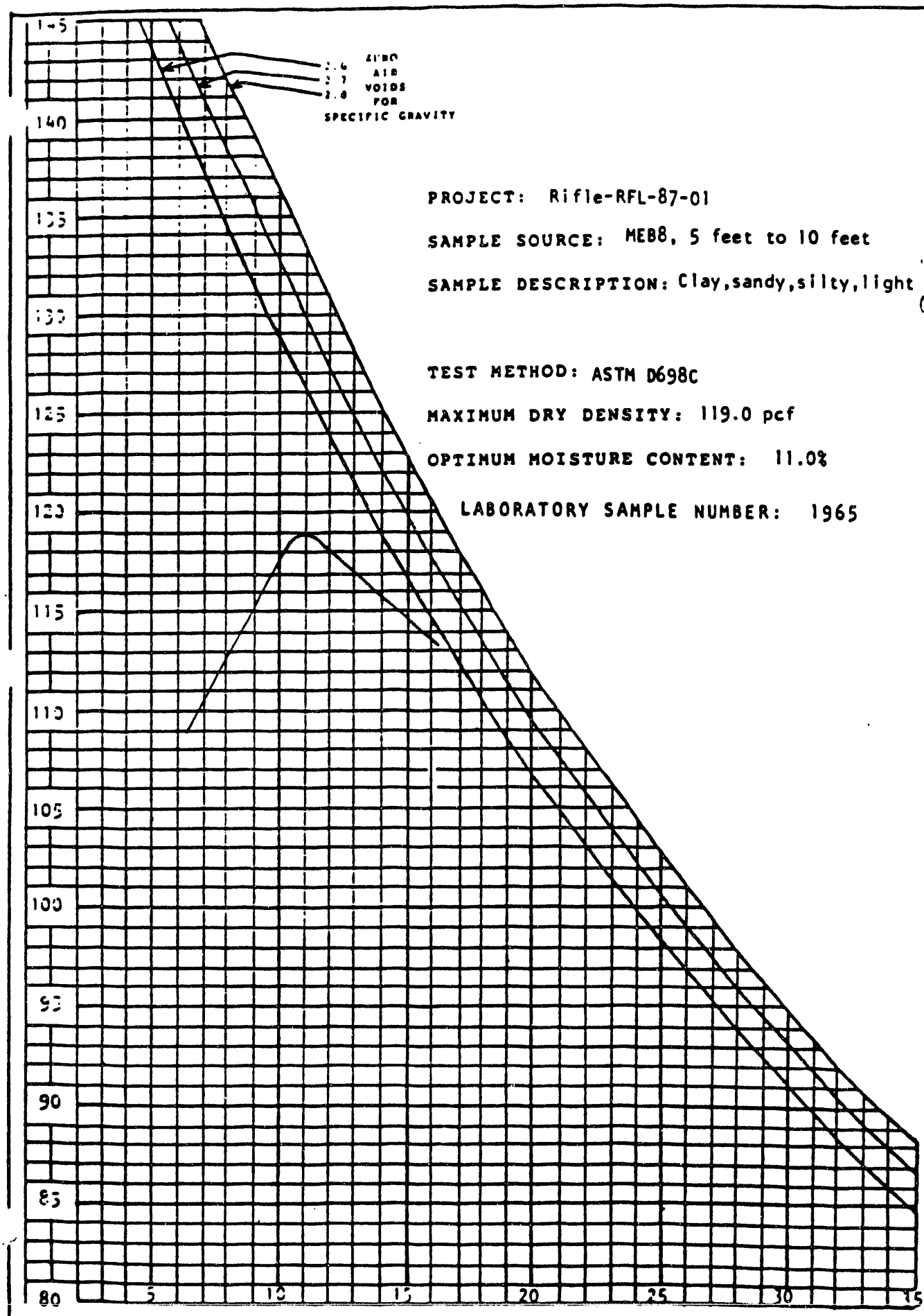
MAXIMUM DRY DENSITY: 112.5 pcf

OPTIMUM MOISTURE CONTENT: 16.5%

LABORATORY SAMPLE NUMBER: 1962

Lambert and Associates

Project No.: M870540E
Date: 12/4/87



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MEB8, 5 feet to 10 feet

SAMPLE DESCRIPTION: Clay,sandy,silty,light brown (CL)

TEST METHOD: ASTM D698C

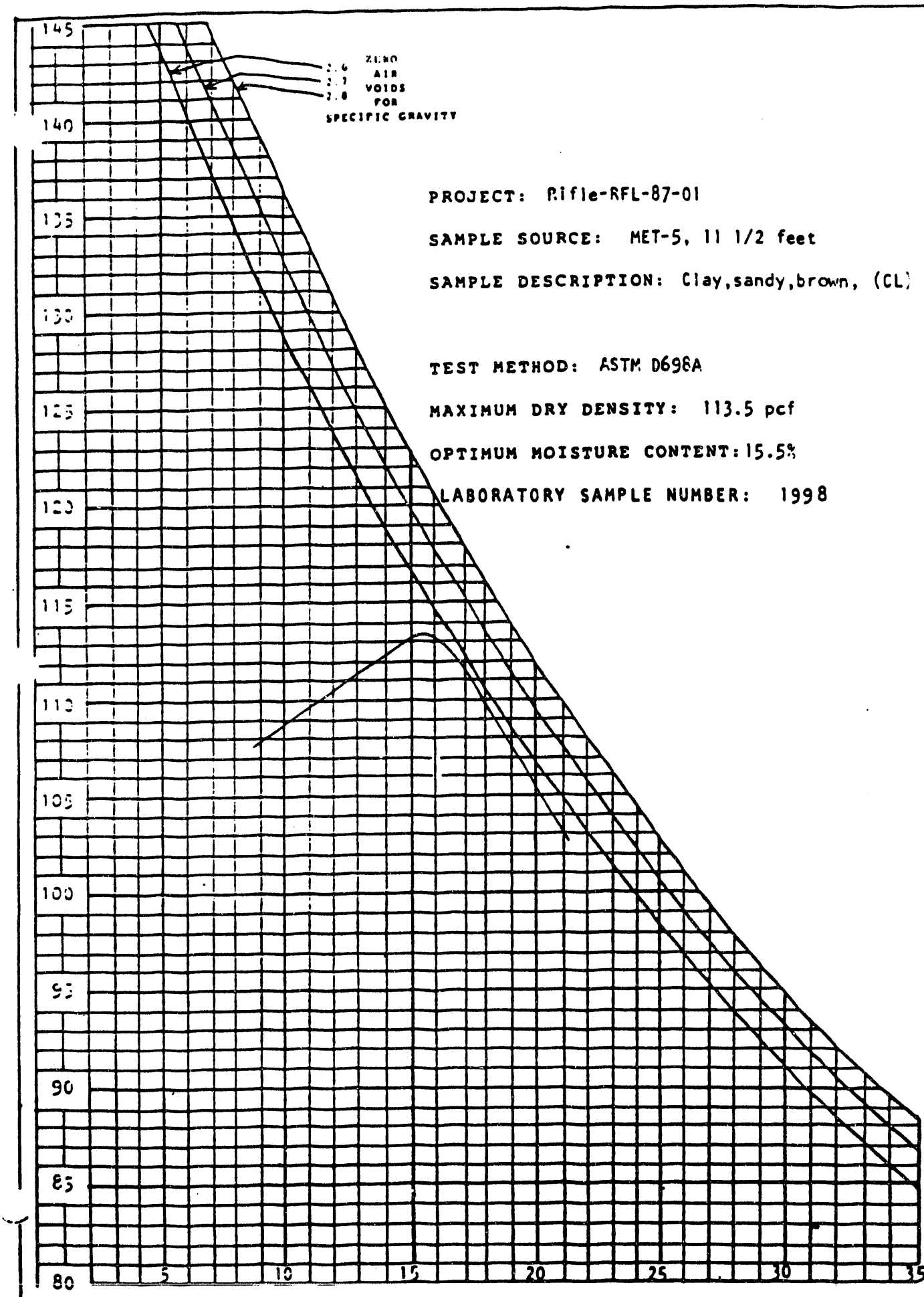
MAXIMUM DRY DENSITY: 119.0 pcf

OPTIMUM MOISTURE CONTENT: 11.0%

LABORATORY SAMPLE NUMBER: 1965

Lambert and Associates

Project No.:	M87054GE
Date:	12/4/87
Figure:	



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MET-5, 11 1/2 feet

SAMPLE DESCRIPTION: Clay,sandy,brown, (CL)

TEST METHOD: ASTM D698A

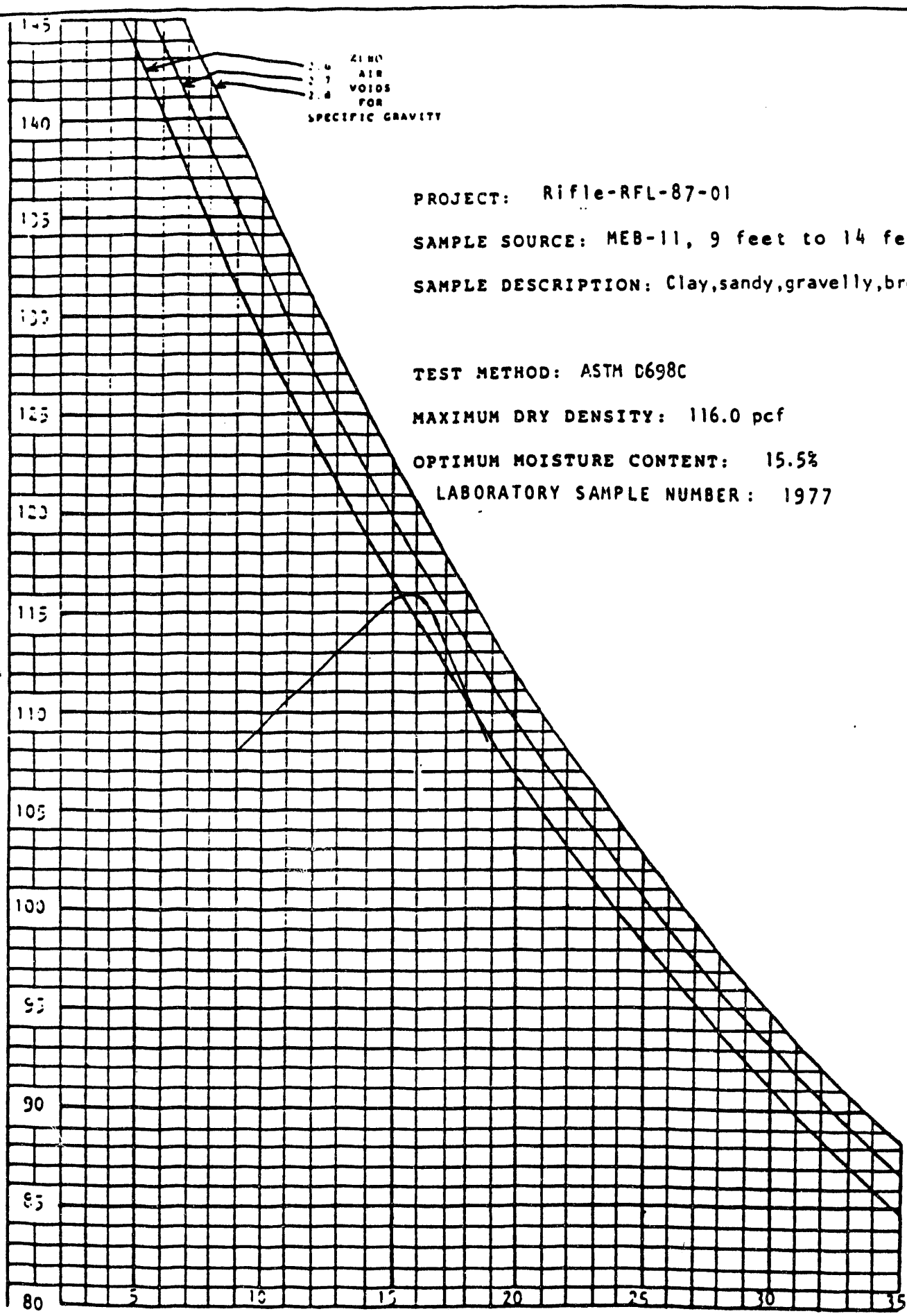
MAXIMUM DRY DENSITY: 113.5 pcf

OPTIMUM MOISTURE CONTENT: 15.5%

LABORATORY SAMPLE NUMBER: 1998

Lambert and Associates

Project No.: M87054GE
Date: 12/4/87
Figure:



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MEB-11, 9 feet to 14 feet

SAMPLE DESCRIPTION: Clay,sandy,gravelly,brown (CL)

TEST METHOD: ASTM D698C

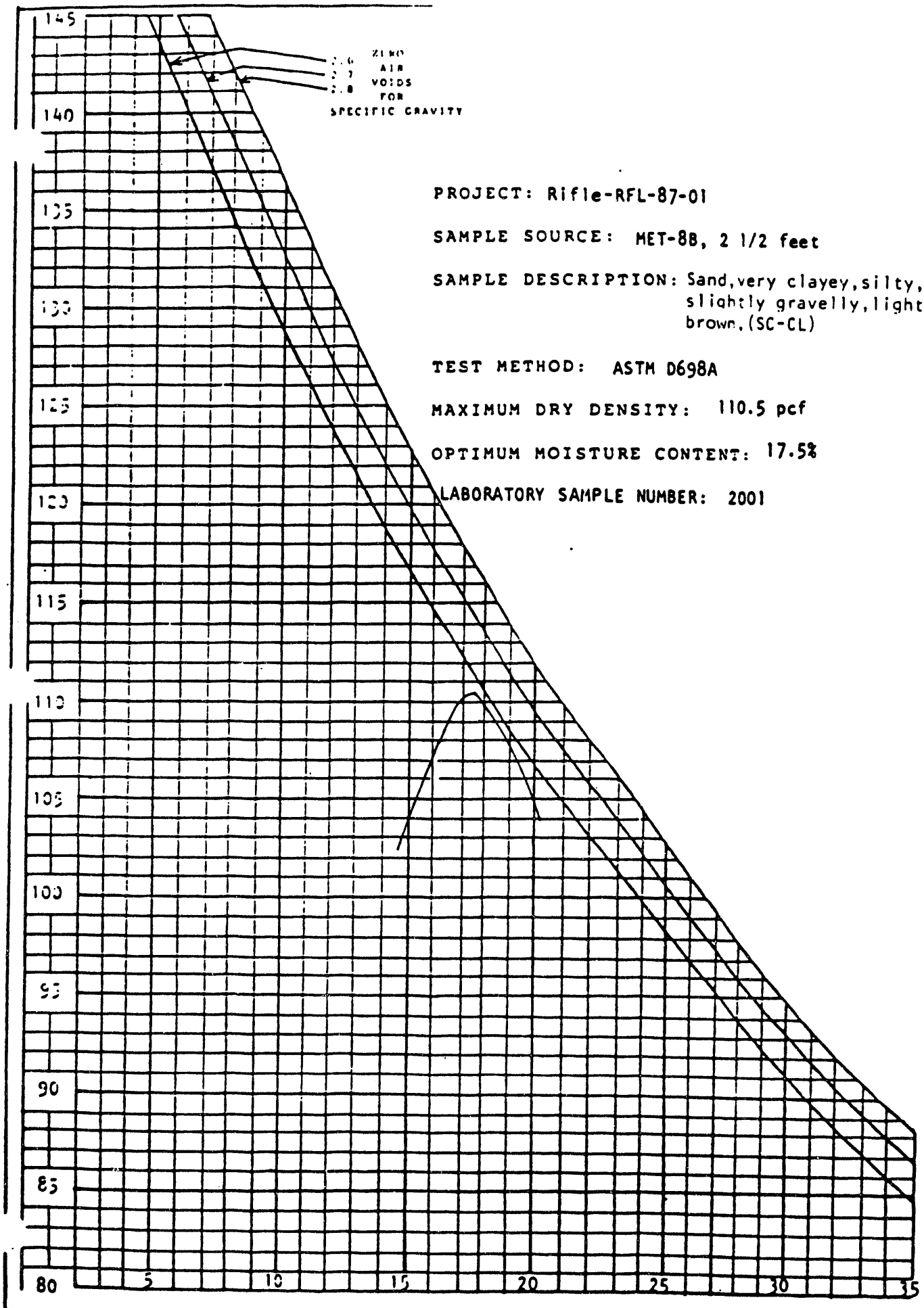
MAXIMUM DRY DENSITY: 116.0 pcf

OPTIMUM MOISTURE CONTENT: 15.5%

LABORATORY SAMPLE NUMBER: 1977

Lambert and Associates

Project No.:	M87054GE
Date:	12/4/87
Figure:	



PROJECT: Rifle-RFL-87-01

SAMPLE SOURCE: MET-8B, 2 1/2 feet

SAMPLE DESCRIPTION: Sand, very clayey, silty, slightly gravelly, light brown, (SC-CL)

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 110.5 pcf

OPTIMUM MOISTURE CONTENT: 17.5%

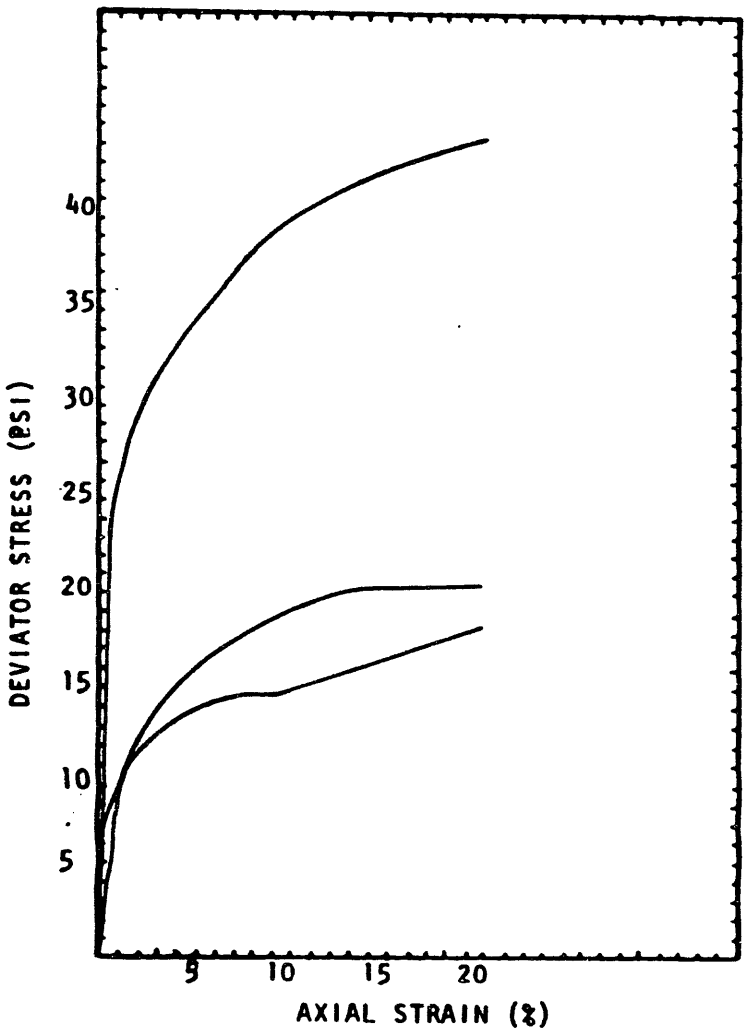
LABORATORY SAMPLE NUMBER: 2001

Lambert and Associates

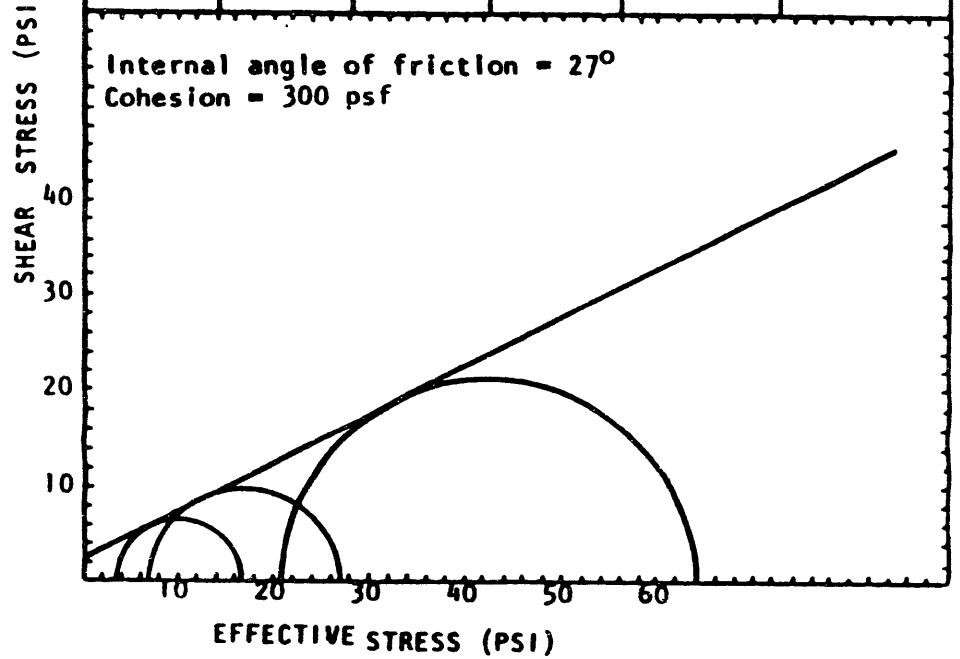
Project No.:	M87054GE
Date:	12/4/87
Figure:	

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (PCF)	CONFIN-ING PRESSURE (PSI)	DEVIATOR STRESS (PSI)	PORE PRESSURE (PSF)
1	16.5	107.8	24.5	13.7	21
2	16.5	107.8	17	19.3	10
3	16.5	107.8	41	43.2	20



TEst Hole: MET-5 at 11 1/2 feet

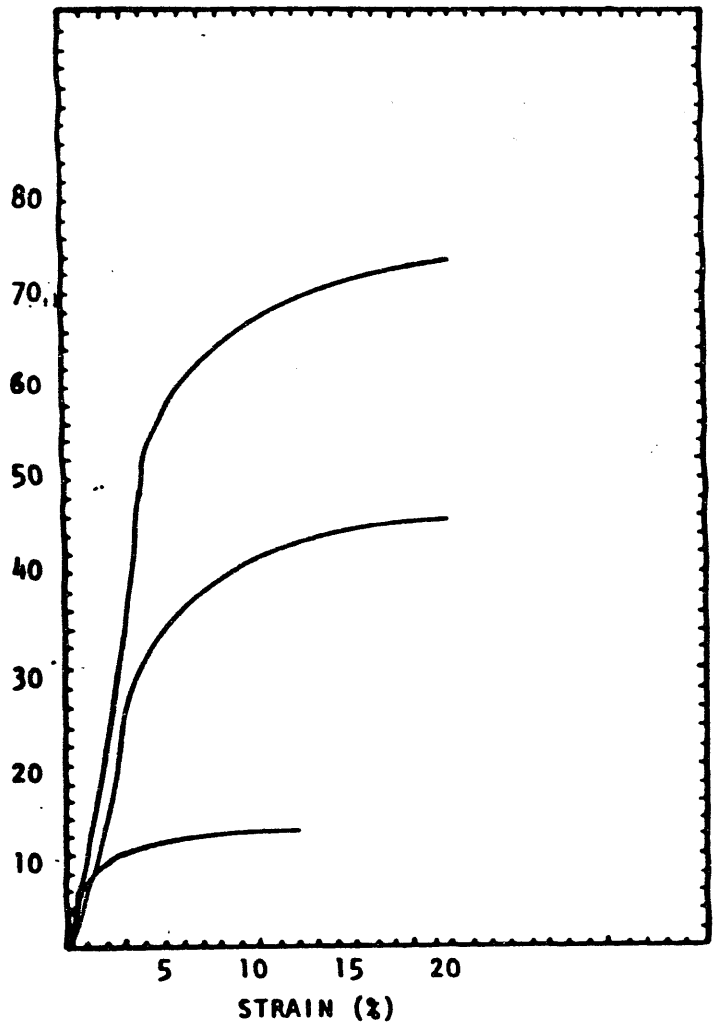
Type of Test: Consolidated Undrained

LABORATORY SAMPLE NUMBER: 1998

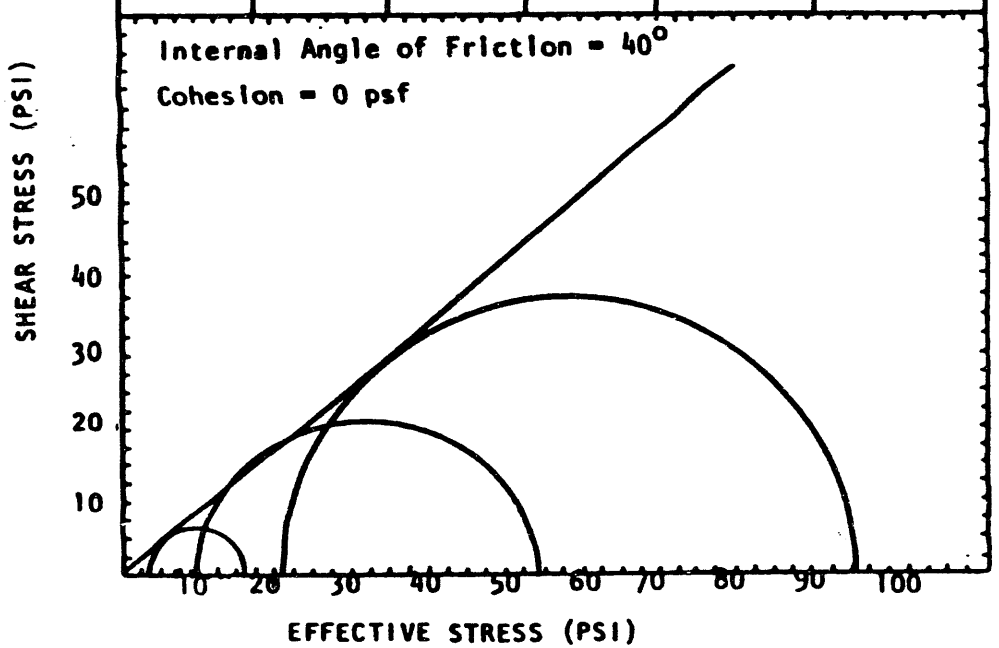
Project No.: M87054GE
Date:
Fig.

Lambert and Associates

TRIAXIAL COMPRESSION TEST



SAMPLE NUMBER	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (PCF)	CONFINING PRESSURE (PSI)	DEVIATOR STRESS (PSI)	PORE PRESSURE (PSF)
1	16.5	107.8	13.5	12.8	10
2	16.5	107.8	34	45.9	25
3	16.5	107.8	41	73.9	20



Test Hole: MET-5 at 11 1/2 feet

Type of Test: Unconsolidated Undrained

Laboratory Sample Number: 1998

Project No.: M87054GE

Date:

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-2 at 12 1/2 Feet to 17 1/2 Feet

LABORATORY SAMPLE NUMBER: 1953

SAMPLE DESCRIPTION:

TRIAXIAL PERMEABILITY: 4.6×10^{-8} cm/sec

CONFINING PRESSURE: 2 psi

INITIAL DRY DENSITY: 105.5 pcf

INITIAL MOISTURE CONTENT: 15.5 percent

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-4 at 15 Feet to 20 Feet

LABORATORY SAMPLE NUMBER: 1957

SAMPLE DESCRIPTION:

TRIAXIAL PERMEABILITY: 1.2×10^{-7} cm/sec

CONFINING PRESSURE: 2 psi

INITIAL DRY DENSITY: 105.5 pcf

INITIAL MOISTURE CONTENT: 18.0 percent

DISPERSION: 53 percent

ATTERBERG LIMITS: Liquid Limit = 37
Plastic Limit = 16
Plasticity Index = 21

SPECIFIC GRAVITY: 2.71

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE MEB-5 at 10 Feet to 15 Feet, Bulk Sample

LABORATORY SAMPLE NUMBER: 1962

SAMPLE DESCRIPTION:

TRIAXIAL PERMEABILITY: 8.9×10^{-8} cm/sec

CONFINING PRESSURE: 2 psi

INITIAL DRY DENSITY: 106.9 pcf

INITIAL MOISTURE CONTENT: 17.5 percent

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MEB-8 at 5 Feet to 10 Feet

LABORATORY SAMPLE NUMBER: 1965

TRIAXIAL PERMEABILITY: 4.9×10^{-7} cm/sec

CONFINING PRESSURE: 2 psi

SAMPLE DESCRIPTION:

INITIAL DRY DENSITY: 113.1 pcf

INITIAL MOISTURE CONTENT: 11.0 percent

TEST RESULT SHEET

PROJECT: RFL-87-01

TEST HOLE: MET 5 at 11 1/2 Feet

LABORATORY SAMPLE NUMBER: 1998

SAMPLE DESCRIPTION:

TRIAXIAL PERMEABILITY: 4.7×10^{-7} cm/sec

CONFINING PRESSURE: 2 psi

INITIAL DRY DENSITY: 107.8 pcf

INITIAL MOISTURE CONTENT: 16.5 percent

RADON BARRIER MATERIAL

TEST RESULTS

Chen & Associates
Consulting Geotechnical Engineers

96 South Zuni
Denver, Colorado 80223
303-744-7105

Casper
Colorado Springs
Ft. Collins
Glenwood Springs
Phoenix
Rock Springs
Salt Lake City
San Antonio

GGC

April 1, 1988

Subject: Laboratory Testing, UMTRAP, Rifle, Colorado

P.O. No. 3050-511-9602, C.O. No. 1

Job No. 1 125 88

Mr. R.E. Cooney
MK-Ferguson Company
P.O. Box 9136
Albuquerque, New Mexico 87119

Dear Mr. Cooney:

As requested, we have performed capillary-moisture relationship tests on each of three soil samples received February 22, 1988, at our Denver laboratory. The results are presented on Table I, enclosed. All specimens were remolded to approximately 95% of the standard Proctor density at slightly over the optimum moisture content (0 to +3%), as provided by you.

If you have any questions or need further assistance, please call.

Sincerely,

CHEN & ASSOCIATES, INC.

By Sally K. Miller
Sally K. Miller, A.E.T.
Soils Laboratory Supervisor

SKM/djb
Rev. By: KRC
Enclosures
cc: Mr. Robert Heneks
MK Engineers, Inc.

Attachment: 5025-RFL-C-09-01125-00

RECEIVED-MKE
APR 5 1988
UMTRA-S.F.

April 1, 1988
UMTRAP, Rifle, Colorado
Job No. 1 125 88

CHEN AND ASSOCIATES, INC.

TABLE I

SUMMARY OF CAPILLARY-MOISTURE RELATIONSHIP TEST RESULTS

Sample No.	MEB-8	MET-5	MET-8
Depth	5'-10'	11.5'	2.5'
Average Initial Moisture Content, %	14.79	16.76	18.83
Average Initial Dry Density, pcf	107.1	108.1	104.8
Average Initial Compaction, %	94.9	95.2	94.8
Tension, bars	Moisture Content, %		
0.1	18.20	18.09	21.16
0.3	15.90	17.31	19.74
0.5	15.30	16.66	19.39
1.0	14.64	15.92	18.40
2.0	13.88	15.12	16.76
4.0	12.43	13.75	15.54
7.0	13.42	15.06	16.64
15.0	12.98	14.00	14.50

RECEIVED · MKE
APR 5 1988
UMTRA · S.F.

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS
TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 3/25/88

CONTRACT [illegible]

BY RYB

SAMPLE IDENTIFICATION Cover Soils - Rifle, Colorado

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MET-8B (2½')	4.6	1.68	2.5E-02	0.21	0.37
MET-8B (2½')	8.4	1.68	1.7E-02	0.39	0.37
MET-8B (2½')	10.0	1.69	2.0E-02	0.47	0.36
MET-8B (2½')	18.0	1.68	2.7E-04	0.83	0.37

[a] BASED ON A SPECIFIC GRAVITY OF 2.66 g/cm^3.

JEG-AL-AS-2 (2/87)

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MEB-8 (5-10')	3.3	1.82	2.3E-02	0.19	0.32
MEB-8 (5-10')	6.6	1.82	2.3E-02	0.38	0.32
MEB-8 (5-10')	10.2	1.82	1.5E-02	0.58	0.32
EB-8 (5-10')	14.3	1.81	6.2E-04	0.82	0.32

[a] BASED ON A SPECIFIC GRAVITY OF 2.68 g/cm^3.

JEG-AL-AS-2 (2/87)

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MET-5 (11½')	6.0	1.73	2.8E-02	0.29	0.35
MET-5 (11½')	9.5	1.74	1.6E-02	0.47	0.35
MET-5 (11½')	10.9	1.75	1.9E-02	0.55	0.35
MET-5 (11½')	15.3	1.73	1.2E-03	0.75	0.35

[a] BASED ON A SPECIFIC GRAVITY OF 2.68 g/cm^3.

CHEN-NORTHERN, INC.

November 20, 1989

TABLE I

Job No. 1 108 90
P.O. No. 3050-511-9602

Summary of Capillary-Moisture Relationship Test Results

Sample Identification	MER - 1 @ 8'	MER - 2 @ 8'	MER - 3 @ 2.5'	MER - 4 @ 14'	MER - 5 @ 5'	MER - 6 @ 5'
Average Initial Moisture Content, %	19.2	20.1	18.1	17.6	19.5	17.4
Average Initial Dry Density, pcf	105.9	103.5	109.1	107.5	103.2	108.8
Average Initial Compaction, %	99.4	99.6	100.1	100.5	100.2	99.8
	Moisture Content, %					
Tension, bars						
1.0	22.7	21.6	18.3	18.5	19.5	22.7
2.0	22.3	22.0	18.8	19.1	20.3	21.6
4.0	20.2	21.3	18.3	18.3	20.0	19.0
7.0	20.0	21.0	18.1	17.4	19.6	19.5
10.0	20.2	20.7	17.6	17.6	19.3	20.1
15.0	19.5	19.9	16.9	16.9	18.6	19.0

MKE DOC. 5025-RFL-R-09-03375-00

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS

TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 10-31-89

CONTRACT C8717 - 124

BY RYB / KW

SAMPLE IDENTIFICATION Rifle, CO (Estes Gulch) Cover Soils

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MER 6 (5)	7.2	1.74	2.1E-02	0.32	0.39
MER 6 (5)	9.1	1.75	1.5E-02	0.41	0.39
MER 6 (5)	10.3	1.76	1.3E-02	0.47	0.38
MER 6 (5)	12.5	1.76	2.3E-03	0.57	0.39
MER 6 (5)	16.2*	1.76	1.5E-04	0.75	0.38

[a] BASED ON A SPECIFIC GRAVITY OF 2.36 g/cm^3.

JEG-AL-AS-2 (2/87)

* Mass weighted average.

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS

TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 10-31-89

CONTRACT 03717 - 124

BY RYB /KKN

SAMPLE IDENTIFICATION Rifle, CO (Estes Gulch) Cover Soils

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MER 5 (5)	5.9	1.67	1.8E-02	0.26	0.39
MER 5 (5)	11.2	1.66	1.2E-02	0.48	0.39
MER 5 (5)	13.4	1.67	9.2E-03	0.58	0.39
MER 5 (5)	18.6*	1.65	1.7E-04	0.78	0.39
MER 5 (5)	19.2*	1.66	1.4E-04	0.81	0.39

[a] BASED ON A SPECIFIC GRAVITY OF 2.72 g/cm^3.

JEG-AL-AS-2 (2/87)

*Mass weighted average

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS

TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 10-31-89

CONTRACT C8717 - 124

BY RYB / KKN

SAMPLE IDENTIFICATION Rifle, CO (Estes Gulch) Cover Soils

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MER 4 (14)	8.3	1.72	1.1E-02	0.39	0.37
MER 4 (14)	10.4	1.72	9.2E-03	0.49	0.37
MER 4 (14)	12.2	1.72	7.1E-03	0.57	0.37
MER 4 (14)	16.0*	1.72	3.3E-04	0.75	0.37
MER 4 (14)	17.4*	1.72	1.8E-04	0.81	0.37

[a] BASED ON A SPECIFIC GRAVITY OF 2.72 g/cm^3.

JEG-AL-AS-2 (2/87)

*Mass weighted average.

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS

TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 10-31-89

CONTRACT [illegible] - 124

BY RYB / KKN

SAMPLE IDENTIFICATION Rifle, CO (Estes Gulch) Cover Soils

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MER 3 (2½)	3.7	1.75	1.4E-02	0.18	0.36
MER 3 (2½)	8.0	1.75	1.4E-02	0.39	0.36
MER 3 (2½)	9.5	1.76	1.1E-02	0.46	0.36
MER 3 (2½)	16.6*	1.74	4.0E-04	0.78	0.37
MER 3 (2½)	17.9*	1.74	2.3E-04	0.85	0.37

[a] BASED ON A SPECIFIC GRAVITY OF 2.75 g/cm^3.

JEG-AL-AS-2 (2/87)

* Mass weighted average.

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS

TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 10-31-89

CONTRACT C3717 - 124

BY RYB / KKW

SAMPLE IDENTIFICATION Rifle, CO (Estes Gulch) Cover Soils

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MER 2 (8)	6.6	1.67	1.8E-02	0.29	0.39
MER 2 (8)	9.2	1.67	1.5E-02	0.40	0.39
MER 2 (8)	11.5	1.67	1.3E-02	0.50	0.39
MER 2 (8)	13.1	1.68	8.3E-03	0.57	0.38
MER 2 (8)	17.9*	1.67	3.8E-04	0.77	0.39

[a] BASED ON A SPECIFIC GRAVITY OF 2.72 g/cm^3.

JEG-AL-AS-2 (2/87)

*Mass weighted average

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS

TIME-DEPENDENT DIFFUSION TEST METHOD

REPORT DATE 10-31-89

CONTRACT C8717 - 124

BY RYB / KKN

SAMPLE IDENTIFICATION Rifle, CO (Estes Gulch) Cover Soils

SUBMITTED BY Rogers & Associates Engineering Corporation DATE RECEIVED

SAMPLE ID	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION [a] (Mp/P)	COMMENTS POROSITY
MER 1 (8)	4.1	1.71	1.9E-02	0.19	0.36
MER 1 (8)	8.4	1.71	1.3E-02	0.40	0.36
MER 1 (8)	10.8	1.70	1.1E-02	0.51	0.36
MER 1 (8)	11.9	1.71	6.7E-03	0.57	0.36
MER 1 (8)	17.5*	1.71	1.6E-04	0.83	0.36

[a] BASED ON A SPECIFIC GRAVITY OF 2.66 g/cm^3.

JEG-AL-AS-2 (2/87)

* Mass Weighted Average

SUMMARY OF SELECT TEST RESULTS

TEST HOLE NUMBER	DEPTHS (FEET)	LABORATORY SAMPLE #2674	RELATIVE COMPACTION	BENTONITE (PERCENT)	PERMEABILITY (CM/S)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	SPECIFIC GRAVITY
MET-1	7½	A	95%	0	4.5×10^{-7}	33	16	2.772
MET-1	7½	A	100%	0	1.5×10^{-7}	33	16	2.772
MET-1	7½	B	95%	7	3.7×10^{-8}	50	33	2.735
MET-1	7½	B	100%	7	3.2×10^{-8}	50	33	2.735
MEB-2	12½ - 17½	C	95%	0	5.4×10^{-8}	30	16	2.775
MEB-2	12½ - 17½	C	100%	0	------	30	16	2.775
MEB-2	12½ - 17½	D	95%	7	2.7×10^{-8}	40	25	2.655
MEB-2	12½ - 17½	D	100%	7	1.9×10^{-8}	40	25	2.655
MEB-9	15 - 20	E	95%	0	-------	30	14	2.617
MEB-9	15 - 20	E	100%	0	-------	30	14	2.617
MEB-9	15 to 20	F	95%	7	5.3×10^{-8}	42	26	2.730
MEB-9	15 - 20	F	100%	7	5.0×10^{-8}	42	26	2.730
MET MWR-1	7½	G	95%	14	2.6×10^{-8}	62	43	2.744
MET-1	7½	G	100%	14	1.5×10^{-8}	62	43	2.744
MEB-2	12½ - 17½	H	95%	14	5.2×10^{-9}	56	38	2.628
MEB-2	12½ - 17½	H	100%	14	5.0×10^{-9}	56	38	2.628
MEB-9	15 - 20	I	95%	14	1.1×10^{-8}	70	55	2.722
MEB-9	15 - 20	I	100%	14	1.1×10^{-8}	70	55	2.722

Project: Rifle Additional

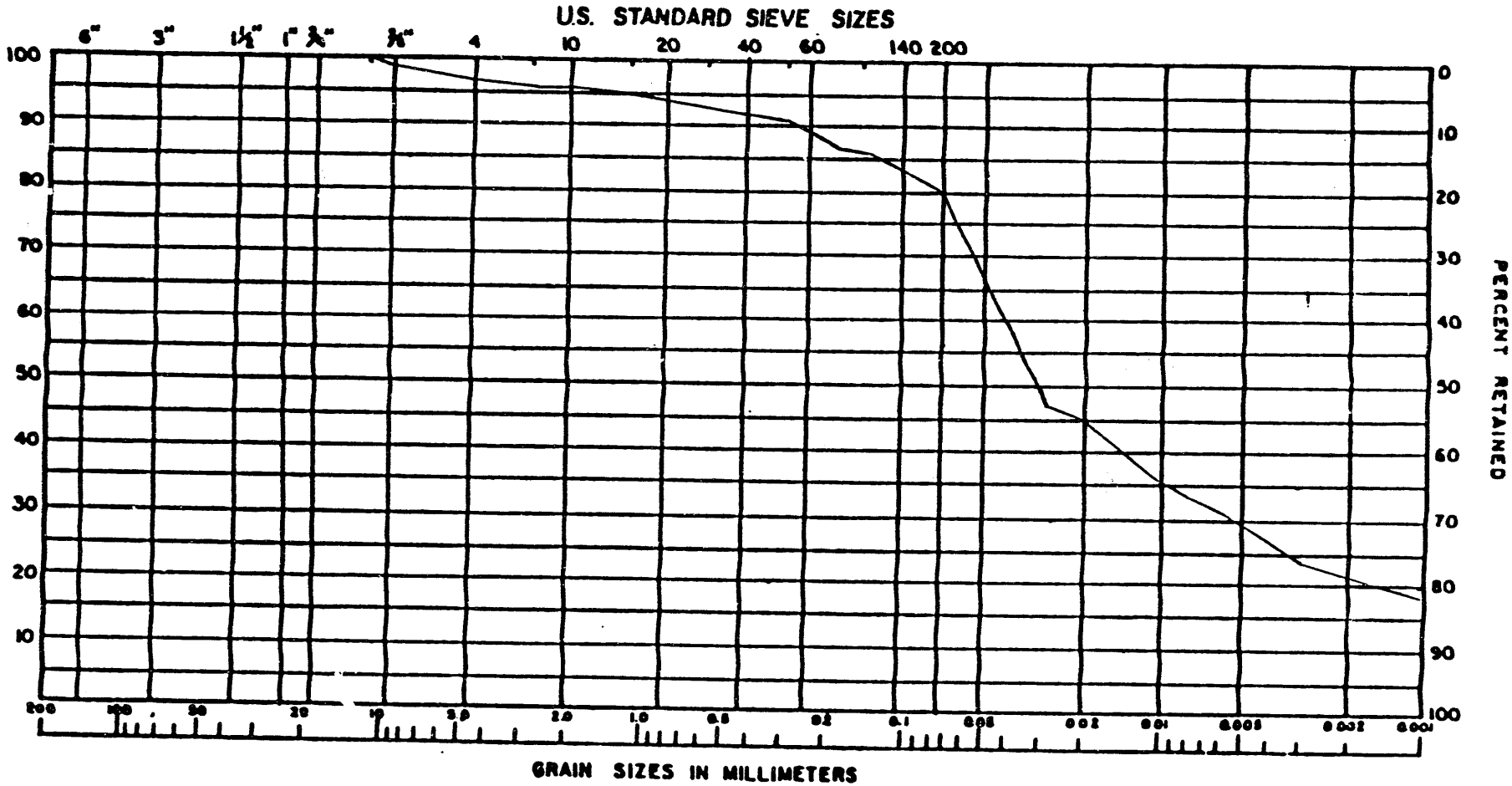
Job Number: M8911 3GE

GRAIN SIZE DISTRIBUTION CURVES

Fig. 1

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

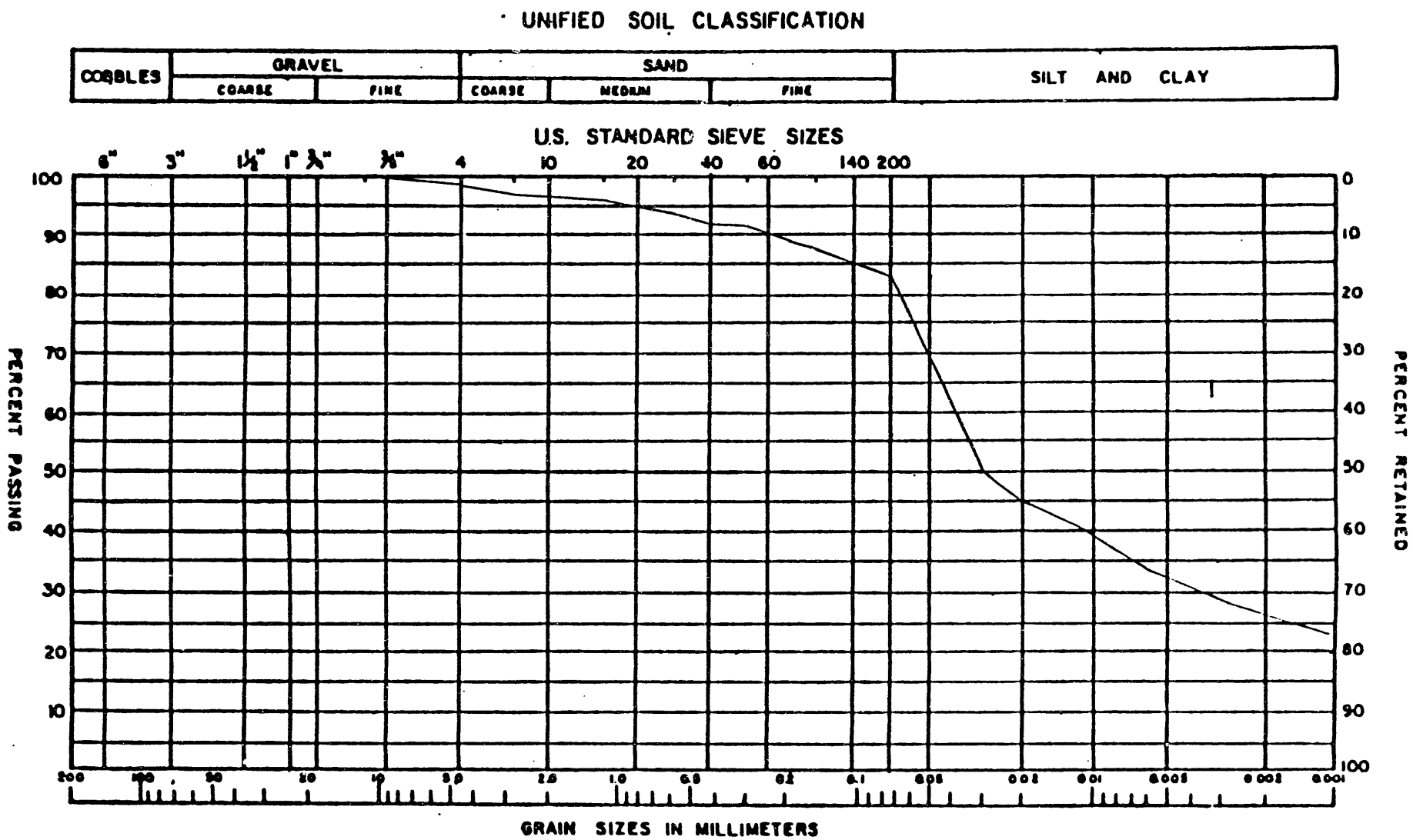


TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MET-1	7 1/2	33	16	2.772	10.2	2671-A
CLASSIFICATION						

Project: Rifle Additional

Job Number: M98113GE

GRAIN SIZE DISTRIBUTION CURVES



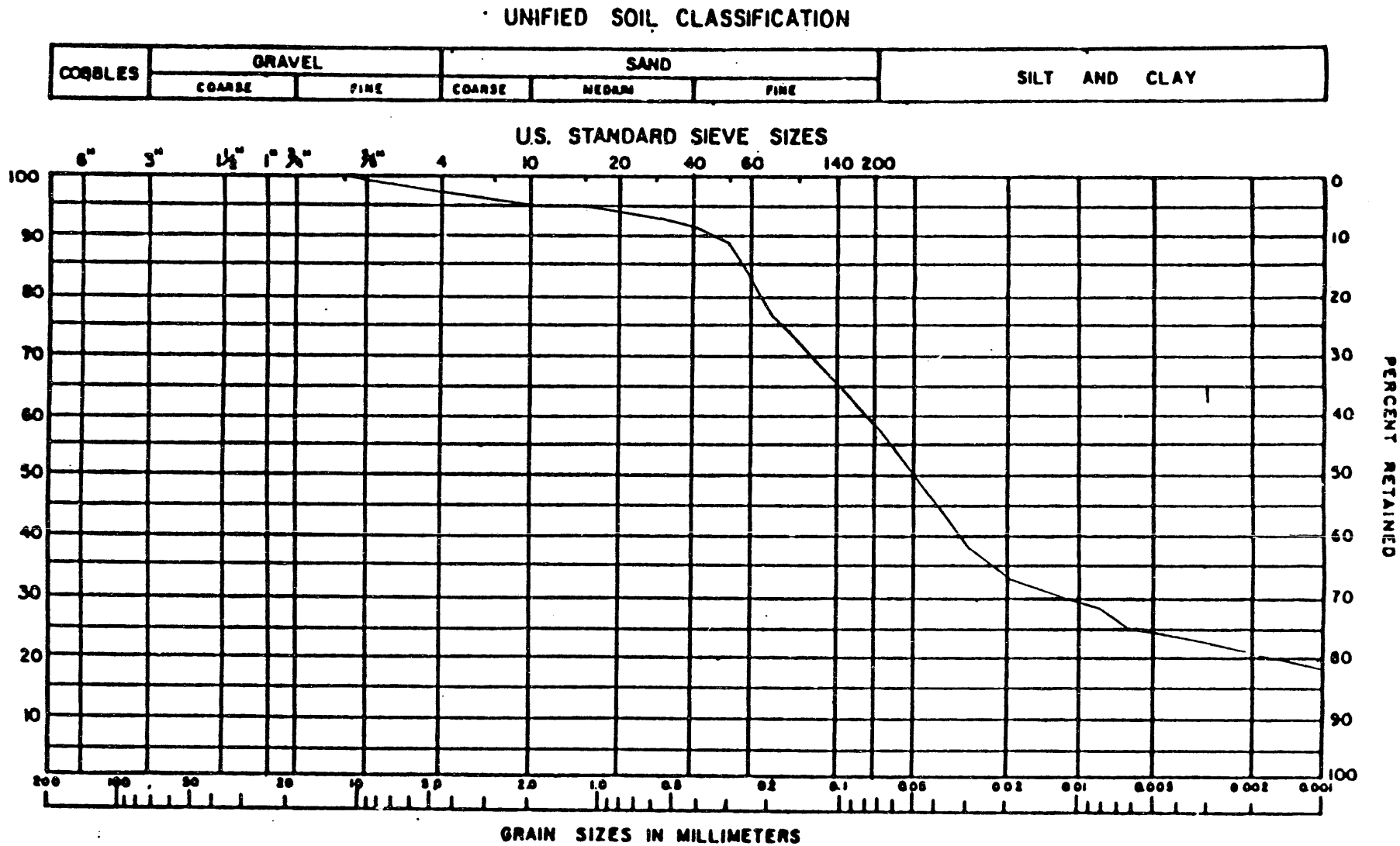
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MET-1	7 1/2	50	33	2.735	10.4	2674-B
CLASSIFICATION						

Fig. 2

Project: Rifle Additional

Job Number: M3113GE

GRAIN SIZE DISTRIBUTION CURVES



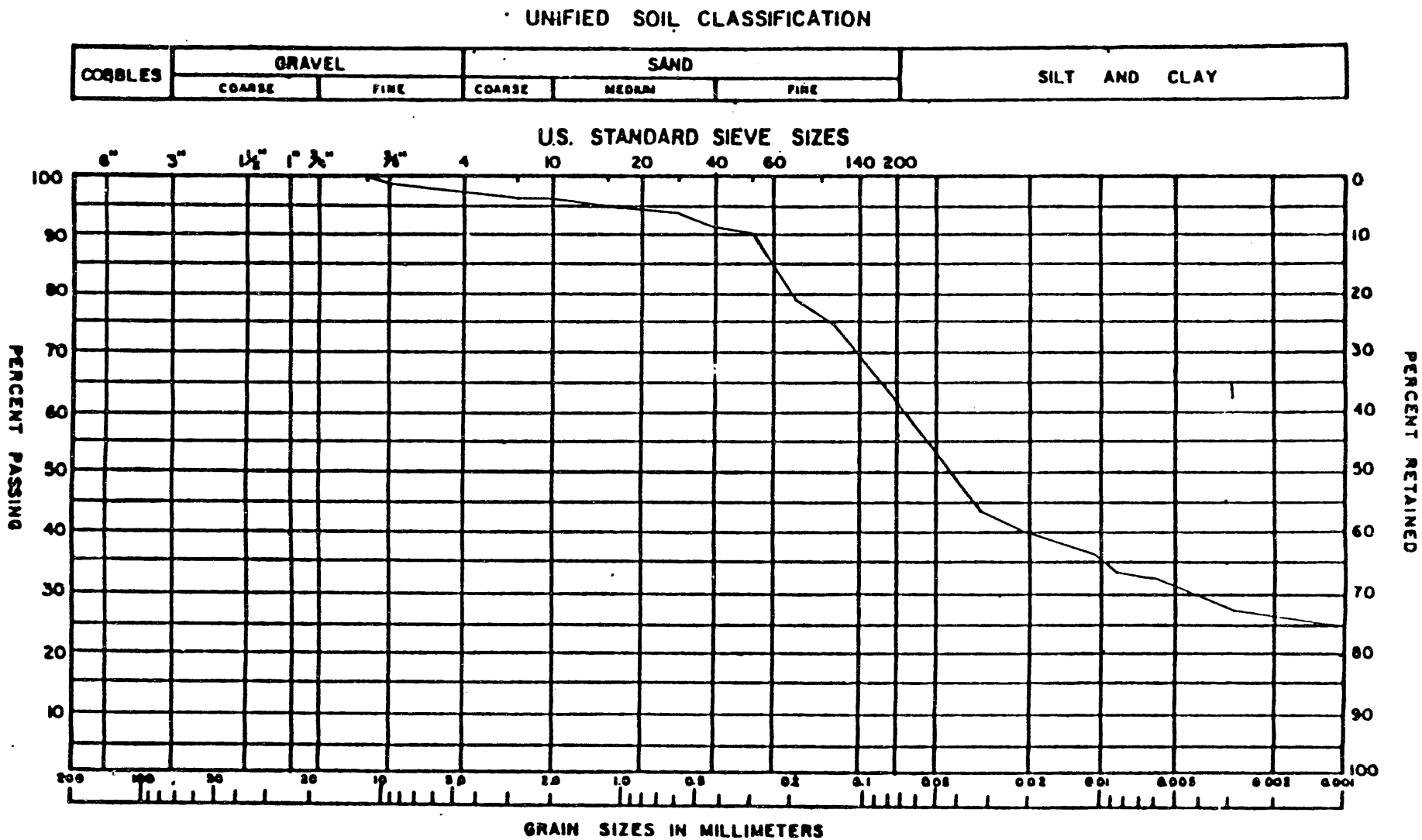
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-2	12½ to 17½	30	16	2.775	9.2	2674-C
CLASSIFICATION						

Project: Rifle Additional

Job Number: M2113GE

GRAIN SIZE DISTRIBUTION CURVES

Fig: 4



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-2	12½ to 17½	40	25	2.655	8.7	2674-D
CLASSIFICATION						

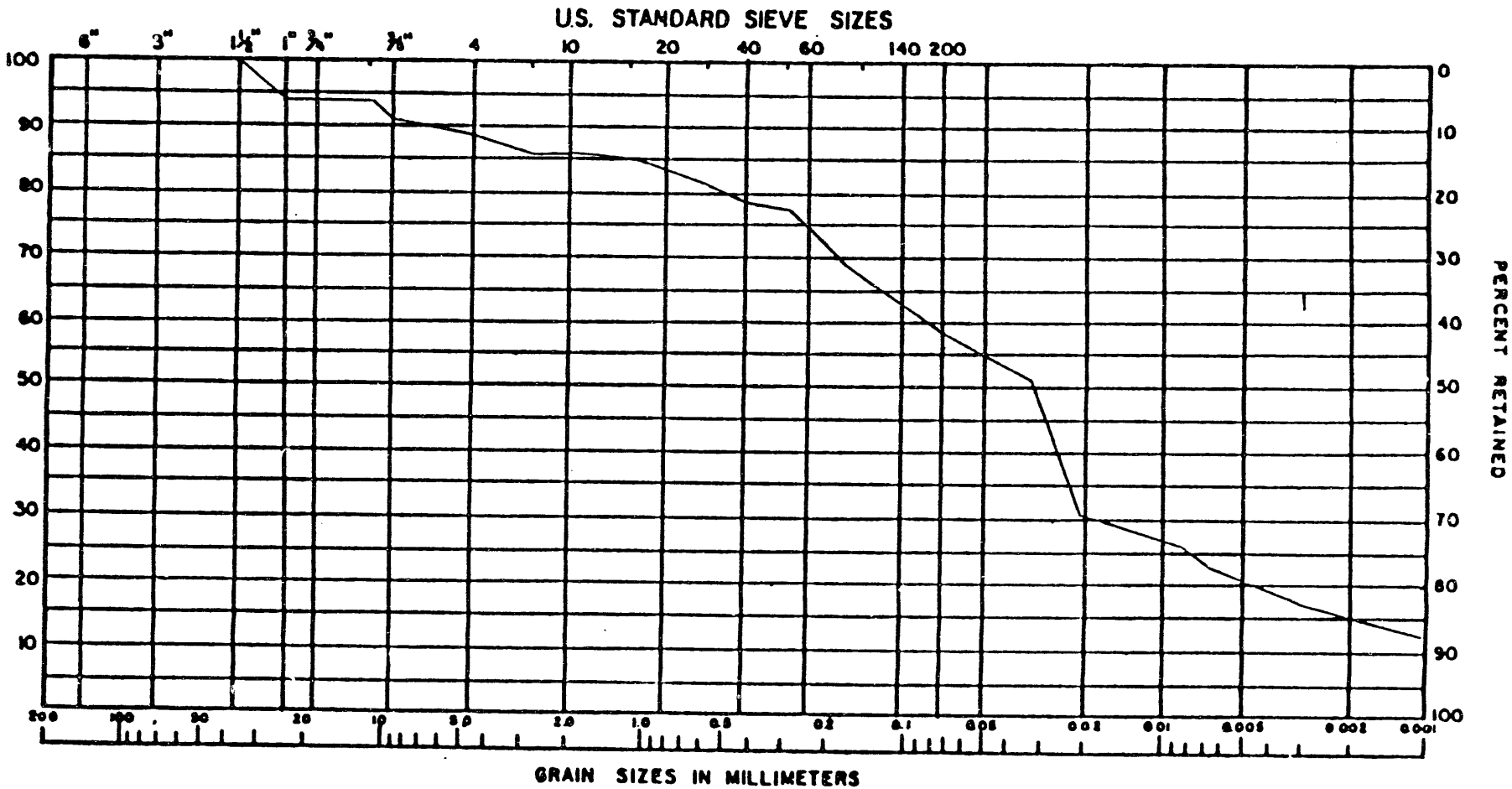
Project: Rifle Additional

Job Number: M-21306

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-9	15 to 20	30	14	2.617	8.6	2674-E
CLASSIFICATION						

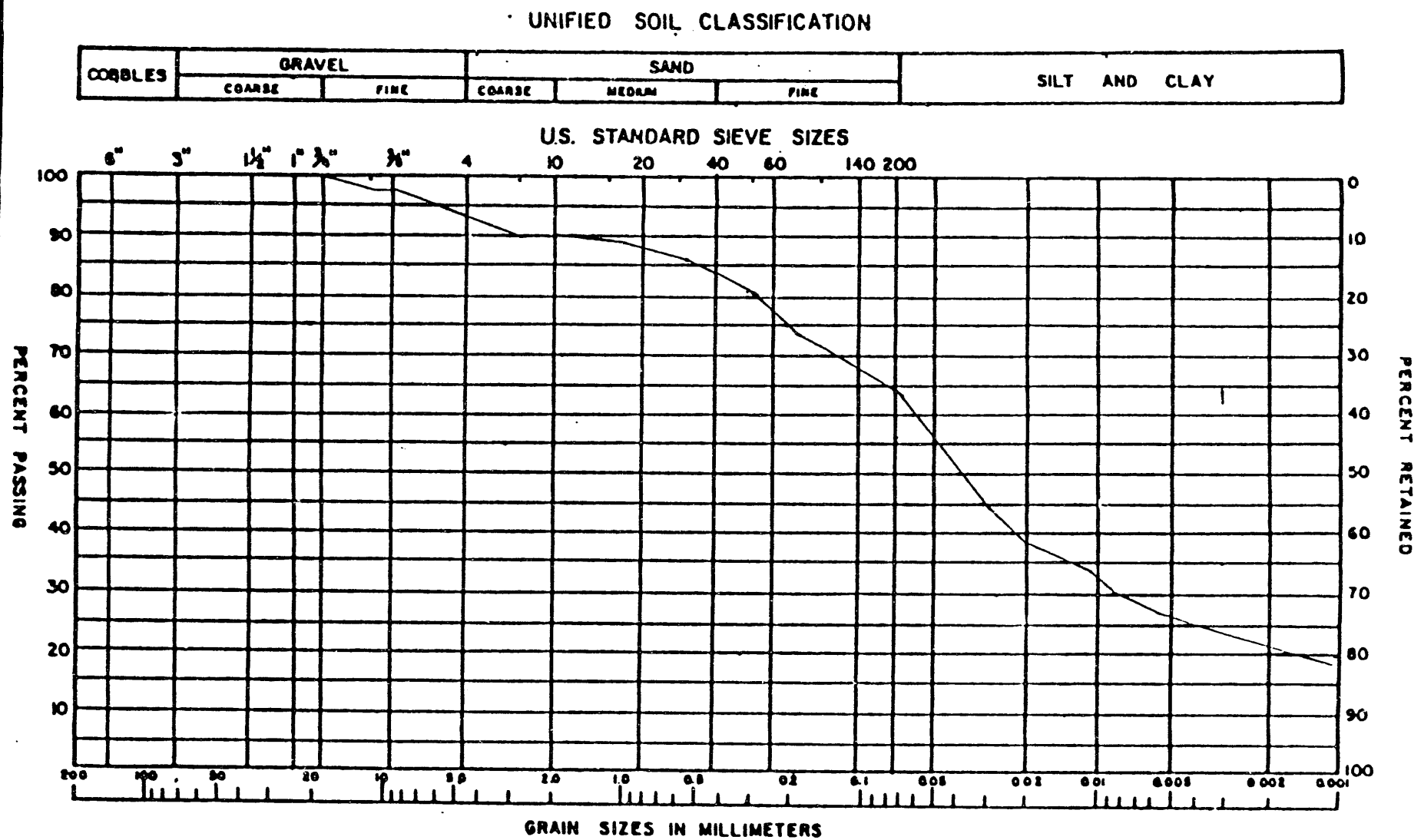
FIG 5

Project: Rifle Additional

Job Number: M88113GE

GRAIN SIZE DISTRIBUTION CURVES

Fig. 6

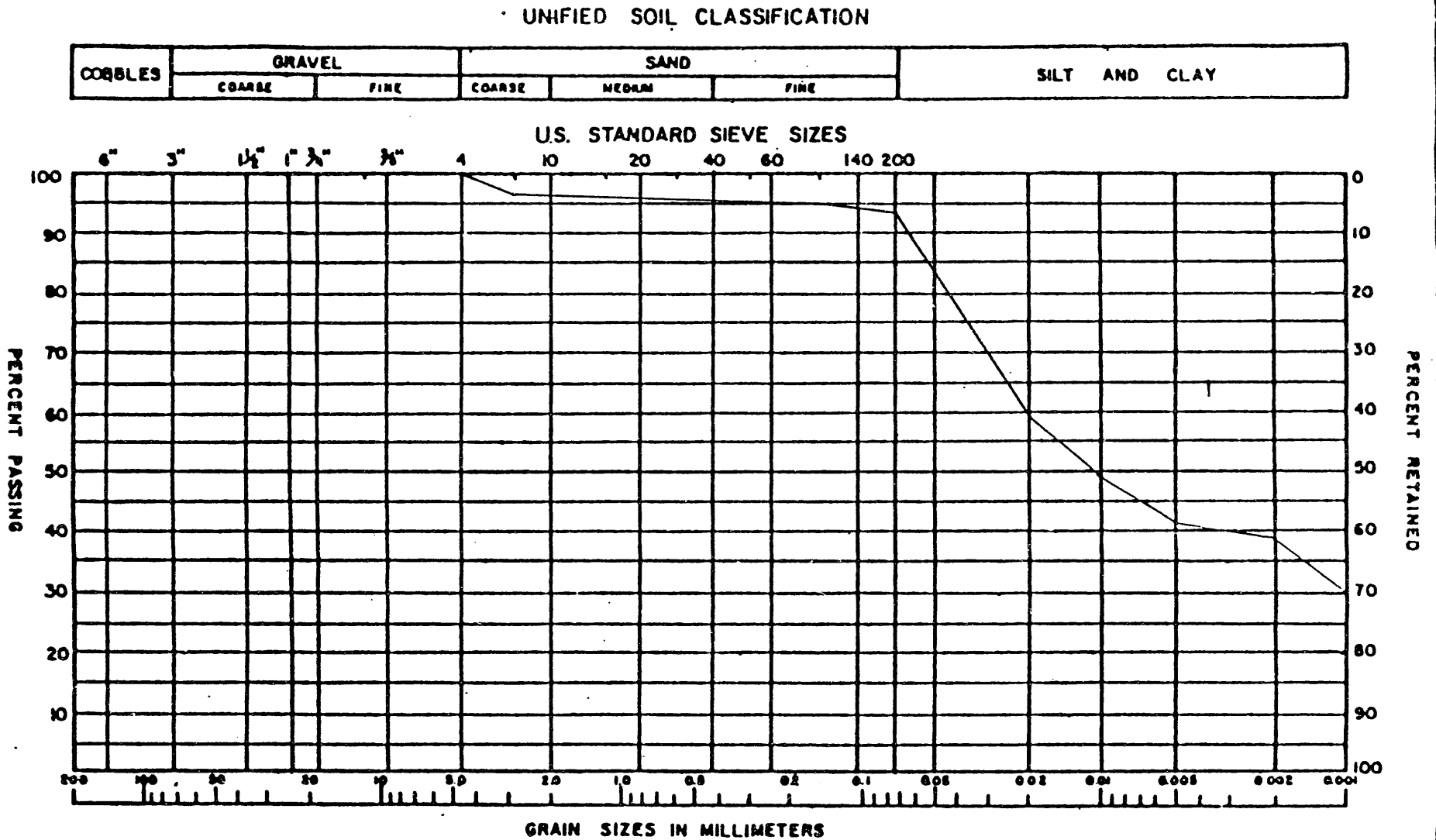


TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-9	15 to 20	42	26	2.730	8.4	2674-F
CLASSIFICATION						

Project: Rifle Additional

Job Number: M88113GE

GRAIN SIZE DISTRIBUTION CURVES



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MET-1	7½	62	43	2.744		2674-G
CLASSIFICATION						

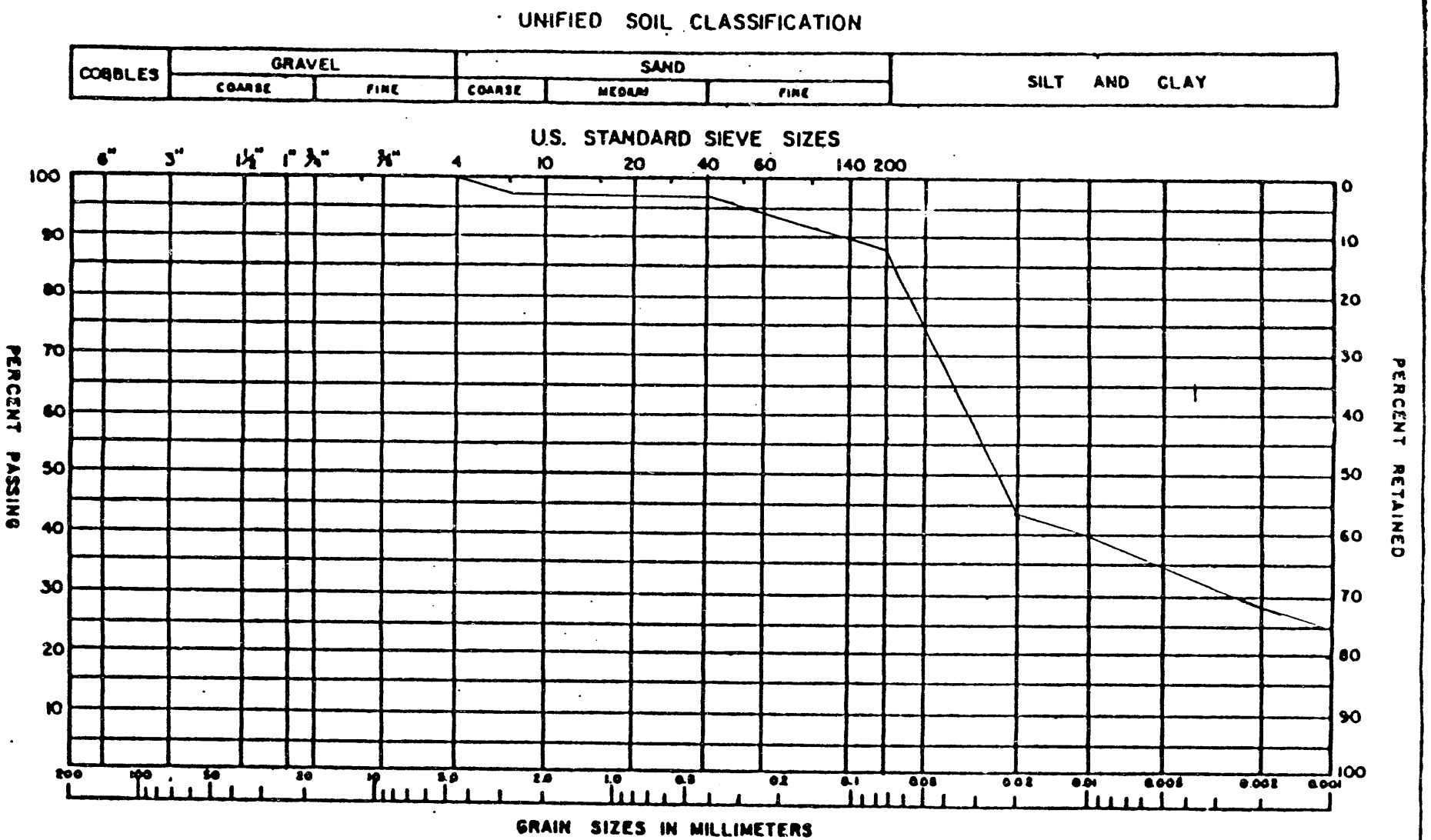
Fig 7

Project: Rifle Additional

Job Number: M8811 3GE

GRAIN SIZE DISTRIBUTION CURVES

Fig: 8

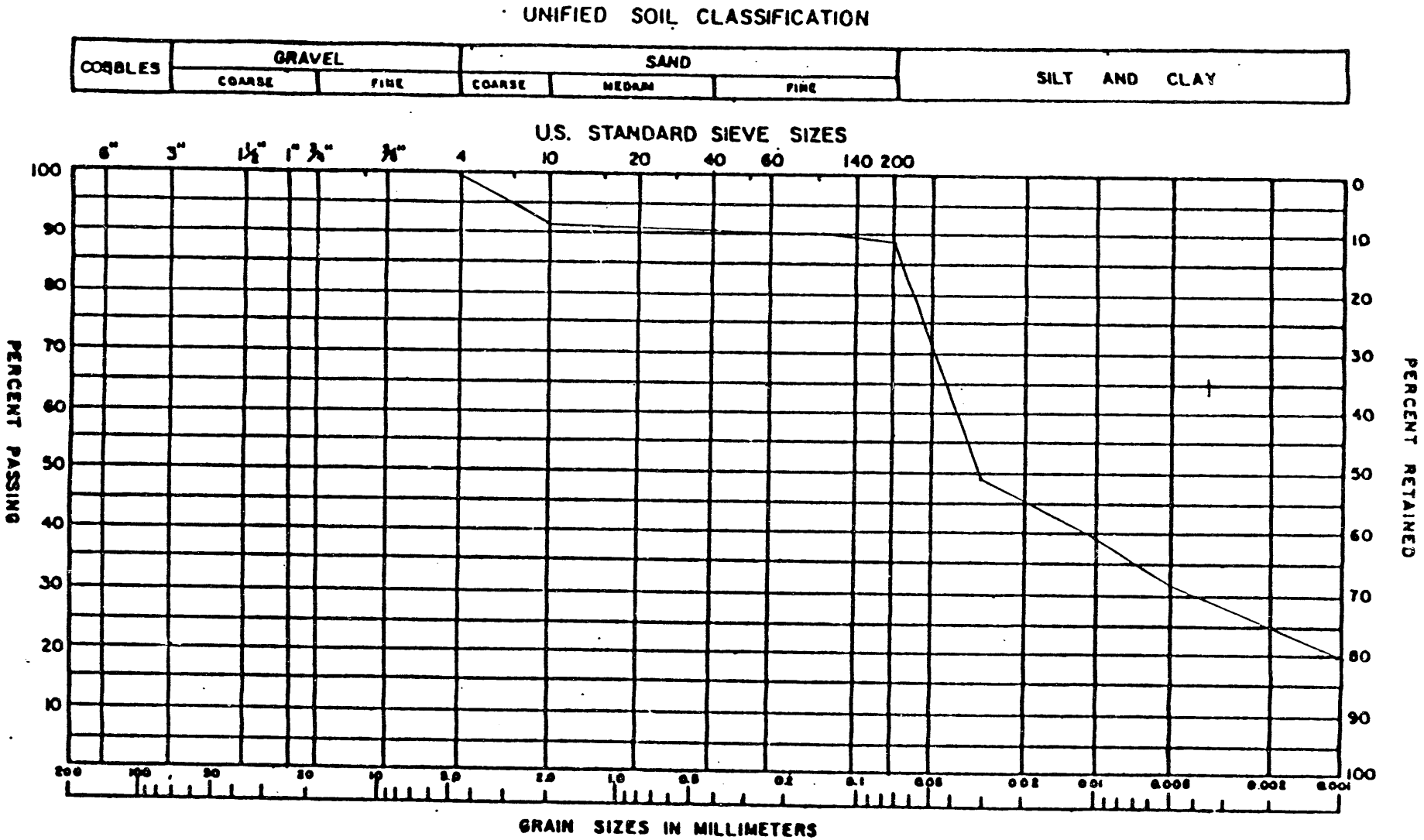


TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-2	12½ to 17½	56	38	2.628		2674-H
CLASSIFICATION						

Project: Rifle Additional

Job Number: M88113GE

GRAIN SIZE DISTRIBUTION CURVES

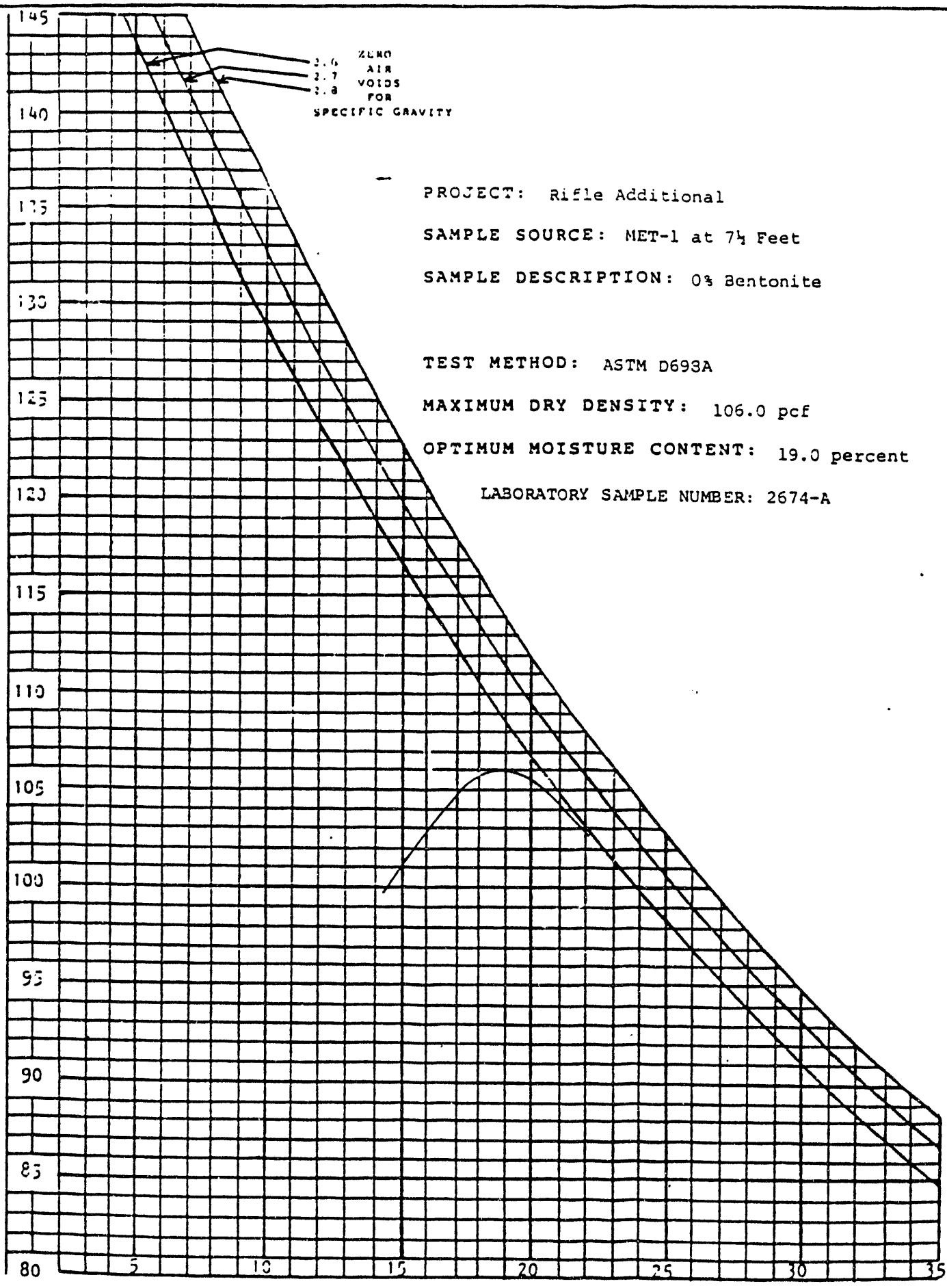


TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MEB-9	15 to 20	70	55	2.722		2674-I
CLASSIFICATION						

Fig: 9

PERMEABILITY TEST RESULTS

TEST HOLE NUMBER	DEPTH (FEET)	RELATIVE COMPACTION	BENTONITE (PERCENT)	PERMEABILITY (CM/S)
MET-1	7½	95%	0	4.5×10^{-7}
MET-1	7½	100%	0	1.5×10^{-7}
MET-1	7½	95%	7	3.7×10^{-8}
MET-1	7½	100%	7	3.2×10^{-8}
MEB-2	12½ to 17½	95%	0	5.4×10^{-8}
MEB-2	12½ to 17½	95%	7	2.7×10^{-8}
MEB-2	12½ to 17½	100%	7	1.9×10^{-8}
MEB-9	15 to 20	95%	0	5.3×10^{-8}
MEB-9	15 to 20	100%	7	5.0×10^{-8}
MET-1	7½	95%	14	2.6×10^{-8}
MET-1	7½	100%	14	1.5×10^{-8}
MEB-2	12½ to 17½	95%	14	5.2×10^{-9}
MEB-2	12½ to 17½	100%	14	5.0×10^{-9}
MEB-9	15 to 20	95%	14	1.1×10^{-8}
MEB-9	15 to 20	100%	14	1.1×10^{-8}



PROJECT: Rifle Additional

SAMPLE SOURCE: MET-1 at 7½ Feet

SAMPLE DESCRIPTION: 0% Bentonite

TEST METHOD: ASTM D693A

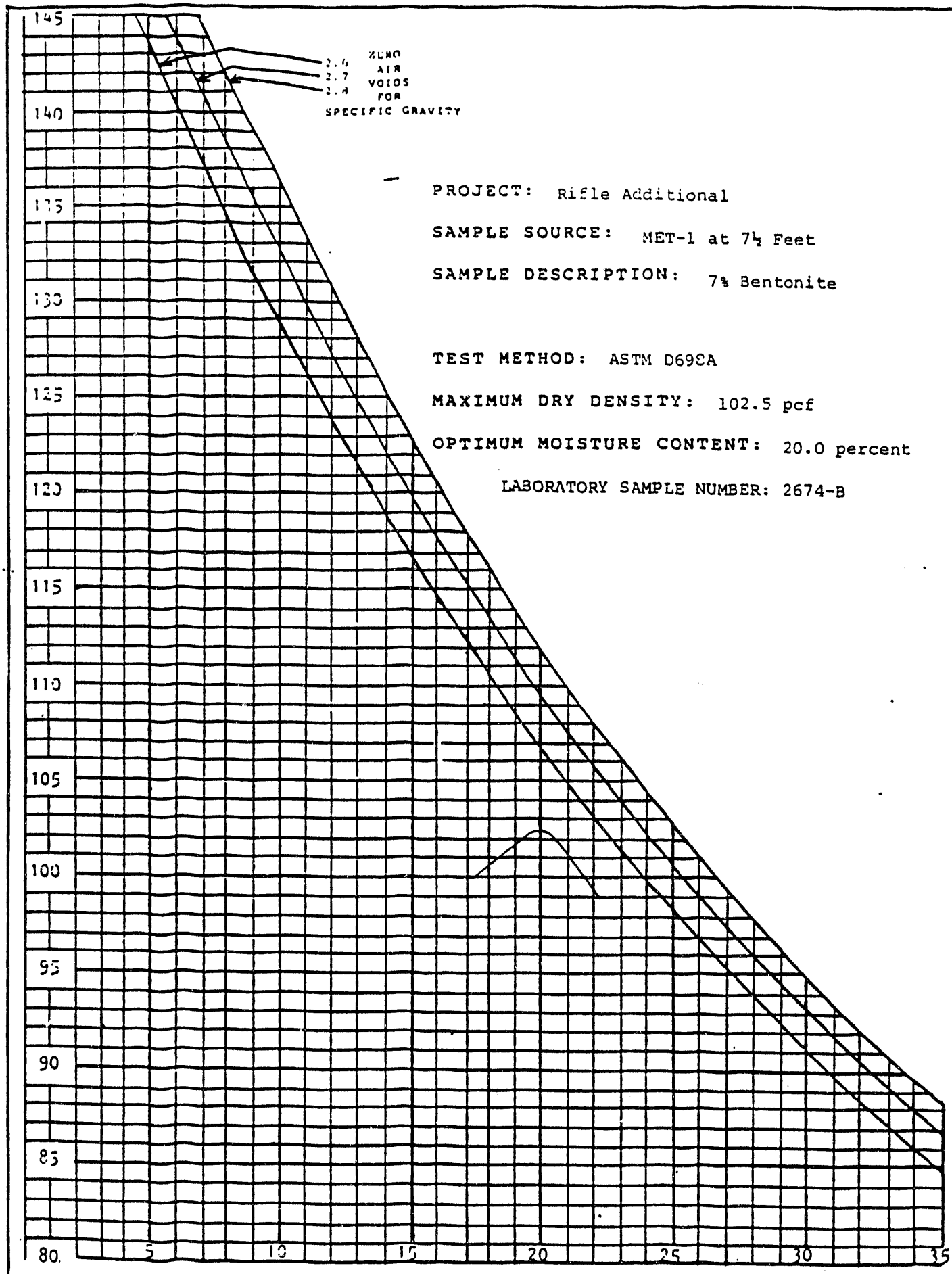
MAXIMUM DRY DENSITY: 106.0 pcf

OPTIMUM MOISTURE CONTENT: 19.0 percent

LABORATORY SAMPLE NUMBER: 2674-A

Lambert and Associates

Project No.:	M88113GE
Date:	2/15/89



PROJECT: Rifle Additional

SAMPLE SOURCE: MET-1 at 7½ Feet

SAMPLE DESCRIPTION: 7% Bentonite

TEST METHOD: ASTM D698A

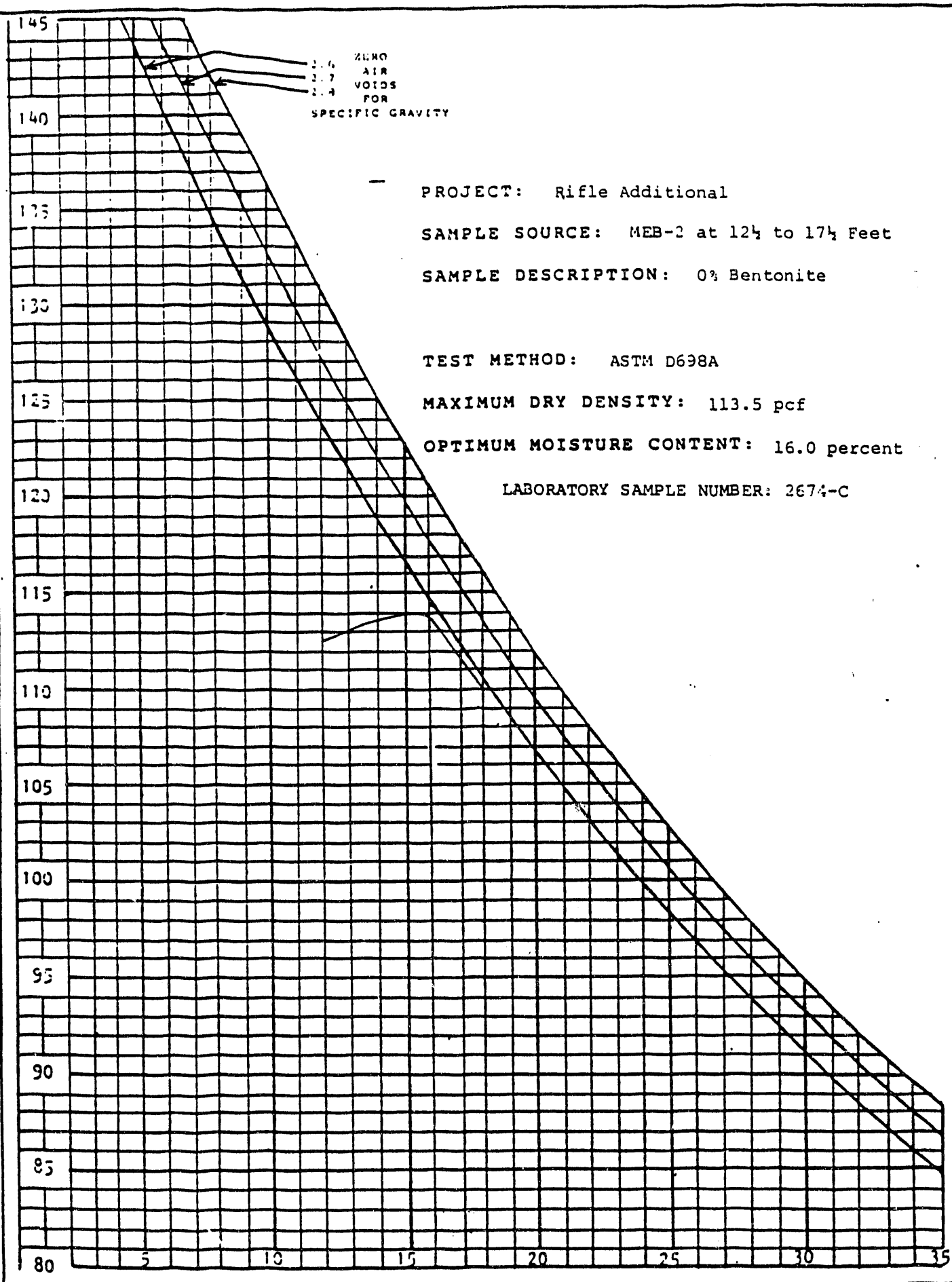
MAXIMUM DRY DENSITY: 102.5 pcf

OPTIMUM MOISTURE CONTENT: 20.0 percent

LABORATORY SAMPLE NUMBER: 2674-B

Lambert and Associates

Project No.:	M88113GE
Date:	2/15/89
Figure:	12



PROJECT: Rifle Additional

SAMPLE SOURCE: MEB-2 at 12½ to 17½ Feet

SAMPLE DESCRIPTION: 0% Bentonite

TEST METHOD: ASTM D698A

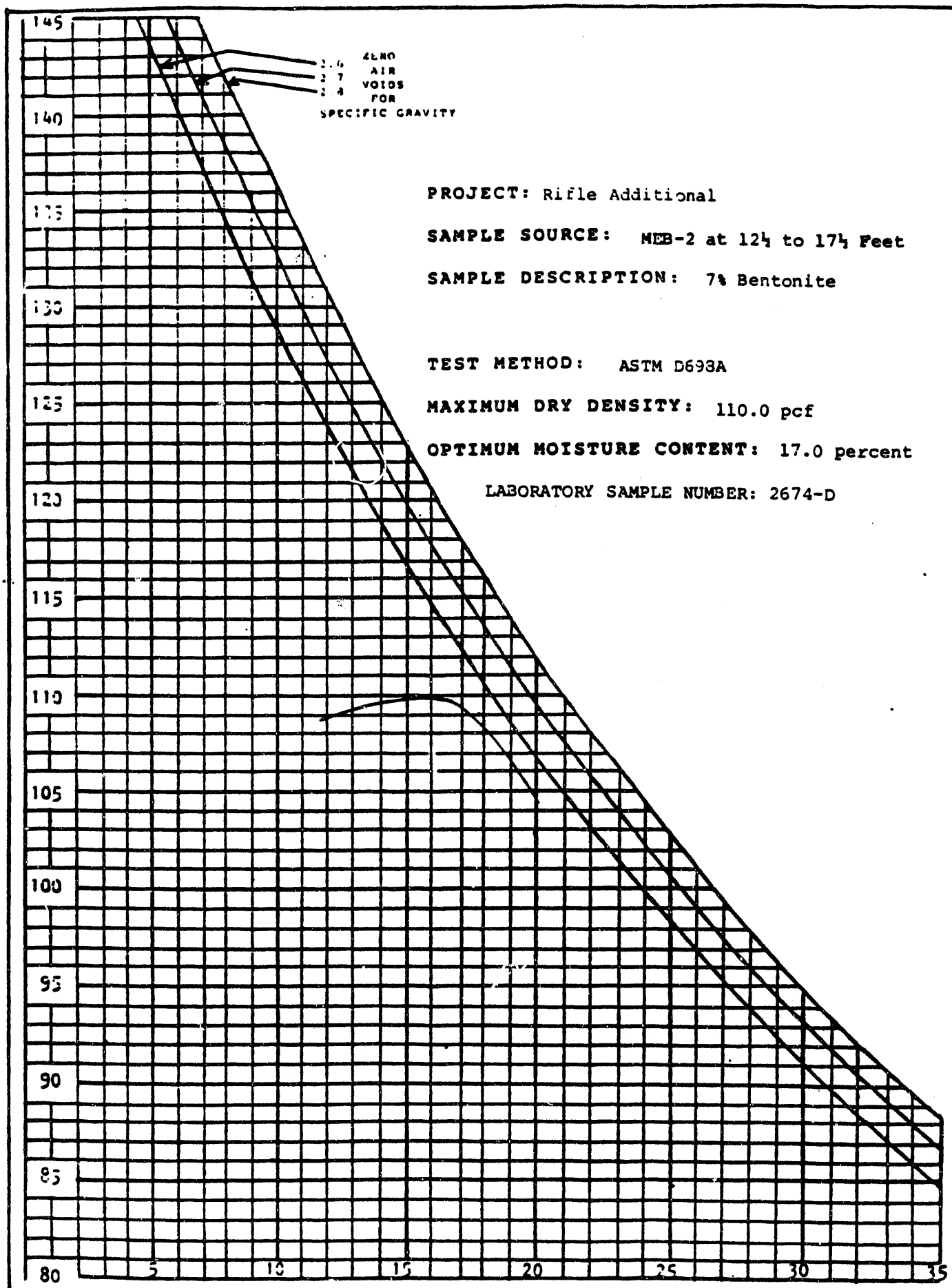
MAXIMUM DRY DENSITY: 113.5 pcf

OPTIMUM MOISTURE CONTENT: 16.0 percent

LABORATORY SAMPLE NUMBER: 2674-C

Lambert and Associates

Project No.:	M88113GE
Date:	2/15/89
Figure:	13



PROJECT: Rifle Additional

SAMPLE SOURCE: MEB-2 at 12½ to 17½ Feet

SAMPLE DESCRIPTION: 7% Bentonite

TEST METHOD: ASTM D693A

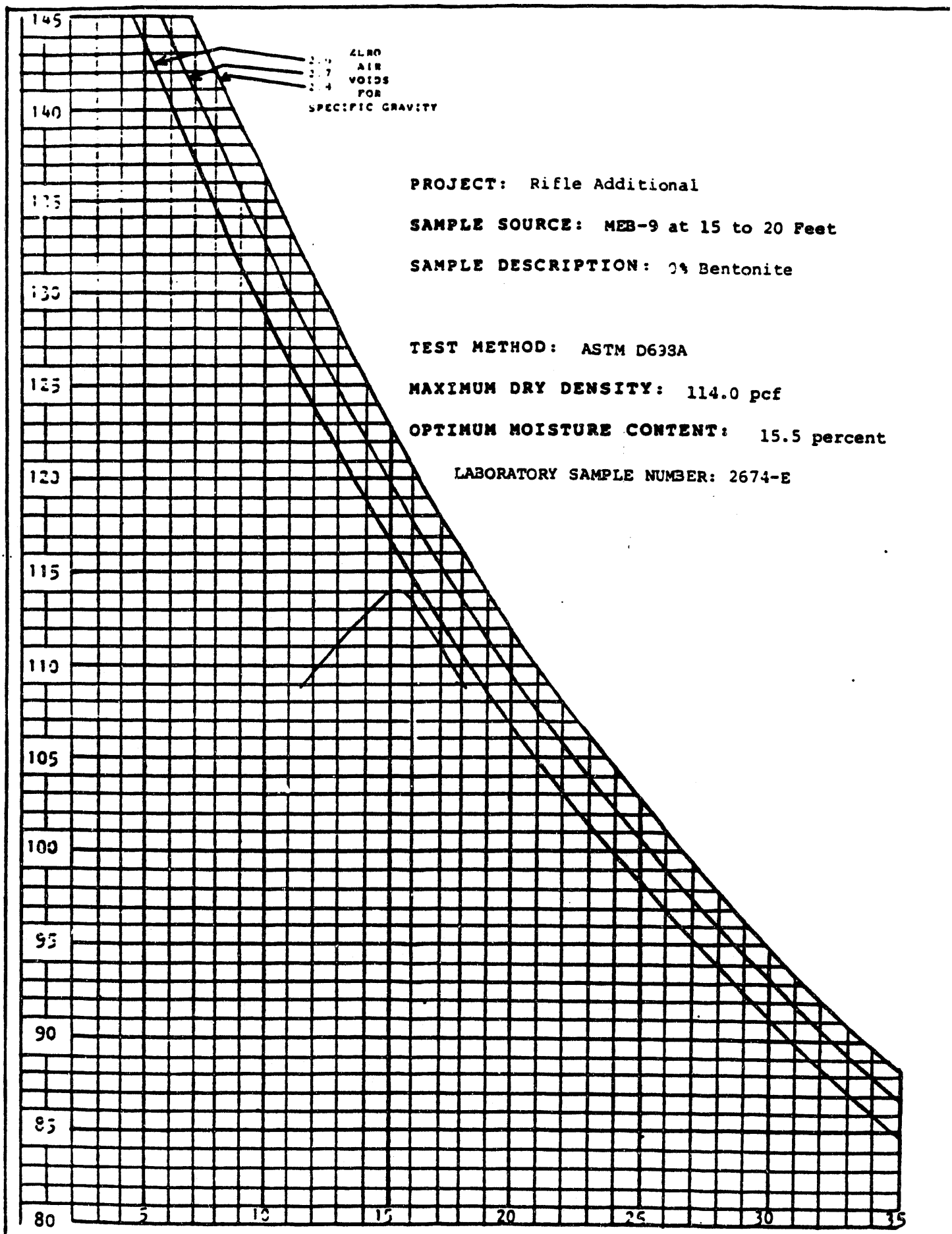
MAXIMUM DRY DENSITY: 110.0 pcf

OPTIMUM MOISTURE CONTENT: 17.0 percent

LABORATORY SAMPLE NUMBER: 2674-D

Lambert and Associates

Project No.:	M88113GE
Date:	2/15/89
Figure:	14



PROJECT: Rifle Additional

SAMPLE SOURCE: MEB-9 at 15 to 20 Feet

SAMPLE DESCRIPTION: 0% Bentonite

TEST METHOD: ASTM D698A

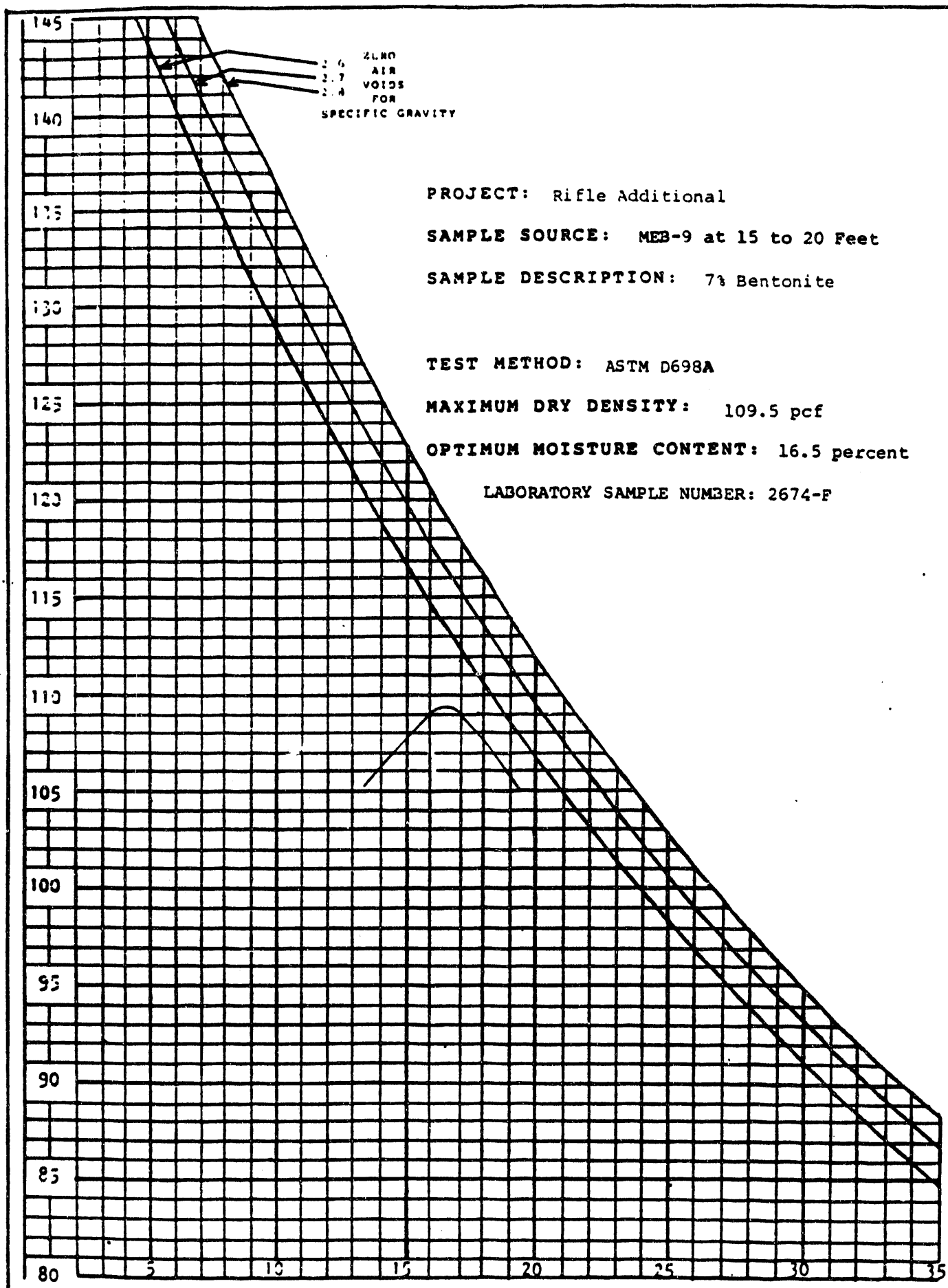
MAXIMUM DRY DENSITY: 114.0 pcf

OPTIMUM MOISTURE CONTENT: 15.5 percent

LABORATORY SAMPLE NUMBER: 2674-E

Lambert and Associates

Project No.:	M88113GE
Date:	2/15/89
Figure:	15



PROJECT: Rifle Additional

SAMPLE SOURCE: MEB-9 at 15 to 20 Feet

SAMPLE DESCRIPTION: 7% Bentonite

TEST METHOD: ASTM D698A

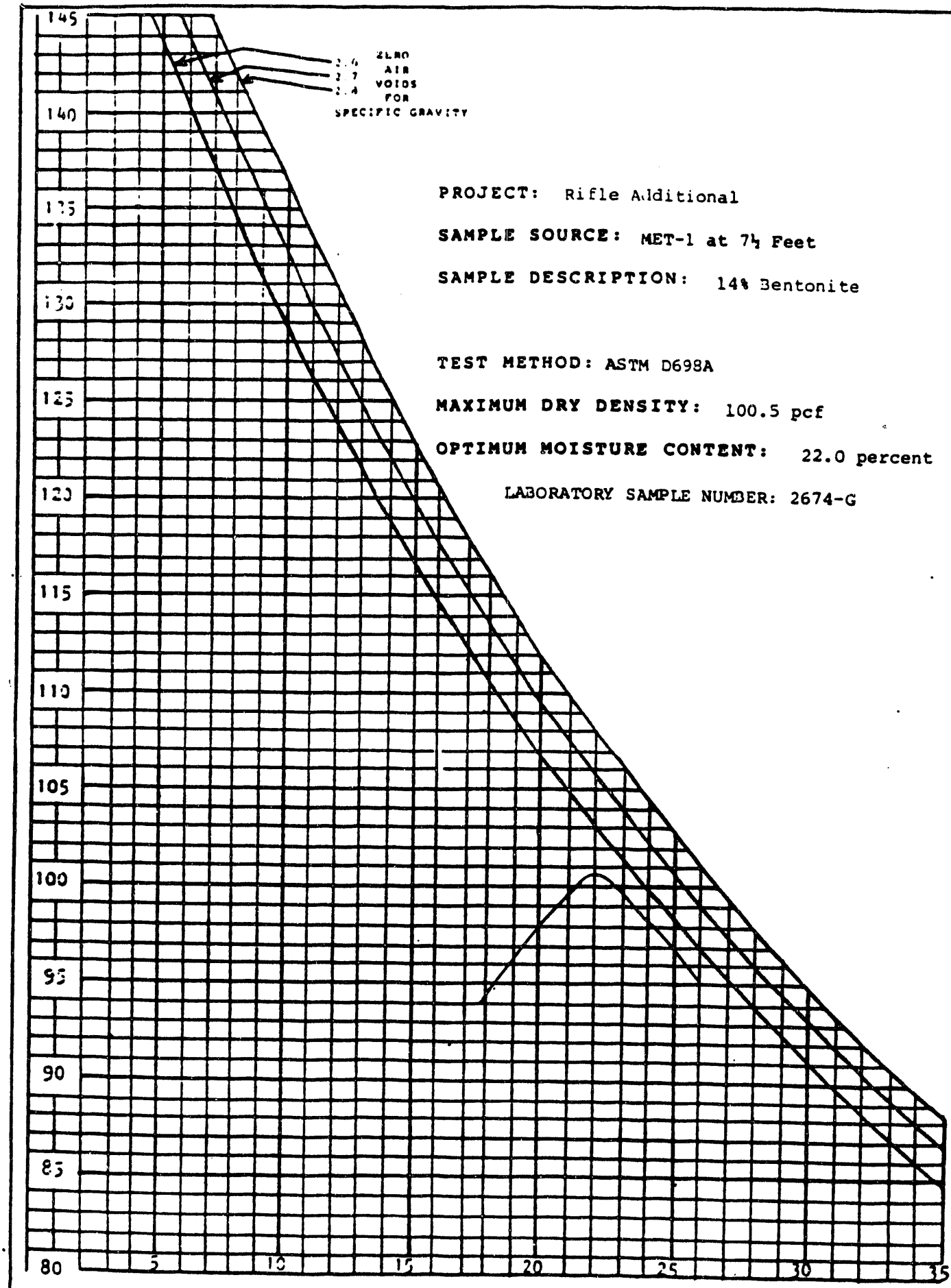
MAXIMUM DRY DENSITY: 109.5 pcf

OPTIMUM MOISTURE CONTENT: 16.5 percent

LABORATORY SAMPLE NUMBER: 2674-F

Lambert and Associates

Project No.:	M88113GE
Date:	2/15/89
Figure:	16



PROJECT: Rifle Additional

SAMPLE SOURCE: MET-1 at 7½ Feet

SAMPLE DESCRIPTION: 14% Bentonite

TEST METHOD: ASTM D698A

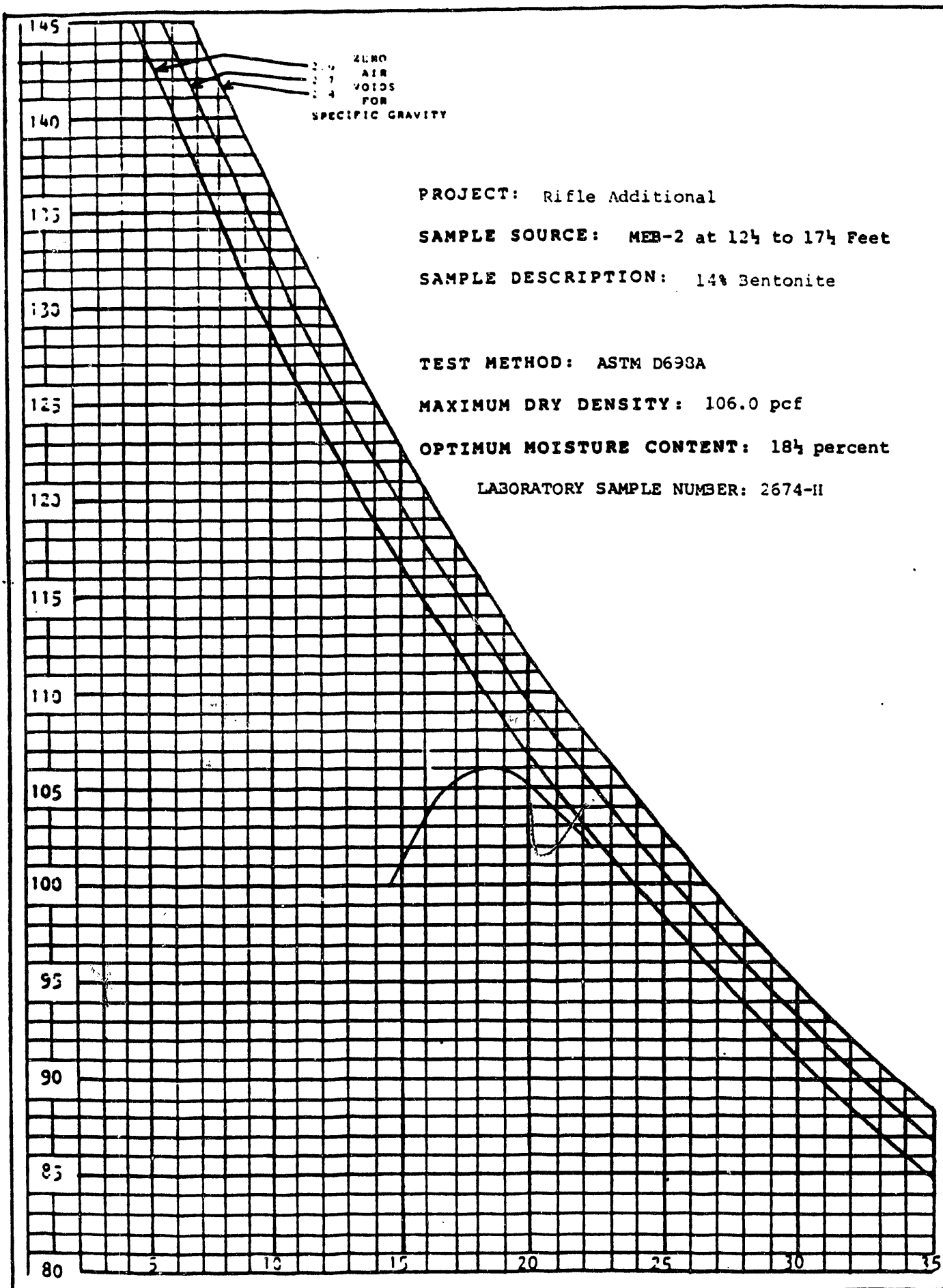
MAXIMUM DRY DENSITY: 100.5 pcf

OPTIMUM MOISTURE CONTENT: 22.0 percent

LABORATORY SAMPLE NUMBER: 2674-G

Lambert and Associates

Project No.:	M88113GE
Date:	2/15/89
Figure:	17



PROJECT: Rifle Additional

SAMPLE SOURCE: MEB-2 at 12½ to 17½ Feet

SAMPLE DESCRIPTION: 14% Bentonite

TEST METHOD: ASTM D698A

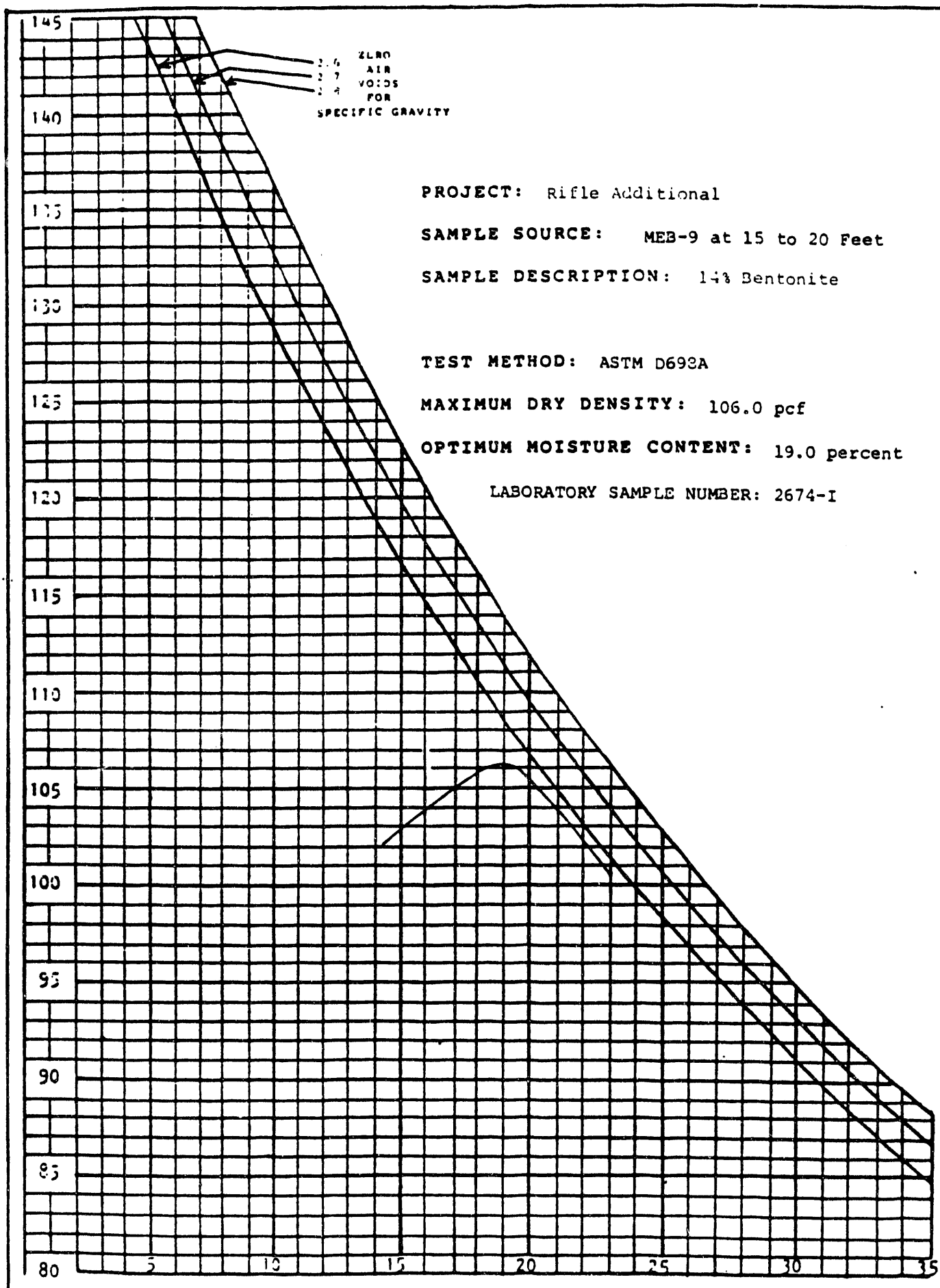
MAXIMUM DRY DENSITY: 106.0 pcf

OPTIMUM MOISTURE CONTENT: 18½ percent

LABORATORY SAMPLE NUMBER: 2674-H

Lambert and Associates

Project No.:	M38113GE
Date:	2/15/89
Figure:	18



PROJECT: Rifle Additional

SAMPLE SOURCE: MEB-9 at 15 to 20 Feet

SAMPLE DESCRIPTION: 14% Bentonite

TEST METHOD: ASTM D698A

MAXIMUM DRY DENSITY: 106.0 pcf

OPTIMUM MOISTURE CONTENT: 19.0 percent

LABORATORY SAMPLE NUMBER: 2674-I

Lambert and Associates

Project No.:	MC9113GE
Date:	2/15/89
Figure:	19

ADDENDUM D7

LABORATORY TEST DATA
ON BENTONITE AMENDED RADON BARRIER MATERIAL

UMTRA - RIFLE
PERMEABILITY OF RADON BARRIER AMENDED WITH BENTONITE

Attached are the completed test results and analyses of laboratory testing programs to determine the permeability of radon barrier materials from Estes Gulch when amended with bentonite.

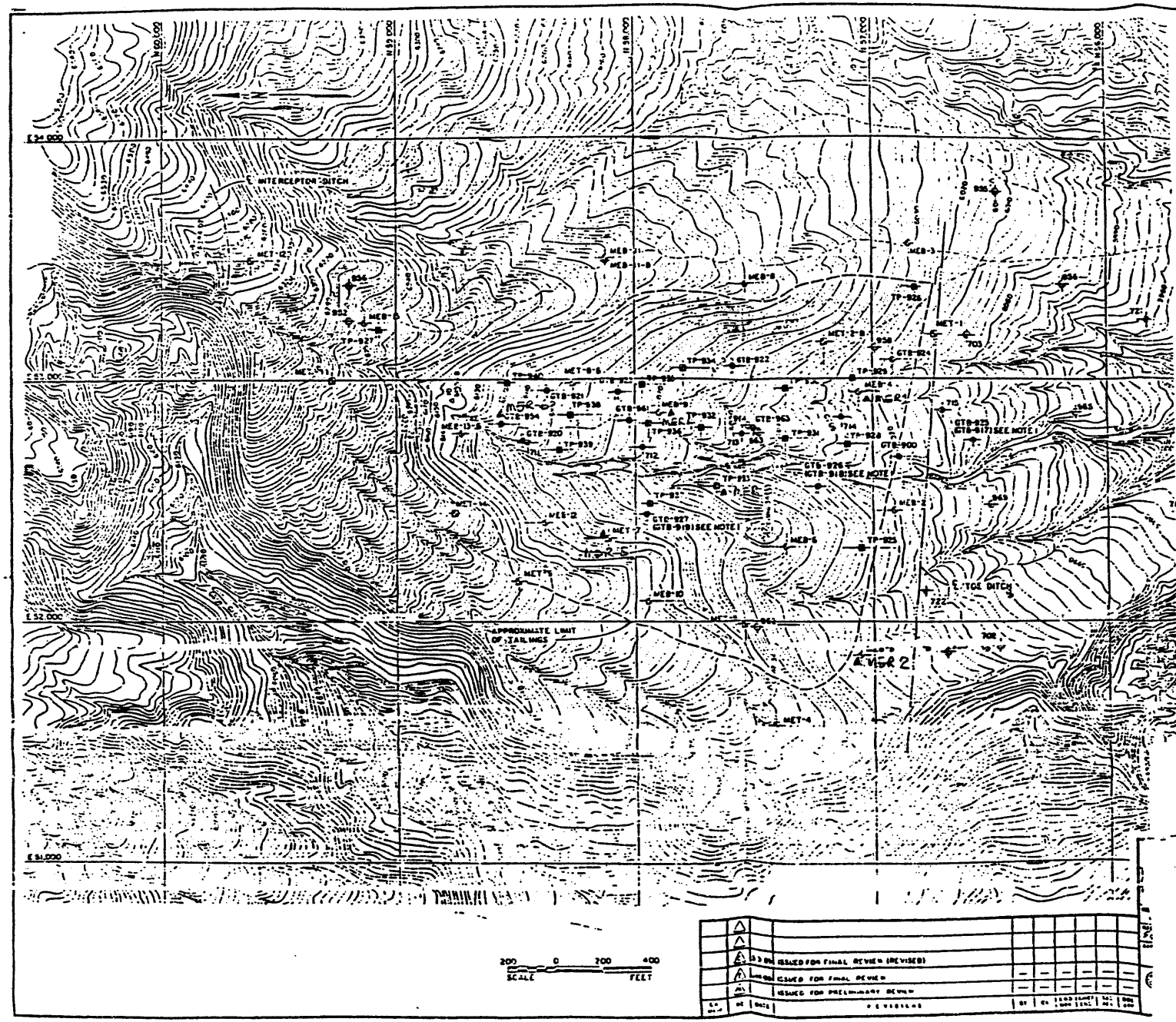
The latest test results are for radon barrier material amended with 10% bentonite and compacted to 100% of Standard Proctor. The samples of radon barrier material were taken from test pits MER 1, 3, 4 and 5. Previously, tests were performed on samples mixed with 0, 7 and 14 percent bentonite and compacted to both 95 and 100% of Standard Proctor.

The results of the laboratory testing programs (shown in the attachments) indicate that mixing the radon barrier materials with 10% bentonite, and compacting to 100% of Standard Proctor would produce a hydraulic conductivity of approximately 0.9×10^{-8} cm/sec. As noted in the previous report, there is no appreciable decrease in permeability when the amount of bentonite is increased beyond 10%.

The groundwater protection strategy requires that a maximum permeability of 2×10^{-8} cm/sec be ensured. Consequently, by specifying 10% bentonite, and 100% Standard Proctor compaction, a permeability of 2×10^{-8} cm/sec or less should be achieved. (See attached graph)

For construction, the bentonite will be mixed with the radon barrier materials in a pugmill before spreading. Thus bentonite losses will be minimized. If it is anticipated that some bentonite may be lost during field placement and compaction, the bentonite content could be increased to 11%.

Triaxial compression tests on radon barrier material amended with 10% bentonite are being performed. The stability of the embankment will be evaluated after these results have been received. All the other characterization test results have been received and are being evaluated.



NOTES:

1. THE HOLE NUMBERS IN PARENTHESIS ARE THE HOLE NUMBERS USED IN THE DRAFT RAP.
2. SEE SPECIFICATION SECTION 2090 FOR SEALING OF MONITORING WELLS.

REFERENCE DRAWINGS:

LEGEND:

- 712 — ANGLE HOLE BY UMTRA TECHNICAL ASSISTANCE CONTRACTOR
- 835 — MONITORING WELL BY UMTRA TECHNICAL ASSISTANCE CONTRACTOR
- GTB-922 — BOREHOLE BY UMTRA TECHNICAL ASSISTANCE CONTRACTOR
- TP-930 — TEST PIT BY UMTRA TECHNICAL ASSISTANCE CONTRACTOR
- MEB-6 — BORE HOLE BY MK-FERGUSON (1987)
- MET-4 — TEST PIT BY MK-FERGUSON (1987)
- ▲ MER 2 Test pit by MKF (1989)

3	8/90	ISSUED FOR FINAL REVIEW (REVISED)					
2	6/90	ISSUED FOR FINAL REVIEW	—	—	—	—	—
1		ISSUED FOR PRELIMINARY REVIEW	—	—	—	—	—
		REVISIONS	BY	CK			

Fig # 1

Test Pit & Boring Locations

Estes Gulch

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: AMTRA - RFL
Feature: Radon Barrier
Item:

Contract No. 5025-05
Designed: ABY
Checked:

Sheet 2 of 2
File No.
Date: 9-13-
Date:

RESULTS OF PERMEABILITY TESTS

Amended with 10% bentonite

Compacted to 100% max dry density (ASTM D6

Sample from Test Pits	K sat (cm/sec)	'B' value
MER 1 (8')	2.3×10^{-8}	98.2
MER 3 (2½')	7.5×10^{-9}	100
MER 4 (14')	2.1×10^{-9}	100
MER 5 (5')	7.5×10^{-10}	96.7

(See attached copy of Fig 1 for the location of the test pits)

Geometric Mean = 4.1×10^{-9} cm/sec

If the permeability of sample MER 5 is ignored (low B value, low permeability), then the geometric mean is

$$\sqrt[3]{2.3 \times 10^{-8} \times 7.5 \times 10^{-9} \times 2.1 \times 10^{-9}} = 7.1 \times 10^{-9} \text{ cm/sec (conserve}$$

This value is used in the analysis.

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Project: UMTRA - RFL
Feature:
Item:
Contract No.:
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Sheet:
File No.: 1-2
Date:
Date:

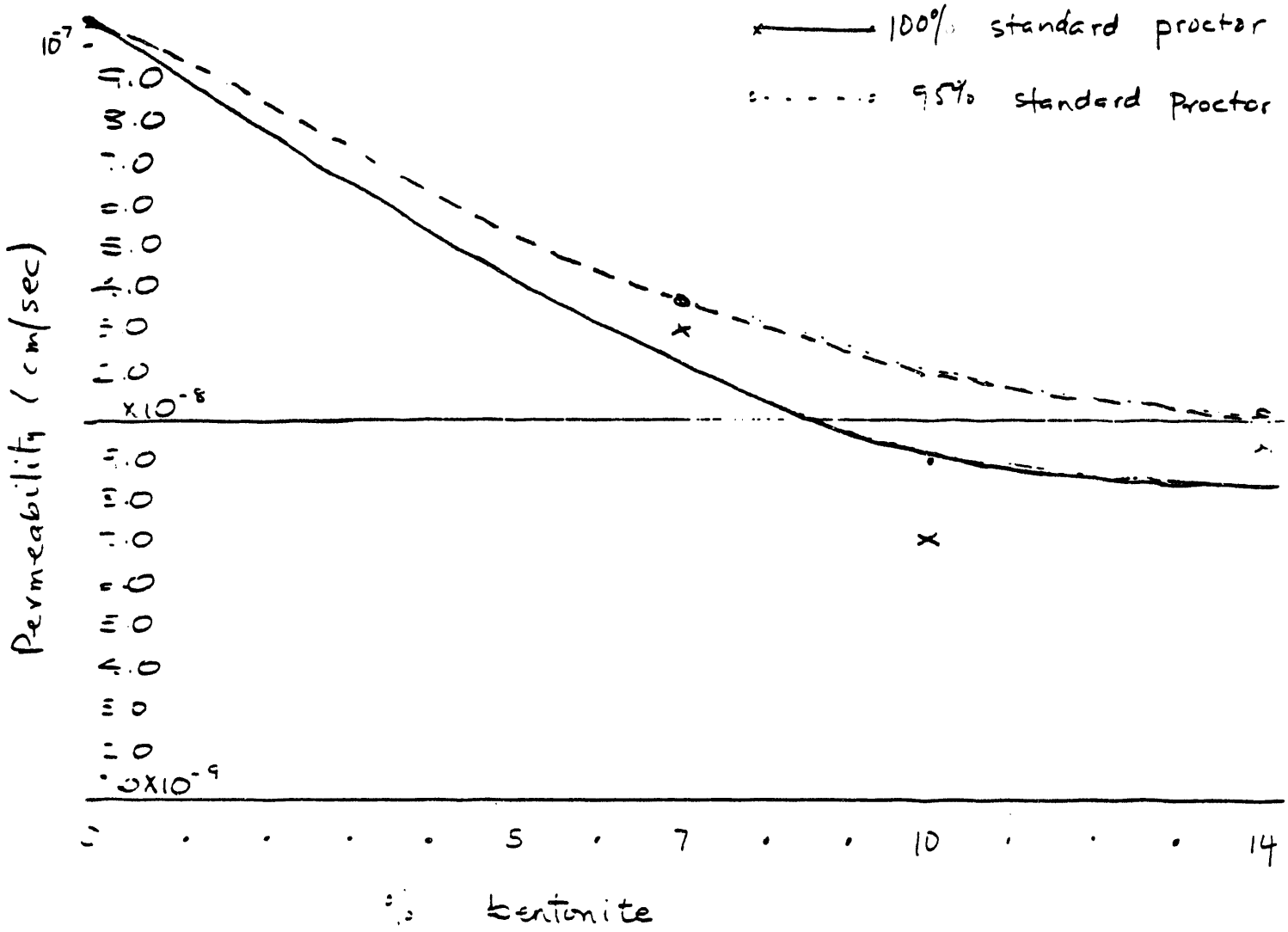
FINAL TEST RESULTS

Test Hole	MET - 1			MEB - 2			MEB - 9		
Sample depth									
	Permeability cm/sec			Permeability, cm/sec			Permeability, cm/sec		
Percent Bentonite	0	7	14	0	7	14	0	7	14
95% compaction	4.5×10^{-7}	3.7×10^{-8}	2.6×10^{-8}	5.4×10^{-8}	2.7×10^{-8}	5.2×10^{-9}	NP	5.3×10^{-8}	1.4×10^{-8}
100% compaction	1.5×10^{-7}	3.2×10^{-8}	1.5×10^{-8}	NP	1.9×10^{-8}	5.0×10^{-9}	NP	5.0×10^{-8}	1.1×10^{-8}

NP - Not performed

Geometric Mean of Permeability

	Compaction 95%	Compaction 100%
0% bentonite	1.6×10^{-7}	1.5×10^{-7}
7% bentonite	3.8×10^{-8}	3.1×10^{-8}
14% bentonite	1.2×10^{-8}	9.4×10^{-9}



CONCLUSIONS

To achieve a permeability of 2×10^{-8} cm/sec or less, the radon barrier should be amended with 10% bentonite (min.) and compacted to 100 percent maximum density (ASTM D698). From the above graph, a permeability of about 0.9×10^{-8} cm/sec should be achieved. The bentonite is to be mixed

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Project UMTRA-REL
Feature Radon Barrier
Item Hydraulic Conductivity

Contract No. 5025-05
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Checked

Sheet 5
File No.
Date 9-25
Date

in a pugmill, thus losses from field mixing will be minimised. Also by specifying 100% compactive effort, we can be assured of a minimum compactive effort greater than say 98%. This will ensure a permeability value less than 2×10^{-8} cm/sec.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: UMTRA - Rifle
Feature: Radon Barrier
Item: Hydraulic Conductivity

Contract No. 5025-05
Designed: ABY
Checked:

Sheet 6 of 2
File No.
Date: 9-25-
Date:

LABORATORY TEST DATA

Lambert and Associates

CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

PERMEABILITY TEST

PROJECT NUMBER M88113-E DATE 12-14-88

PROJECT NAME P. Site (add.) TECHNICIAN D N

TEST HOLE MET-1 DEPTH 7½' LABORATORY SAMPLE NO. 2674-A

SAMPLE LENGTH 2.5 in. SAMPLE DIAMETER 1.251 in. SAMPLE AREA 1.229 in²

SAMPLE DESCRIPTION clay, remolded to 95% of 105.5 pcf @ 19.0% OMC

Cell #5

Dec. 30, 88
B = 100%
Cell = 13 psi

TIME	Δt (sec)	Head (psi)	ΔH	Cum. Q (mL)
1756:10	0	10		0
1859:00	3770	10		1.55

PRELIMINARY

K =

$$K = \frac{QL}{Aht} = \frac{(1.55)(2.5)}{(1.229)(3.54)^2(10)(2.x7)(12)(3770)} = 4.5 \times 10^{-7} \text{ cm/s}$$

✓ AD

After Test mc

Tare BC = 11.9

Tare + wet = 114.2

Tare + dry = 95.0

m.c. = 23.1%

✓ AD

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DURANGO, CO 81301
(303) 259-5095

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PERMEABILITY TEST

PROJECT NUMBER M88113C-E DATE 12-14-88

PROJECT NAME Rifle (old) TECHNICIAN C.N.

TEST HOLE MET-1 DEPTH 7½' LABORATORY SAMPLE NO. 2674-A

SAMPLE LENGTH 2.5 SAMPLE DIAMETER 1.281 in. SAMPLE AREA 1.289 in²

SAMPLE DESCRIPTION clay remolded to 100% of 105.5 pcf @ 19.0% OMC

Cell #4

Dec. 30, 88
B = 100%
Cell = 13 psi

TIME (hr:)	Δt (sec)	Head (psi)	ΔH	Cum Q (mL)
1642:45	0	10		0
1743:00	3615	10		0.5

PRELIMINARY

K =

$$K = \frac{QL}{Aht} = \frac{(0.5)(2.5)}{(1.289)(2.54)^2(10)(2.307)(12)(3615)} = 1.5 \times 10^{-7}$$

✓ GCD

AFTER TEST MC

Tare A1 = 8.9

Tare + wet = 116.7 ✓ GCD

Tare + dry = 96.4

MC = [redacted]

= 23.2%

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PERMEABILITY TEST

PROJECT NUMBER M 90113 GE DATE 12-12-85

PROJECT NAME R.Sle (redd) TECHNICIAN D.N.

TEST HOLE MET-1 DEPTH 7½' LABORATORY SAMPLE NO. 2674-0

SAMPLE LENGTH 2.5 in. SAMPLE DIAMETER 1.281 in SAMPLE AREA 1.289 in²

SAMPLE DESCRIPTION Clay w/7% Bent. Blend remolded to 95% of 102.5 pcf @ 200% omc

Cell #6

Dec. 31, 88
B = 100%
Cell = 13 psi

TIME (hrs)	Δt (sec)	Head (psi)	ΔH	Cum. Q (mL)
1419:06	0	8		19.0
1520:00	3654	8		19.1

PRELIMINARY

K =

$$K = \frac{QL}{AHt} = \frac{(.1)(2.5)}{(1.289)(2.54)^2(8)(2.307)(12)(3654)} = 3.7 \times 10^{-8} \text{ cm/s}$$

After Test mc
Tare 9 = 8.2
Tare + wet = 110.9
Tare + dry = 84.1
mc = 26.9%

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PERMEABILITY TEST

PROJECT NUMBER MPS 113 C-E DATE 12-12-88

PROJECT NAME Rifle (add.) TECHNICIAN D.N

TEST HOLE MET-1 DEPTH 7½' LABORATORY SAMPLE NO. 2674-B

SAMPLE LENGTH 2.5 in. SAMPLE DIAMETER 1.281 in. SAMPLE AREA 1.[illegible] in²

SAMPLE DESCRIPTION clay w/7% Bent. blend remolded to 100% of 92.5 pcf @ 20% OMC

Cell #7

Dec 30, 88
B = 100%
Cell = 12 psi

TIME (hrs)	Δt (sec)	Head (psi)	ΔH	cum Q (ml)
0852:48	0	9		4.0
1051:38	7130	10		4.2

PRELIMINARY

K =

$$K = \frac{QL}{Aht} = \frac{(.2)(2.5)}{(1.289)(2.54)^2(9.5)(2.307)(12)(7130)} = 3.2 \times 10^{-8} \text{ cm/s}$$

After Test MC.

Tare K = 8.2
Tare + wet = 121.2
Tare + dry = 99.2
MC = 24.2%

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PERMEABILITY TEST

PROJECT NUMBER M85113 G-E DATE 12-30-85

PROJECT NAME R.S/C (old) TECHNICIAN D.N.

TEST HOLE MET-1 DEPTH 7½' LABORATORY SAMPLE NO. 2674-G

SAMPLE LENGTH 2.5" SAMPLE DIAMETER 1.281" SAMPLE AREA 1.289 in

SAMPLE DESCRIPTION Clay w/14% Bent. Blend remolded to 100% of 100.5 pcf @ 22% OM

Cell #2

: cell = 13 psi
? = 100%
on 1-6-89

TIME (hrs)	Δt (sec)	Head (psi)	~~Δq~~	CUM q (mL)
1343:00	0	10		4.0
1443:00	3600	10		4.05

PRELIMINARY

K =

$$K = \frac{Qh}{Aht} = \frac{(.05)(2.5)}{(1.289)(2.54)^2(10)(2.3027)(12)(3600)} = 1.5 \times 10^{-8}\ cm/s$$

After test MC.
Tare BZ = 3.9
Tare + wet = 109.2
Tare + dry = 87.4
MC = 26.1% ✓ AC

✓ AC

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PERMEABILITY TEST

PROJECT NUMBER M851136E DATE 12-30-85

PROJECT NAME R.Slo (add.) TECHNICIAN D.W./RS

TEST HOLE MET-1 DEPTH 7½ FT LABORATORY SAMPLE NO. 2674-G

SAMPLE LENGTH 2.5 in. SAMPLE DIAMETER 1.281 SAMPLE AREA 1.289 in²

SAMPLE DESCRIPTION clay w/14% bentonite blend remolded to 95% of 100.5 pcf @ 22% c.

Cell =

Jun-4-89

B = 100%

TIME (hrs)	Δt (sec)	Head psi	Cell (psi)	Cum Q (ml)
1417:44	0	10	13	0
1527:50	4206	10	13	.1

PRELIMINARY

K =

$$K = \frac{QL}{Aht} = \frac{(.1)(2.5)}{(1.289)(2.54)^2(10)(2.303)(12)(4206)} = 2.6 \times 10^{-9}$$ ✓ AC

After Test MC

Tare HH = 7.8

Tare + wet T = 107.3

Tare + dry = 85.6

MC = 27.9% ✓ AC

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PERMEABILITY TEST

PROJECT NUMBER MP2117 CE DATE 12-14-88

PROJECT NAME Rifle (add) TECHNICIAN D N

TEST HOLE MEB-2 DEPTH 12½ - 17½' LABORATORY SAMPLE NO. 2674-C

SAMPLE LENGTH 2.5 in. SAMPLE DIAMETER 1.281 in SAMPLE AREA 1.289 in²

SAMPLE DESCRIPTION clay, remolded to 95% of 113.5 pcf @ 16.0% OMC

Cell #3

Dec. 30, 88
B = 100%
cell = 13 psi

TIME (hrs)	Δt (sec)	Head (psi)	ΔH	cum Q (ml)
1441:55	0	10		0
1548:30	3995	10		.2

K =

$$K = \frac{QL}{Aht} = \frac{(.2)(2.5)}{(1.289)(2.54)^2(10)(2.307)(12)(3995)} = 5.4 \times 10^{-8} \text{ cm/s}$$

✓ JCD

After Test MC

Tare TH = 7.9

Tare + wet = 117.4

Tare + dry = 98.4

MC = 21.0%

✓ JCD

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PERMEABILITY TEST

PROJECT NUMBER M881136-E DATE 12-29-88

PROJECT NAME R.S/E (additional) TECHNICIAN D.N.

TEST HOLE MEB-2 DEPTH 12½-17½' LABORATORY SAMPLE NO. 2674-D

SAMPLE LENGTH 2.5 in. SAMPLE DIAMETER 1.291 in SAMPLE AREA 1.259 in²

SAMPLE DESCRIPTION Clay w/ 7% Bentonite Dried remolded to 95% of Max DD at
Cell #10 @ 17.0%

cell = 14 psi

TIME	Δt (sec)	Head	ΔH	Q
1543.06	0	10		0
1755:20	7934	10		.2

PRELIMINARY

ρ = 100%
N sec 28

K =

$$K = \frac{QL}{\Delta t A c} = \frac{(.2)(2.5)(\cancel{2.54})}{(1.289)(2.54)^2(10)(2.307)(12)(\cancel{2.54})(7934)} = 2.7 \times 10^{-8} \text{ cm/s}$$

Atter. Test MC

Tare D = 4.0

Tare + wet = 112.4

Tare + dry = 91.2

MC = 24.3%

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PERMEABILITY TEST

PROJECT NUMBER MR8117 C-E DATE 12-14-85

PROJECT NAME Rifle (Gulf: Tailings) TECHNICIAN D.K.

TEST HOLE MEB-2 DEPTH 12½-17½' LABORATORY SAMPLE NO. 2674-D

SAMPLE LENGTH 2.5 in. SAMPLE DIAMETER 1.251 in. SAMPLE AREA 1.2 in²

SAMPLE DESCRIPTION Clay w/ trace bitumen. Blood consolidated to 100% of max DD = 110.0 pcf

cell #1

cell = 14 psi
B = 100%
on Dec 28

TIME (hrs)	Δt (sec)	Head (psi)	ΔH	Cum. Q (mL)
1623:07	0	10		0
1756:20	5593	10		.1

K =

$$K = \frac{QL}{Aht} = \frac{(.1)(2.5)(\cancel{3.54})}{(1.284)(2.54)^2(10)(2.3\times10^{-7})(12)(\cancel{2.54})(5593)} = 1.9\times10^{-8}\ cm/s$$

~~Tare 2 MC~~

Tare 2 dry = 8.

Tare + wet = 121.

Tare + dry = 100

MC = 22.

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PERMEABILITY TEST

PROJECT NUMBER M 58113 C-E DATE 12-30-[illegible]

PROJECT NAME R[illegible] (w[illegible]) TECHNICIAN [illegible]

TEST HOLE AED-9 DEPTH 15-20' LABORATORY SAMPLE NO. 267[illegible]

SAMPLE LENGTH 2.5 in. SAMPLE DIAMETER 1.281 in. SAMPLE AREA 1.288 in²

SAMPLE DESCRIPTION [illegible] w/[illegible] [illegible] [illegible] TO 95% of 106.0 @ 19.0% [illegible]

[illegible] = 11

[illegible] = 13 psi
[illegible] = 100%
[illegible] 1-10-[illegible]

TIME (hr.)	Δt (sec)	Head (psi)	ΔH	Q (ml)
1055.55	0	10		0
1334.33	9518	11		.1

K =

$$K = \frac{QL}{A h t}$$

$$K = \frac{(.1)(2.5)}{(1.284)(2.54)(10.5)(2.307)(12)(9518)} = \cancel{[illegible]} \; 1.1 \times 10^{-8}$$

✓ AC

Time F Z = 8.2

Time [illegible] = 116.3

Time [illegible] =

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

PERMEABILITY TEST

PROJECT NUMBER MSP113 C-E DATE 12-30-88

PROJECT NAME R. Sla (cont) TECHNICIAN D.W. [illegible]

TEST HOLE MEB-9 DEPTH 15-20' LABORATORY SAMPLE NO. 2674-I

SAMPLE LENGTH 2.5 in. SAMPLE DIAMETER 1.281 in. SAMPLE AREA 1.289 in.

SAMPLE DESCRIPTION Clay w/14% Bent Blend remolded to 100% at 10.0 to 19.6% O[illegible]

Cell #5

Jan 11 89

B = 100%

TIME (hrs)	Δt (sec)	Pore Press. Head (psi)	Cell (psi)	Q (in.)
1132:00	0	10	13	0
1413.00	9660	10	13	.10

PRELIMINARY

K =

$$k = \frac{qL}{A h t} = \frac{(.10)(2.5)}{(1.289)(2.5)^2(10)(2.307)(12)(9660)} = 1.1 \times 10^{-8} \text{ cm/s}$$

✓ K

After Test mc.

Tare HZ = 3.7

Tare + wet : 114.0

Tare + dry =

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

PERMEABILITY TEST

PROJECT NUMBER MPS113C-E DATE 12-13-85

PROJECT NAME R. Flo (add.) TECHNICIAN D.N

TEST HOLE MEB-9 DEPTH 15-20' LABORATORY SAMPLE NO. 2674-E

SAMPLE LENGTH 2.5 in SAMPLE DIAMETER 1.281 in SAMPLE AREA 1.289 in²

SAMPLE DESCRIPTION Silty clay w/7% Bent. blend remolded to 95% of 109.5 pcf @ 16.5% OMC. Cell #9

Dec 30, 85
B = 100%
Cell = 13 psi

TIME (hrs)	Δt (sec)	Head (psi)	ΔH	CUM. Q (ml)
1009:00	0	10		0
1209:00	7200	10		.35

PRELIMINARY

K =

$$K = \frac{QL}{Aht} = \frac{(.35)(2.5)}{(1.284)(2.54)^2(10)(2.307)(12)(7200)} = 5.3 \times 10^{-8}\ cm/s$$

After Test mc

Tare 1-E = 8.0
Tare + wet = 114.9
Tare + dry = 94.9

mc = 23.0%

P O BOX 3986
GRAND JUNCTION CO 81502
(303) 245-6506

P O BOX 0045
MONTROSE, CO 81402
(303) 249-2154

463 TURNER, 104 A
DURANGO, CO 81301
(303) 259-5095

Isolpressure? [illegible]

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

PERMEABILITY TEST

PROJECT NUMBER M8811 3 C-F DATE 12-14-88

PROJECT NAME R 41w (additional) TECHNICIAN D.N.

TEST HOLE MER-9 DEPTH 15-20' LABORATORY SAMPLE NO. 2674-F

SAMPLE LENGTH 3.5 in. SAMPLE DIAMETER 1.281 in. SAMPLE AREA 1.289 in²

SAMPLE DESCRIPTION Silty Clay w/7% Bentonite Blend compacted to 100% of Max DD = 109 pcf [illegible]

Cell #2

Cell = 13 psi

TIME (hrs)	Δt (sec)	Head	ΔH	Q
1030:30	0	10		0
1219:30	6540	10		.3

PRELIMINARY

K =

Dec. 28, 1988

B = 100%

$$K = \frac{QL}{Aht} = \frac{(.3\ cm^3)(3.5\ in)(2.54\ cm/in)}{(1.289\ in^2)(2.54\ cm/in)^2(10\ cm)(2.54\ cm/in)(12\ in/ft)^2(6540\ s)}$$

$K = 5.0 \times 10^{-8}$ cm/s

RECEIVED-MKE
JAN 18 1989
LIMTRA.SS

After Test

MC =

Tare AC = 11.

Tare+wet = 125

Tare+dry = 105

MC = 23.4

CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

PROJECT: Rifle PROJECT NUMBER: MA9054GE DATE SAMPLED: 5-19-89

LOCATION: Estes Gulch-MER-1 @ 8' SAMPLE SOURCE: SEE Program Sheet LAB SAMPLE NO: 2904-04

SAMPLE DESCRIPTION: Clay w/ 10% Bentonite Blend DATE TESTED: 7-5-89 TESTED BY: DN

COEFFICIENT OF PERMEABILITY TEST

INITIAL MOISTURE CONTENT		
	Initial	Final
1. Moisture Tin No.	A	OP
2. Wt Wet Soil + Tare (g)		125.4
3. Wt Dry Soil + Tare (g)		
4. Wt Water (#2 - #3) (g)		
5. Tare Weight (g)		8.1
6. Wt Dry Soil (#3 - #5) (g)		
7. Moisture Content (%)	19.6%	

PERMEAMETER NO: _____
BURETTE NO: _____
BURETTE AREA = _____ in²
SAMPLE DATA:
DIAMETER = 1.281 in
AREA = 1.289 in²
LENGTH = 0.541 in
VOLUME = 3.54 x 10⁻³ ft³
WET WEIGHT = 108.9 gm
UNIT WEIGHT = 136.7 pcf
99.9% compact

REMARKS

Test Boring: MER-1

"B" Value = 13.5 / 13.75 = 9

CONSTANT HEAD

Trial Number	1	2			
Time, t_1	10:37	1837			
Time, t_0	2313	1037			
Elapsed Time, $t_1 - t_0$ (sec)	21040	28800			
Temperature, T (°C) (°F)					
Constant Head, H (in)	170.	170.0			
Outflow + Tare (g)	11.6	4.2			
Tare Weight (g)	1.7	1.7			
Outflow Weight (g)	9.4	2.5			
Additional Pressure Head in of water	- 0 -	- 0 -			
Coefficient of Permeability, $k_t \times 10^{-8}$ (cm/sec)	2.38	2.3x10⁻⁸			

$$k_t = \frac{QL}{HAt} \cdot \left(\frac{1}{6.45}\right) \text{ (cm/sec)}$$

Q=Outflow (CM³)
H=Constant Head (in)
L=Sample Length (in)
A=Sample Area (in2)
t=Elapsed Time (sec)

$K_t = 2.3 \times 10^{-8}$ (cm/sec)

FALLING HEAD

Trial Number					
Time, t_1					
Time, t_0					
Elapsed Time, $t_1 - t_0$ (sec)					
Initial Head, H_0 (in)					
Final Head, H_1 (in)					
Temperature, T (°C) (°F)					
Coefficient of Permeability, $k_t \times 10^{-3}$ (cm/sec)					

$$k_t = \frac{aL}{A(t_1 - t_0)} \ln\left(\frac{H_0}{H_1}\right) (2.54)$$

a=Area of Stand pipe (in²)
A=Area of Sample (in²)
L= Length of Sample (in)
$T_1 - T_0$= Elapsed Time (sec)
H_0=Initial Head (in)
H_1=Final Head (in)

K_t =

Checked by: D.A.

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

PROJECT: R. Sle PROJECT NUMBER: M890546E DATE SAMPLED: 5-19-

LOCATION: Estes Gulch - MPR 3@2½' SAMPLE SOURCE: SFF Process Slurry LAB SAMPLE NO: 290

SAMPLE DESCRIPTION: Clay w/10% Bent Blend DATE TESTED: 7-5-89 TESTED BY: DN

COEFFICIENT OF PERMEABILITY TEST

INITIAL MOISTURE CONTENT	Initial	Final
1. Moisture Tin No.		
2. Wt Wet Soil + Tare (g)		
3. Wt Dry Soil + Tare (g)		
4. Wt Water (#2 - #3)(g)		
5. Tare Weight (g)		
6. Wt Dry Soil (#3 - #5)(g)		
7. Moisture Content (%)	19.5	

PERMEAMETER NO: _____

BURETTE NO: _____

BURETTE AREA = _____ in²

SAMPLE DATA:

DIAMETER = 1.281 in

AREA = 1.289 in²

LENGTH = 2.541 in

VOLUME = 1.895x10⁻³ ft³

WET WEIGHT = 110.9 gm

UNIT WEIGHT wet = 129.0 pcf } 99.9 % compact.

dry = 108.8

REMARKS

$B = \frac{6.0}{6.0} = 100\%$

CONSTANT HEAD

Trial Number	1	2	3		
Time, t_1 9-1	0837	1710	0808		
Time, t_0 8-31	2028	0837	1710		
Elapsed Time, $t_1 - t_0$ (sec)	43740	30780	31980		
Temperature, T (°C)(°F)					
Constant Head, H (in)	15.52	15.52	15.52		
Outflow + Tare (g)	3.4	4.9	16.9		
Tare Weight (g)	1.5	3.4	4.8		
Outflow Weight (g)	1.9	1.5	12.0		
Additional Pressure Head in of water	0	0	0		
Coefficient of Permeability, $k_T \times 10^{-}$ (cm/sec)	8.6x10⁻⁹	9.6x10⁻⁹	7.5x10⁻⁹		

$k_T = \frac{QL}{HAT}\left(\frac{1}{6.45}\right)$ (cm/s

Q=Outflow (CM³)
H=Constant Head (in)
L=Sample Length (in)
A=Sample Area (in2)
T=Elapsed Time (sec)

$K_t = 7.5 \times 10^{-9}$ cm/sec

FALLING HEAD

Trial Number					
Time, t_1					
Time, t_0					
Elapsed Time $t_1 - t_0$ (sec)					
Initial Head, H_0 (in)					
Final Head, H_1 (in)					
Temperature, T (°C)(°F)					
Coefficient of Permeability, $k_T \times 10^{-3}$ (cm/sec)					

$k_T = \frac{aL}{A(t_1 - t_0)} \ln\left(\frac{H_0}{H_1}\right)$ (2.54)

a=Area of Stand pipe (in
A=Area of Sample (in²)
L= Length of Sample (in)
$T_1 - T_0$= Elapsed Time (sec
H_0=Initial Head (in)
H_1=Final Head (in)

K_t =

Checked by: [illegible]

SCHMIDT AND ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

PROJECT: - R. 3/c PROJECT NUMBER: M590546E DATE SAMPLED: 5-19-89

LOCATION: Estes Gulch MER 4 & 14' SAMPLE SOURCE: SEE Program Sheet LAB SAMPLE NO: 2907-07

SAMPLE DESCRIPTION: Clay w/ 10% Dark Brown Sand DATE TESTED: 7-5-89 TESTED BY: DN

COEFFICIENT OF PERMEABILITY TEST

INITIAL MOISTURE CONTENT	Initial	Final
1. Moisture Tin No.		
2. Wt Wet Soil + Tare (g)		
3. Wt Dry Soil + Tare (g)		
4. Wt Water (#2 - #3)(g)		
5. Tare Weight (g)		
6. Wt Dry Soil (#3 - #5)(g)		
7. Moisture Content (%)	17.5	

PERMEAMETER NO: _____
BURETTE NO: _____
BURETTE AREA = _____ in²
SAMPLE DATA:
DIAMETER = 1.281 in
AREA = 1.289 in²
LENGTH = 3.523 in
VOLUME = 1.882×10⁻³ ft³
WET WEIGHT = 167.2 gm
UNIT WEIGHT$_{wet}$ = 125.6 pcf
γ_{dry} = 106.9 pcf } 99.9% compact

REMARKS

B = 7.75 / 7.75 = 100%

CONSTANT HEAD

Trial Number	1	2	3		
Time, t_1 9-1	0842	1714	0810		
Time, t_0 8-31	2033	0842	1814		
Elapsed Time, $t_1 - t_0$ (sec)	43740	30720	31260		
Temperature, T (°C) (°F)					
Constant Head, H (in)	15.52	15.52	15.52		
Outflow + Tare (g)	13.4	14.0	17.4		
Tare Weight (g)	1.7	13.4	14.0		
Outflow Weight (g)	11.7	0.6	3.4		
Additional Pressure Head in of water	0	0	0		
Coefficient of Permeability, k_t = 10⁻⁹ (cm/sec)	5.2×10⁻⁹	3.5×10⁻⁹	2.1×10⁻⁹		

$$k_t = \frac{QL}{HAT}\left(\frac{1}{6.45}\right) \text{(cm/sec)}$$

Q=Outflow (CM³)
H=Constant Head (in)
L=Sample Length (in)
A=Sample Area (in2)
T=Elapsed Time (sec)

$K_t = 2.1 \times 10^{-9}$ cm/sec

FALLING HEAD

Trial Number					
Time, t_1					
Time, t_0					
Elapsed Time, $t_1 - t_0$ (sec)					
Initial Head, H_0 (in)					
Final Head, H_1 (in)					
Temperature, T (°C) (°F)					
Coefficient of Permeability, k_t = 10⁻³ (cm/sec)					

$$k_t = \frac{aL}{A(t_1 - t_0)} \ln\left(\frac{H_0}{H_1}\right) (2.54)$$

a=Area of Stand pipe (in²)
A=Area of Sample (in²)
L= Length of Sample (in)
$T_1 - T_0$= Elapsed Time (sec)
H_0=Initial Head (in)
H_1=Final Head (in)

K_t =

Checked by: _____

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

TEST RESULTS

PROJECT Rifle PROJECT NO. M89054GE DATE 5/13/8[illegible]

LOCATION RFL-3701 SOURCE MER-1

SAMPLE NO. 2904 SPECIFICATION*

NATURAL MOISTURE CONTENT

DEPTH				
2 ft	Sample Number:	2904-01	Moisture (percent)	8.0%
5 ft.	Sample Number:	2904-02	Moisture (percent)	10.5%
5 ft.	Sample Number:	2904-03	Moisture (percent)	10.0%
8 ft.	Sample Number:	2904-04	Moisture (percent)	8.7%
8 ft.	Sample Number:	2904-05	Moisture (percent)	7.8%
15 ft.	Sample Number:	2904-08	Moisture (percent)	10.0%

Before adding bentonite

Figure B1

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TEST RESULTS

PROJECT Rifle PROJECT NO. M89054GE DATE 5/19/89

LOCATION RFL-8701 SOURCE [illegible]

SAMPLE NO. 2905 SPECIFICATION* _____

NATURAL MOISTURE CONTENT

DEPTH				
3 ft.	Sample Number:	2905-01	Moisture (percent)	7.9%
5 ft.	Sample Number:	2905-03	Moisture (percent)	7.9%
5 ft.	Sample Number:	2905-04	Moisture (percent)	8.1%
8 ft.	Sample Number:	2905-05	Moisture (percent)	9.1%
8 ft.	Sample Number:	2905-06	Moisture (percent)	8.6%
10 ft.	Sample Number:	2905-07	Moisture (percent)	8.8%

Before adding bentonite

Figure B2

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TEST RESULTS

PROJECT Rifle PROJECT NO. M89054GE DATE 5-12-89

LOCATION RFL-BT01 SOURCE [illegible]

SAMPLE NO. 2906 SPECIFICATION* _____

NAUTURAL MOISTURE CONTENT

DEPTH				
2 1/2 ft.	Sample Number:	2906-01	Moisture (percent)	9.1%
2 1/2 ft.	Sample Number:	2906-02	Moisture (percent)	9.4%
8 ft.	Sample Number:	2906-05	Moisture (percent)	9.1%
8 ft.	Sample Number:	9206-06	Moisture (percent)	[illegible]
12 ft.	Sample Number:	9206-08	Moisture (percent)	6.9%

Before adding bentonite

Figure 33

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TEST RESULTS

PROJECT Rifle PROJECT NO. M89054GE DATE 5.19.89

LOCATION RFL-8701 SOURCE MEA

SAMPLE NO. 2907 SPECIFICATION#

NATURAL MOISTURE CONTENT

DEPTH			
6 1/2 ft.	Sample Number:	2907-04	Moisture (percent) 3.3%
14 ft.	Sample Number:	2907-07	Moisture (percent) 7.6%
14 ft.	Sample Number:	2907-08	Moisture (percent) 7.7%

Before adding bentonite

Figure B4

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

TEST RESULTS

PROJECT Rifle PROJECT NO. M8905408 DATE 5-10-89

LOCATION RFL-8701 SOURCE MER-5

SAMPLE NO. 2908 SPECIFICATION#

NATURAL MOISTURE CONTENT

DEPTH			
2 ft.	Sample Number:	2908-01	Moisture (percent) 10.7%
2 ft.	Sample Number:	2908-02	Moisture (percent) 11.2%
5 ft.	Sample Number:	2908-03	Moisture (percent) 11.0%
5 ft.	Sample Number:	2908-04	Moisture (percent) 11.7%
8 ft.	Sample Number:	2908-06	Moisture (percent) 11.1%
12 ft.	Sample Number:	2908-08	Moisture (percent) 10.3%

Before adding bentonite

Figure B5

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TEST RESULTS

PROJECT Rifle PROJECT NO. M89054GE DATE 5/19/89

LOCATION RFL-8701 SOURCE MER U

SAMPLE NO. 2909 SPECIFICATION* _____

NATURAL MOISTURE CONTENT

DEPTH				
2 1/2 ft.	Sample Number:	2909-02	Moisture (percent)	9.7%
5 ft.	Sample Number:	2909-03	Moisture (percent)	9.2%
5 ft.	Sample Number:	2909-04	Moisture (percent)	8.9%
7 1/2 ft.	Sample Number:	2909-05	Moisture (percent)	8.6%

Before adding bentonite

Figure B6

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TEST RESULTS

PROJECT Rifle PROJECT NO. M89054GE DATE 5-10-89

LOCATION RFL-8701 SOURCE MEP-1

SAMPLE NO. 2904 SPECIFICATION*

NATURAL MOISTURE CONTENT

DEPTH		
2 Ft.	Sample Number: 2904-01	Moisture (Percent) 8.9%
5 Ft.	Sample Number: 2904-02	Moisture (Percent) 10.5%
5 Ft.	Sample Number: 2904-03	Moisture (Percent) 10.1%
8 Ft.	Sample Number: 2904-04	Moisture (Percent) 7.7%
8 Ft.	Sample Number: 2904-05	Moisture (Percent) 8.0%
15 Ft.	Sample Number: 2904-08	Moisture (Percent) 10.1%

10 percent bentonite added

Figure B7

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

TEST RESULTS

PROJECT Rifle PROJECT NO. M8005408 DATE 8-13-80

LOCATION RFL-8701 SOURCE MER-2

SAMPLE NO. 2905 SPECIFICATION*

NATURAL MOISTURE CONTENT

DEPTH			
3 FT.	Sample Number: 2905-01	Moisture (Percent)	8.6%
5 Ft.	Sample Number: 2905-03	Moisture (Percent)	8.3%
5 Ft.	Sample Number: 2905-04	Moisture (Percent)	7.8%
8 Ft.	Sample Number: 2905-05	Moisture (Percent)	10.4%
8 Ft.	Sample Number: 2905-06	Moisture (Percent)	8.3%
10 Ft.	Sample Number: 2905-07	Moisture (Percent)	8.9%

10 percent bentonite added

Figure B8

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

TEST RESULTS

PROJECT Rifle PROJECT NO. M8905463 DATE 5-10-89

LOCATION RFL-8701 SOURCE MER-3

SAMPLE NO. 2906 SPECIFICATION*

NATURAL MOISTURE CONTENT

DEPTH				
2½ Ft.	Sample Number:	2906-01	Moisture (Percent)	7.9%
2½ Ft.	Sample Number:	2906-02	Moisture (Percent)	9.6%
8 Ft.	Sample Number:	2906-05	Moisture (Percent)	5.4%
8 Ft.	Sample Number:	2906-06	Moisture (Percent)	8.7%
12 Ft.	Sample Number:	2906-08	Moisture (Percent)	5.8%

10 percent bentonite added

Figure 39

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

TEST RESULTS

PROJECT Rifle PROJECT NO. M89054GE DATE 3-10-89

LOCATION RFL-8701 SOURCE MER-4

SAMPLE NO. 2907 SPECIFICATION*

NATURAL MOISTURE CONTENT

DEPTH			
6½ Ft.	Sample Number:	2907-04	Moisture (Percent) 8.6%
14 Ft.	Sample Number:	2907-07	Moisture (Percent) 7.5%
14 Ft.	Sample Number:	2907-08	Moisture (Percent) 7.6%

10 percent bentonite added

Figure B10

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

TEST RESULTS

PROJECT Rifle PROJECT NO. M80054GE DATE 5-12-80

LOCATION RFL-8701 SOURCE MER-5

SAMPLE NO. 2908 SPECIFICATION*

NATURAL MOISTURE CONTENT

DEPTH				
2 Ft.	Sample Number:	2908-01	Moisture (Percent)	11.4%
2 Ft.	Sample Number:	2908-02	Moisture (Percent)	10.6%
5 Ft.	Sample Number:	2908-03	Moisture (Percent)	9.8%
5 Ft.	Sample Number:	2908-04	Moisture (Percent)	10.2%
8 Ft.	Sample Number:	2908-06	Moisture (Percent)	10.5%
12 Ft.	Sample Number:	2908-08	Moisture (Percent)	10.2%

10 percent bentonite added

Figure B11

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

TEST RESULTS

PROJECT Rifle PROJECT NO. M89054GE DATE 3-10-89

LOCATION RFL-8701 SOURCE MER-6

SAMPLE NO. 2909 SPECIFICATION*

NATURAL MOISTURE CONTENT

DEPTH				
2½ Ft.	Sample Number:	2909-02	Moisture (Percent)	10.1%
5 Ft.	Sample Number:	2909-03	Moisture (Percent)	8.9%
5 Ft.	Sample Number:	2909-04	Moisture (Percent)	9.3%
7½ Ft.	Sample Number:	2909-05	Moisture (Percent)	8.8%

10 percent bentonite added

Figure B12

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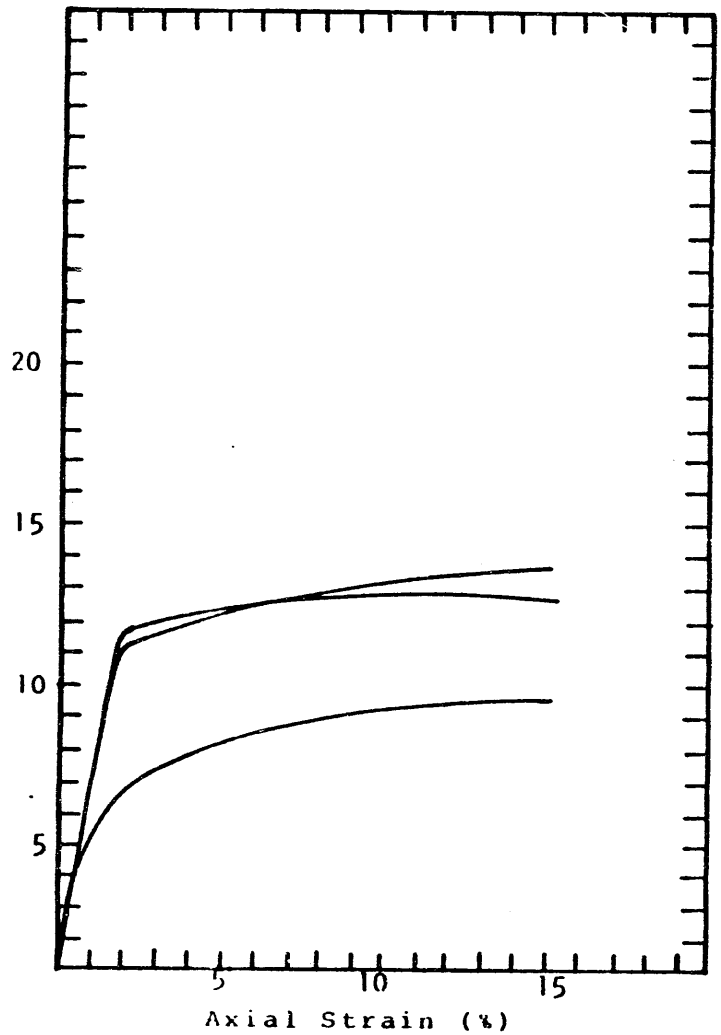
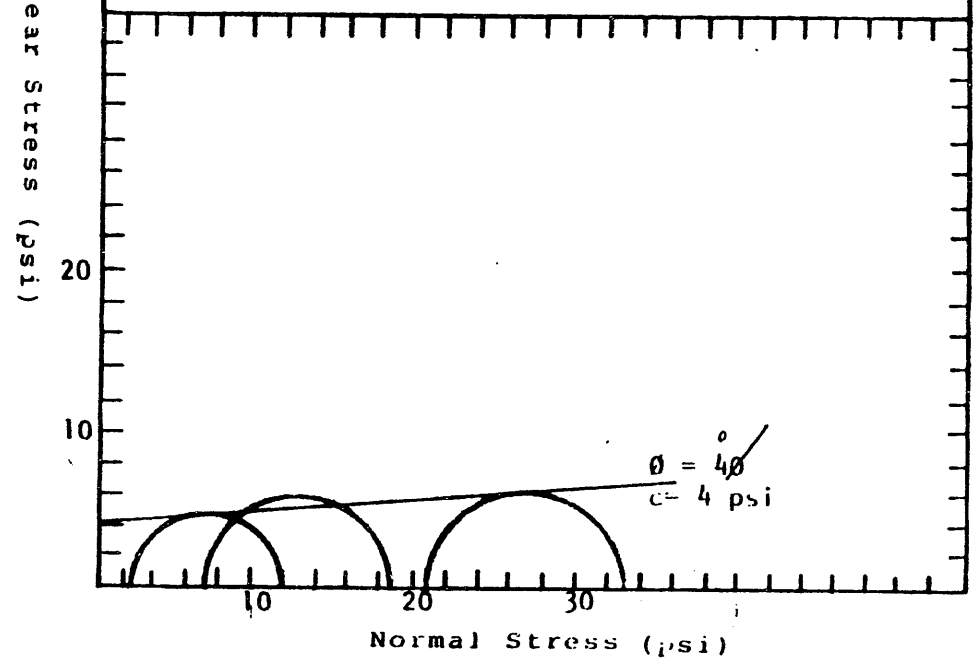


Boring Number & Depth	Initial Moisture Content	Initial Dry Density PCF	Confining Pressure PSI	Deviator Stress PSI	Pore Pressure PSI	"B" Value
MER-1 @ 5 ft	19.5	102.4	2.5	10.2	60	95.5
	19.5	102.4	6.8	12.2	54	96.9
	19.5	102.4	21.5	10.3	60	98.7



Sample Description: 10% bentonite added
Sample No. 2904-02

Type of Test: Consolidated Undrained

TRIAXIAL COMPRESSION TEST

Project No.: M3905436
Date: 10/23/93
Figure: B13

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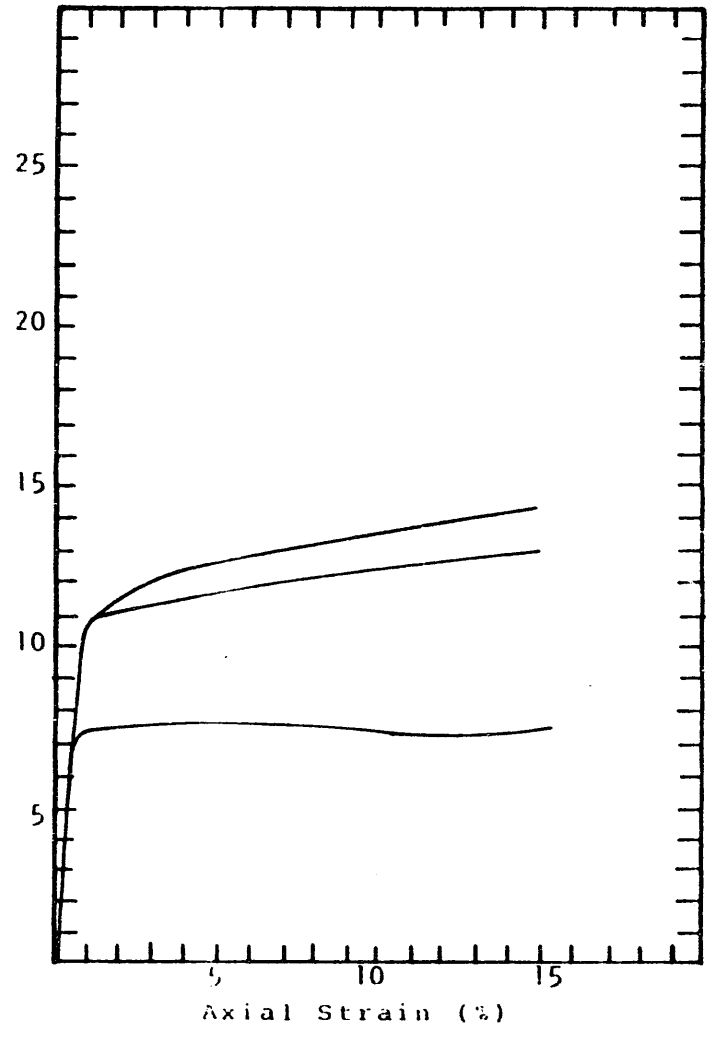

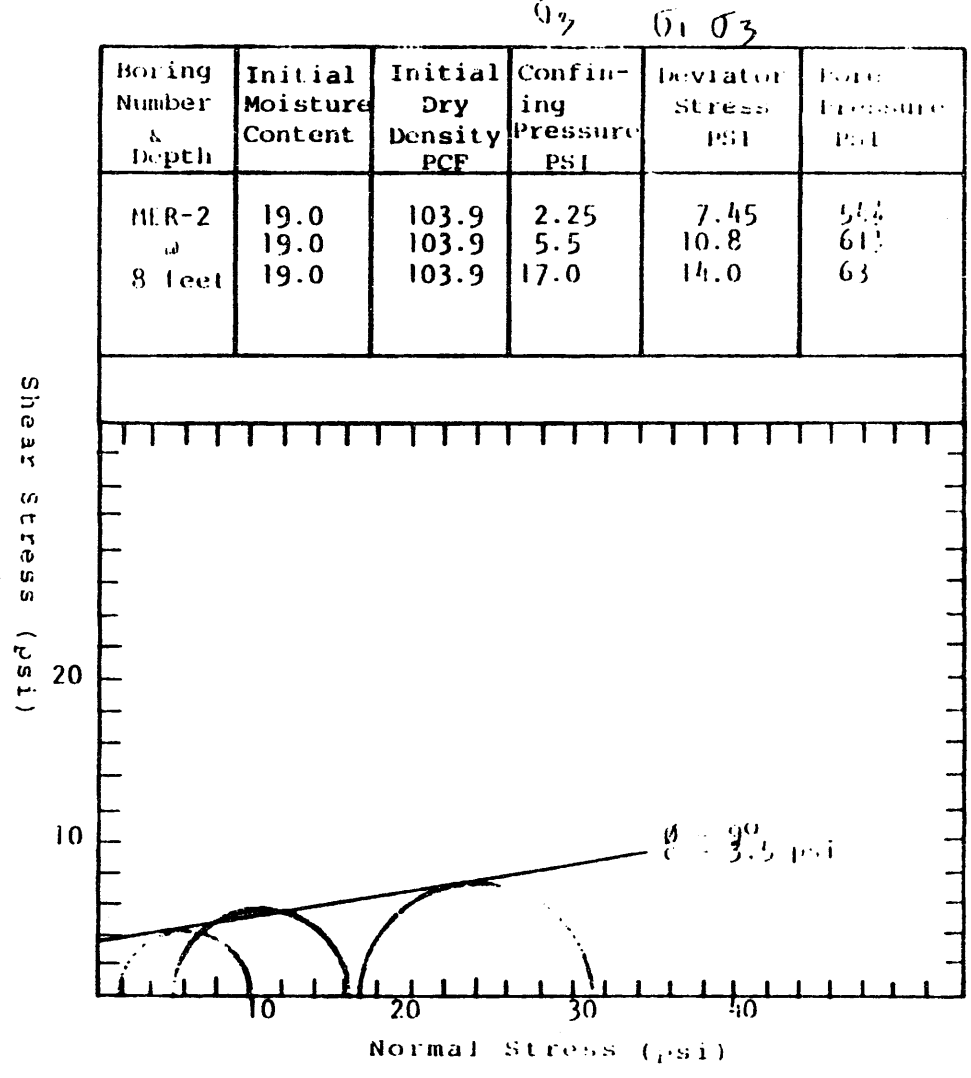

Boring Number & Depth	Initial Moisture Content	Initial Dry Density PCF	Confining Pressure PSI (σ_3)	Deviator Stress PSI ($\sigma_1 - \sigma_3$)	Pore Pressure PSI	"B" Value
MER-2 @ 8 feet	19.0	103.9	2.25	7.45	54.4	93.1
	19.0	103.9	5.5	10.8	61.5	96.8
	19.0	103.9	17.0	14.0	63	96.4

$\phi = 9^{\circ}$
$c = 3.5$ psi

Sample Description: 10 bentonite added
Sample Number: 2905-05

Type of Test: Consolidated Undrained

TRIAXIAL COMPRESSION TEST

Project No.: 2905-15
Date:
Figure:

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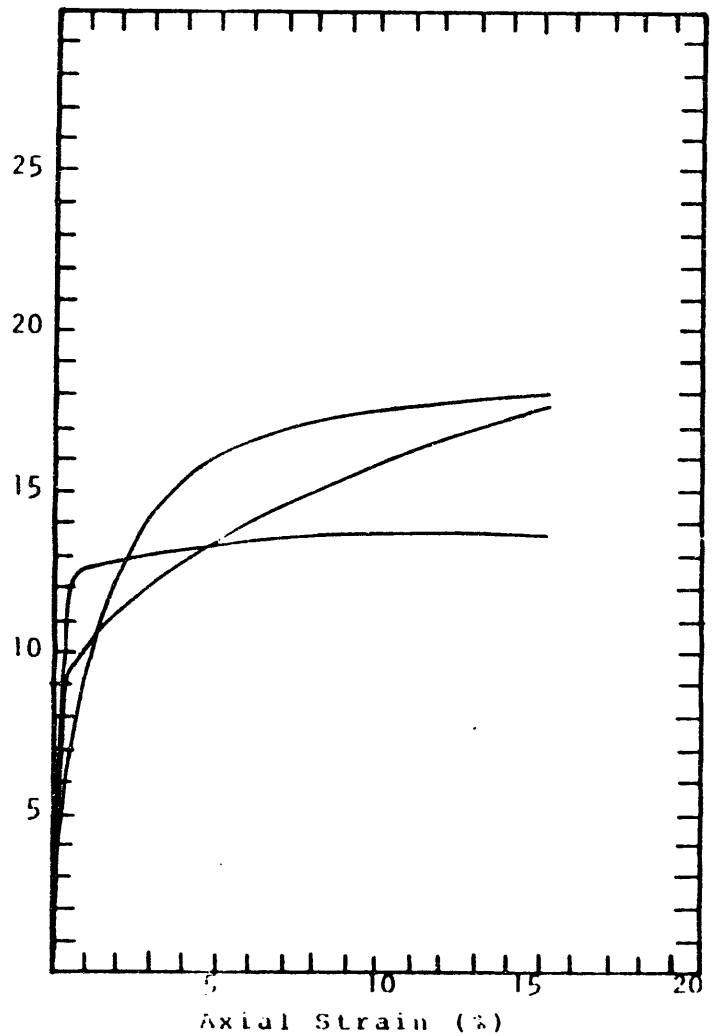
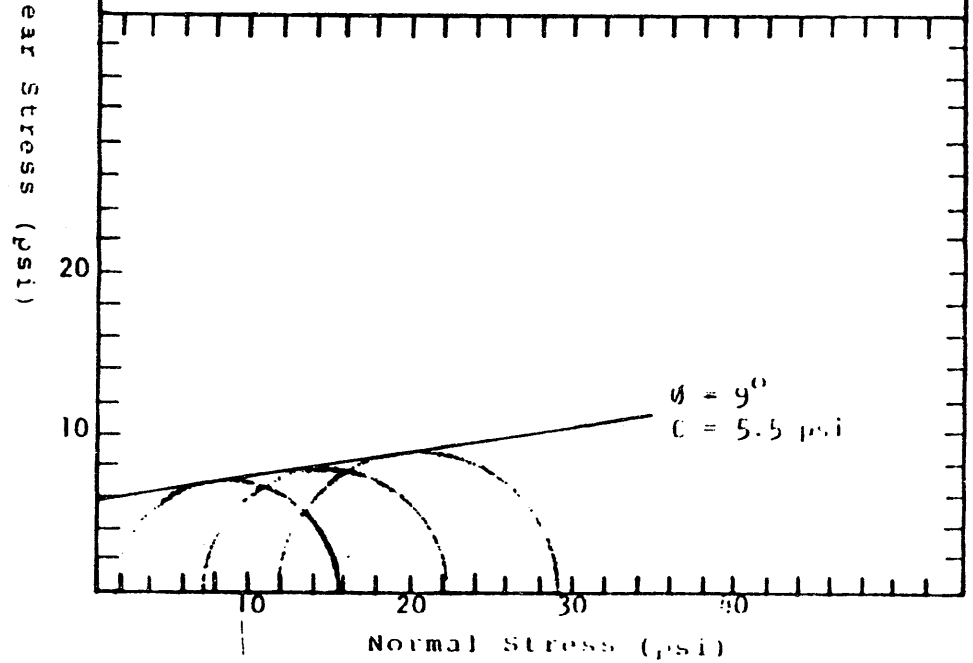


Boring Number & Depth	Initial Moisture Content	Initial Dry Density PCF	Confining Pressure PSI	Deviator Stress PSI	Pore Pressure PSI	'B' Value
MER-2 @ 8 feet	19.0	104.0	1.75	13.4	56.25	97.2
	19.0	104.0	7.5	13.7	53.5	97.4
	19.0	104.0	12.0	16.5	61.0	98.8

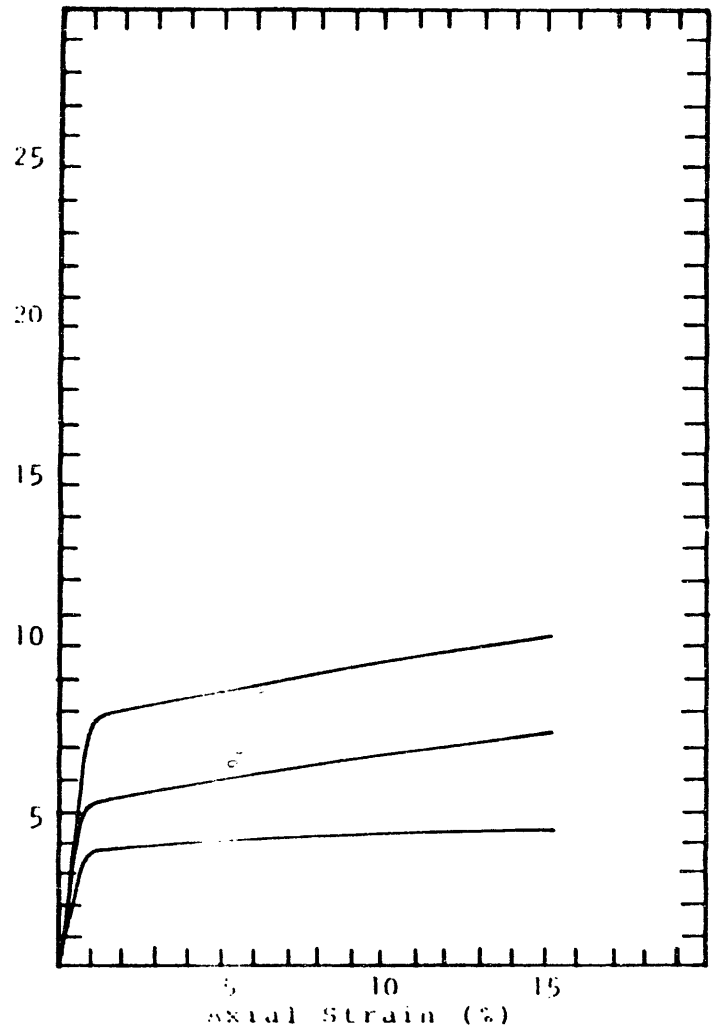


Sample Description: 10% bentonite added
Sample Number: 2905-05

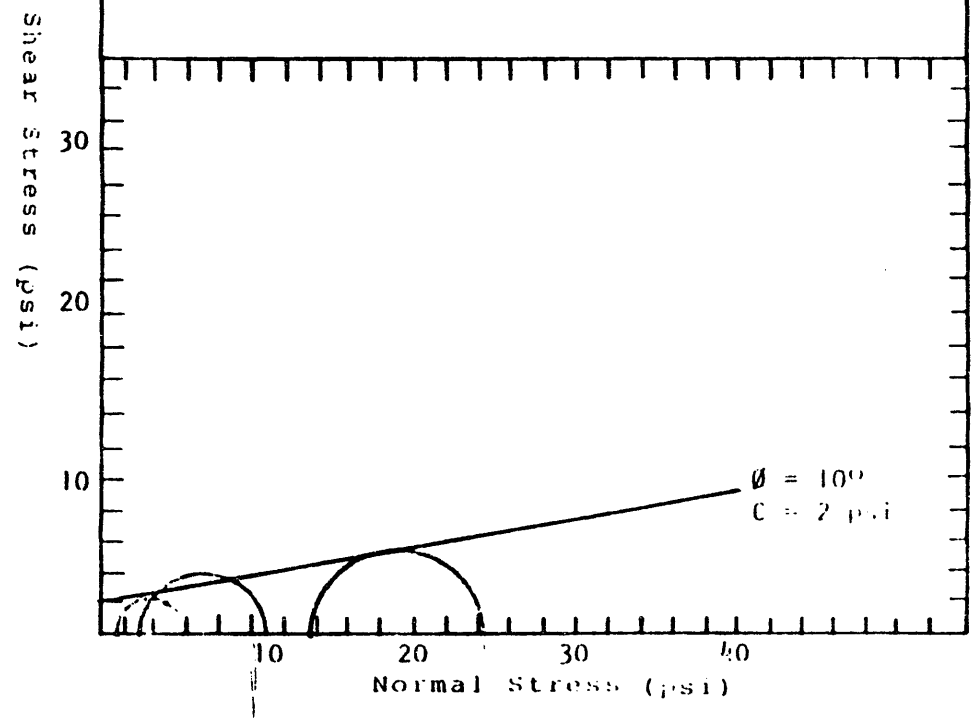
Type of Test: Unconsolidated Undrained

TRIAXIAL COMPRESSION TEST

Project No.:	1390[illegible]GE
Date:	
Figure:	315



Boring Number & Depth	Initial Moisture Content	Initial Dry Density PCF	Confining Pressure PSI	Deviator Stress PSI	Pore Pressure PSI	"B" Value
MER-3 @ 3 feet	18.0 18.0 18.0	106.9 106.9 106.9	1.5 3.0 14.0	4.6 7.5 10.3	51 53.5 56	100.0 96.7 100.0



Sample Description: 10% bentonite added
Sample Number: 2906-05

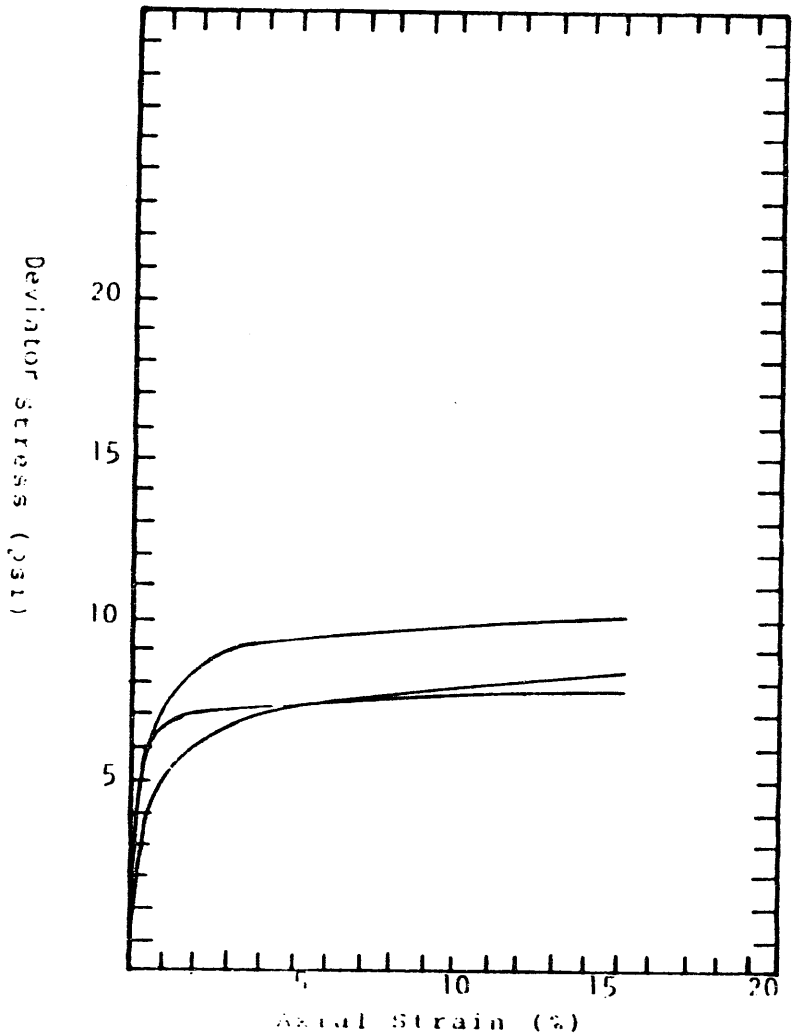
Type of Test: Unconsolidated undrained

TRIAXIAL COMPRESSION TEST

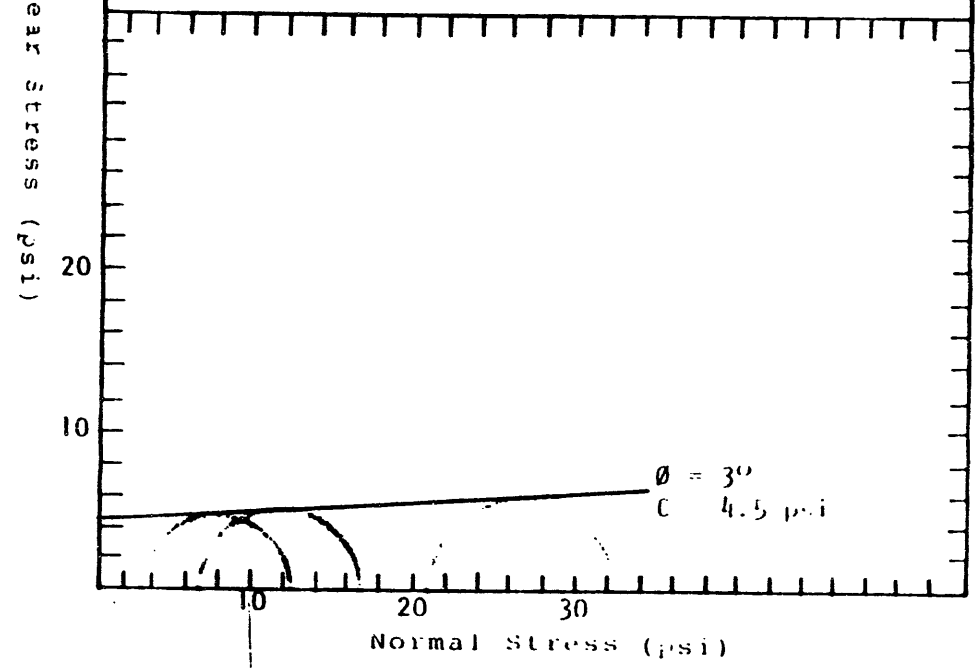
Lambert and Associates

Project No.: M-905 GE
Date:
Figure:

Lambert and Associates



Boring Number & Depth	Initial Moisture Content	Initial Dry Density PCF	Confining Pressure PSI	Deviator Stress PSI	Pore Pressure PSI	'B' Value
MER-6 @ 5 feet	16.5	108.9	3.5	8.9	60.0	98.8
	16.5	108.9	7.0	9.4	54.5	97.0
	16.5	108.9	21.0	11.2	55.5	97.3



Sample Description: 10% bentonite added
Sample Number: 2909-03

Type of Test: Consolidated Undrained

TRIAXIAL COMPRESSION TEST

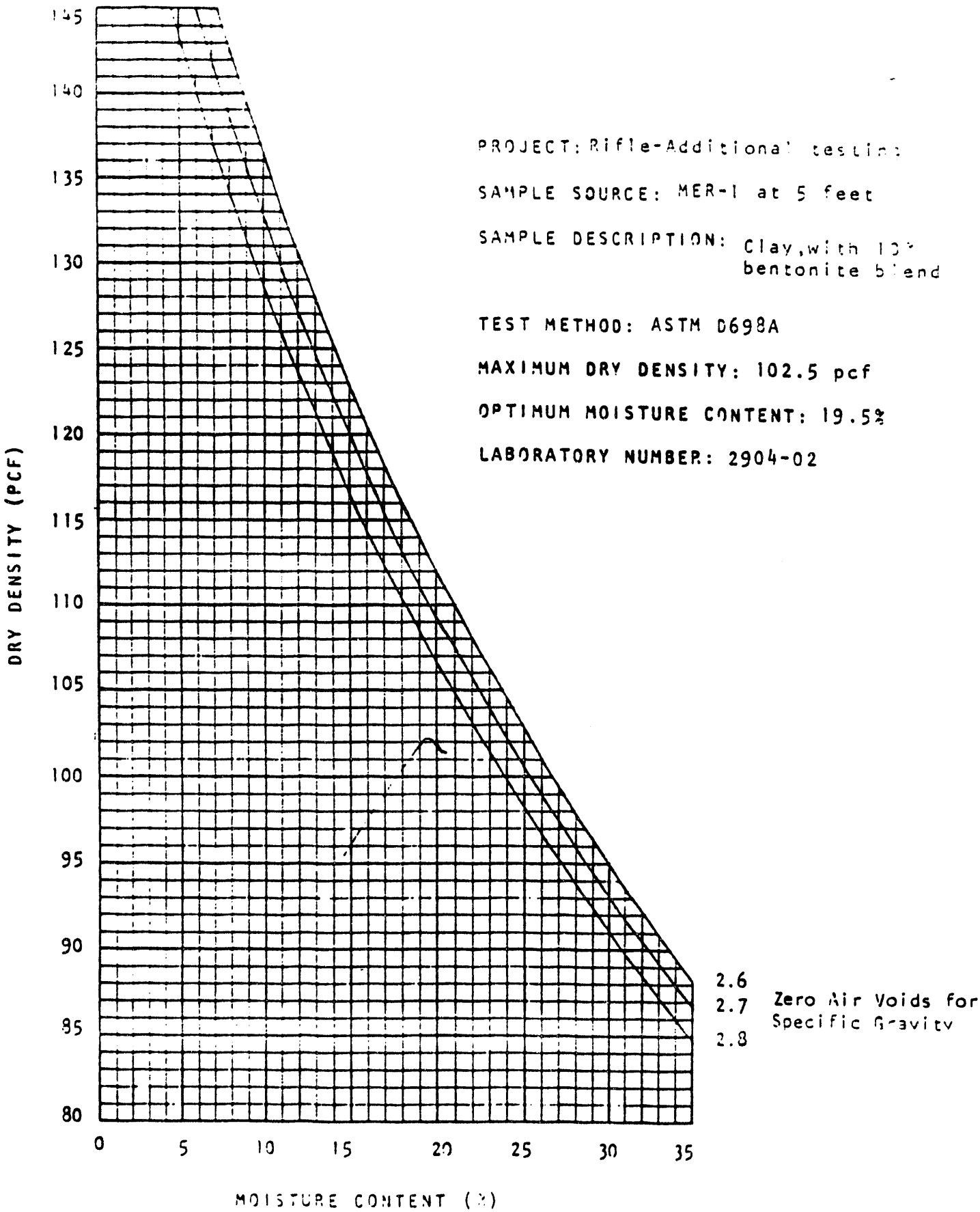
Project No.: 43905-GE
Date:
Figure:

TRIAXIAL PERMEABILITY TEST RESULTS

SAMPLE NUMBER	TEST HOLE	DEPTH (FEET)	INITIAL DRY DENSITY (PCF)	INITIAL MOISTURE CONTENT (PERCENT)	~~INITIAL~~ FINAL MOISTURE CONTENT (PERCENT)	'B' VALUE	PERMEABILITY (CM/SEC)
2904-04	MER-1	8	106.4	19.0	31.2	98.2	2.3×10^{-8}
2906-01	MER-3	2 1/2	108.8	18.5	23.2	100.0	7.5×10^{-9}
2907-07	MER-4	14	106.9	17.5	23.2	100.0	2.1×10^{-9}
2908-03	MER-5	5	102.9	20.0	26.2	99.9	7.5×10^{-10}

Lambert and Associates

Project No.: M09054GE
Date:
Figure:



PROJECT: Rifle-Additional testing

SAMPLE SOURCE: MER-1 at 5 feet

SAMPLE DESCRIPTION: Clay, with 10% bentonite blend

TEST METHOD: ASTM D698A

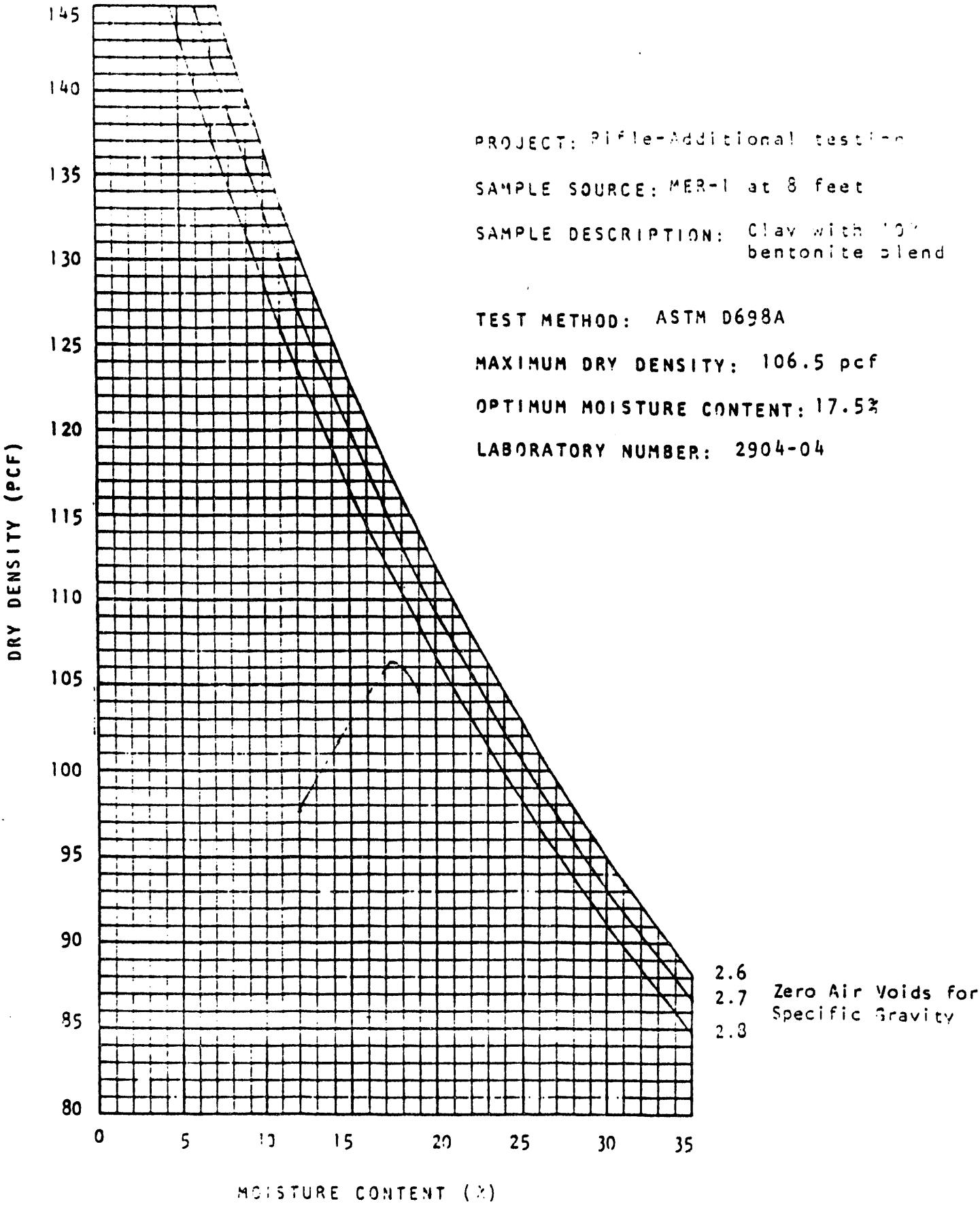
MAXIMUM DRY DENSITY: 102.5 pcf

OPTIMUM MOISTURE CONTENT: 19.5%

LABORATORY NUMBER: 2904-02

Lambert and Associates

Project No.:	M8905-46E
Date:	
Figure:	



PROJECT: Rifle-Additional testing

SAMPLE SOURCE: MER-1 at 8 feet

SAMPLE DESCRIPTION: Clay with 10% bentonite blend

TEST METHOD: ASTM D698A

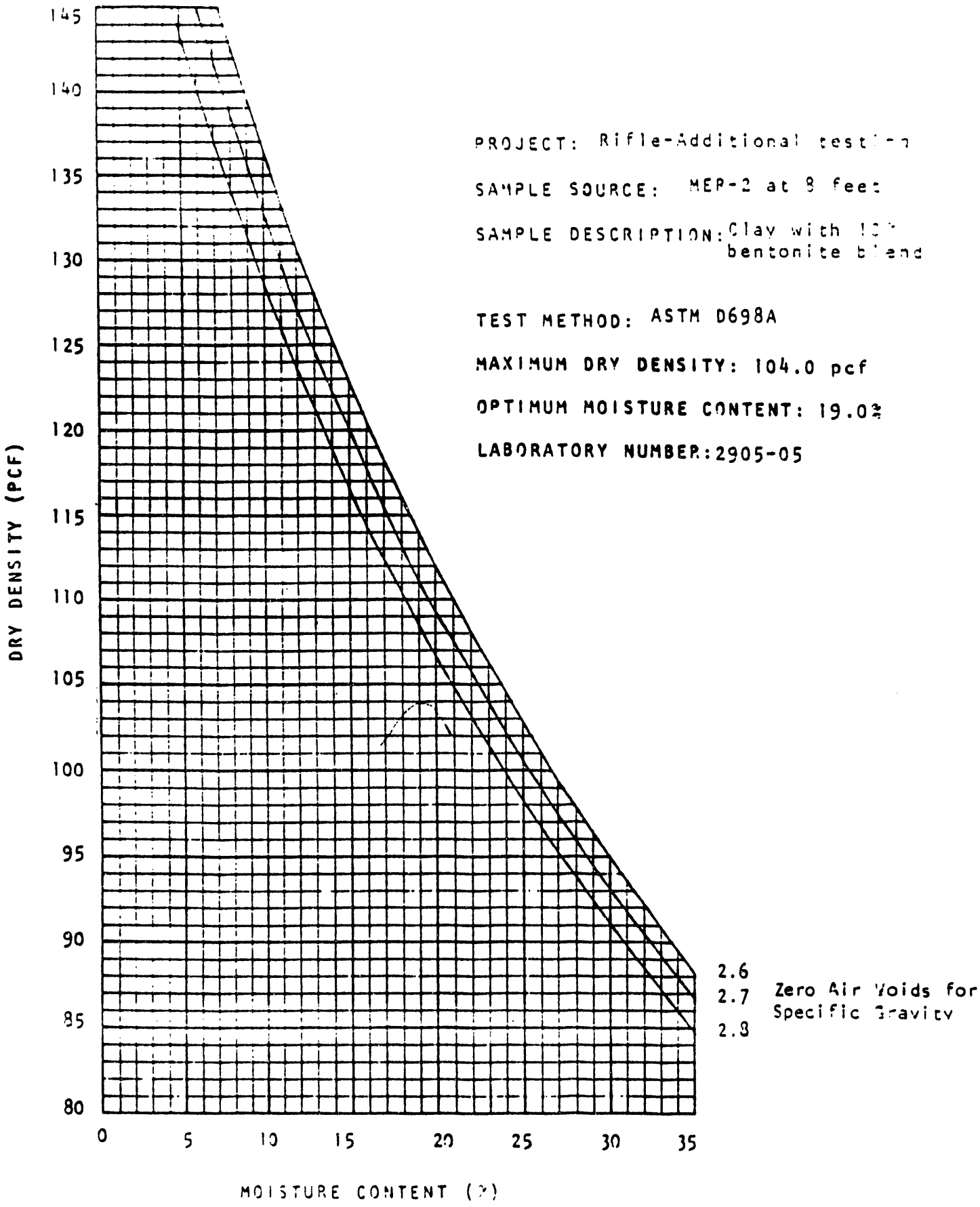
MAXIMUM DRY DENSITY: 106.5 pcf

OPTIMUM MOISTURE CONTENT: 17.5%

LABORATORY NUMBER: 2904-04

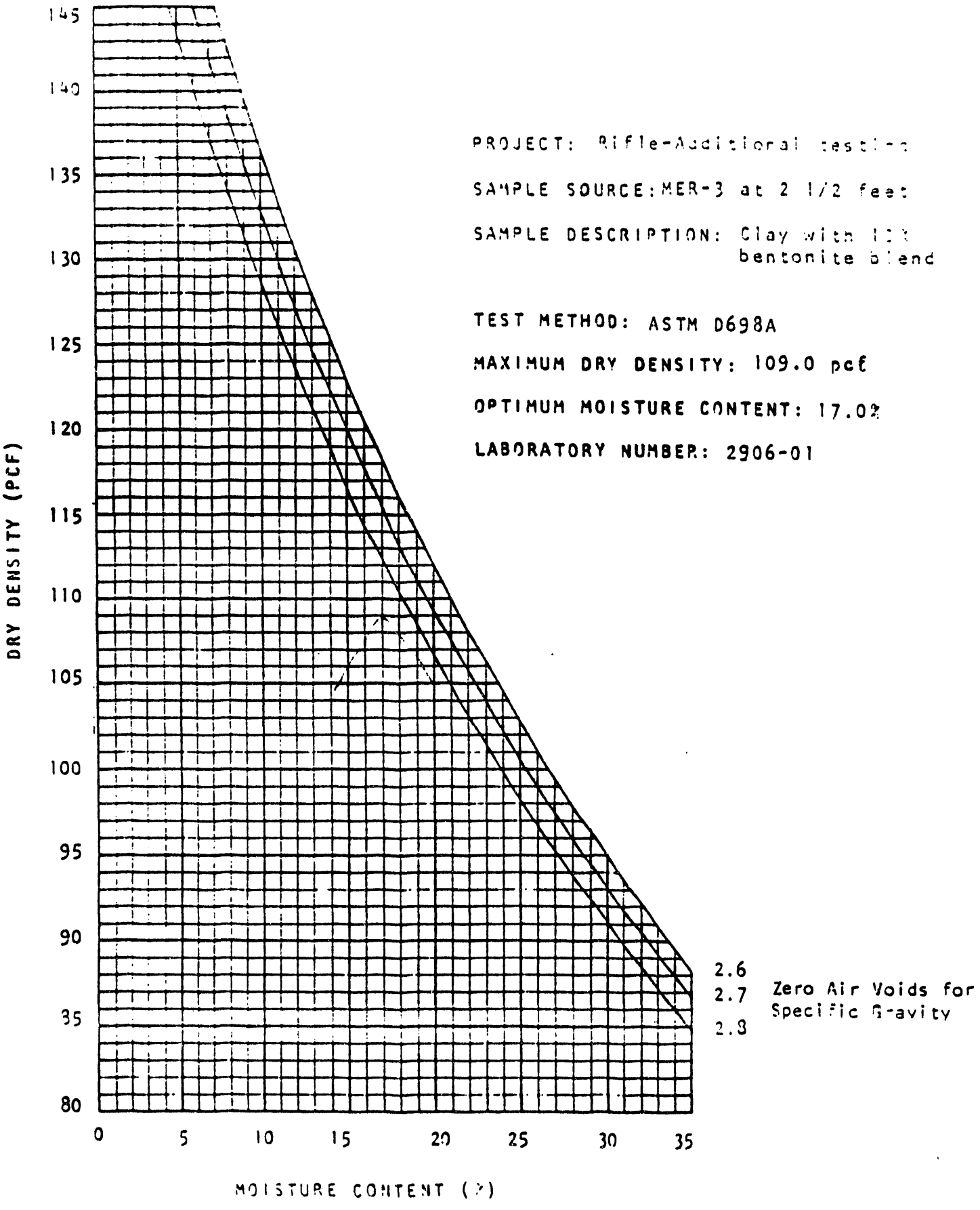
Lambert and Associates

Project No.:	M3305-4GE
Date:	
Figure:	6



Lambert and Associates

Project No.: M8905-06
Date:
Figure:



PROJECT: Rifle-Additional testing

SAMPLE SOURCE: MER-3 at 2 1/2 feet

SAMPLE DESCRIPTION: Clay with 10% bentonite blend

TEST METHOD: ASTM D698A

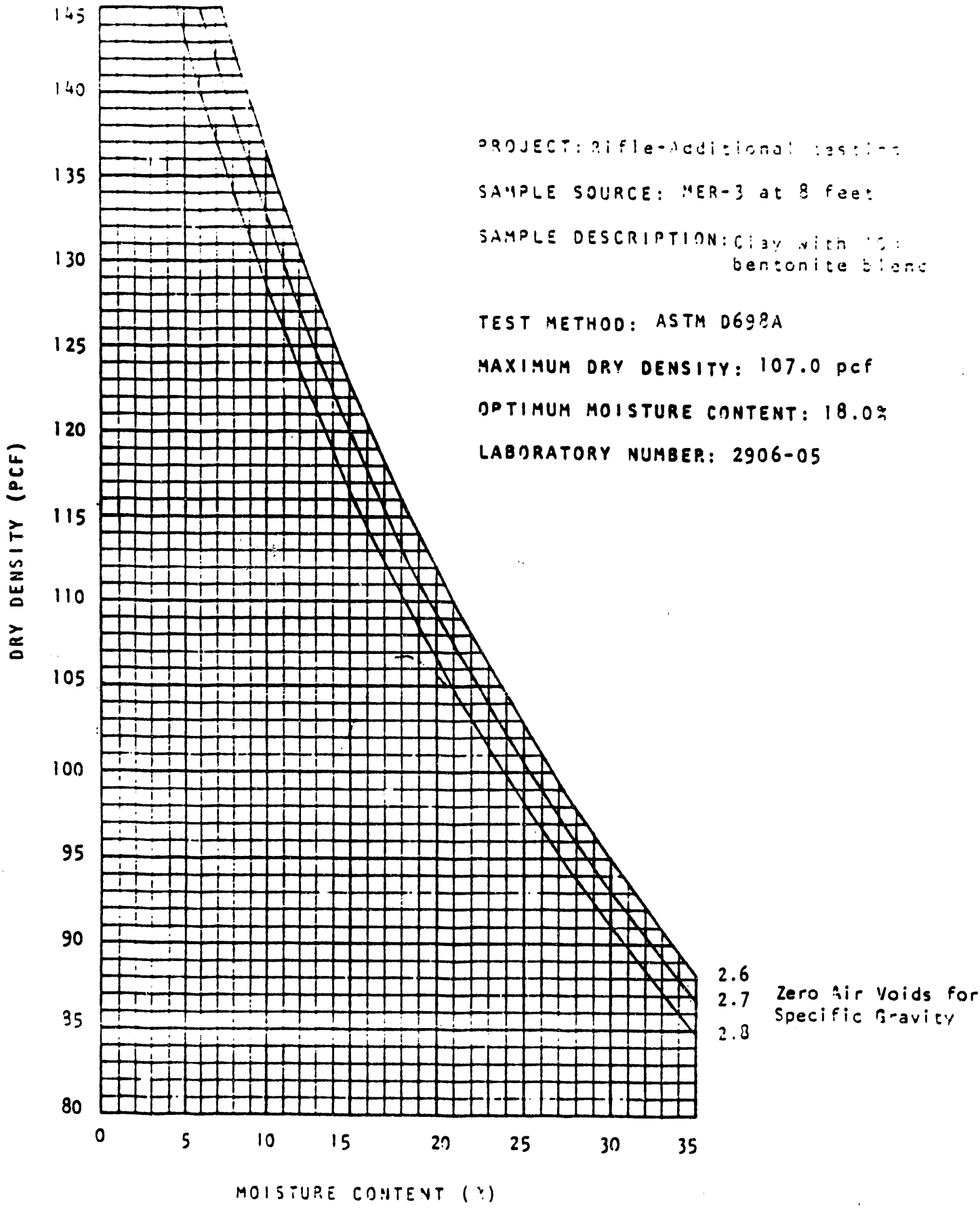
MAXIMUM DRY DENSITY: 109.0 pcf

OPTIMUM MOISTURE CONTENT: 17.0%

LABORATORY NUMBER: 2906-01

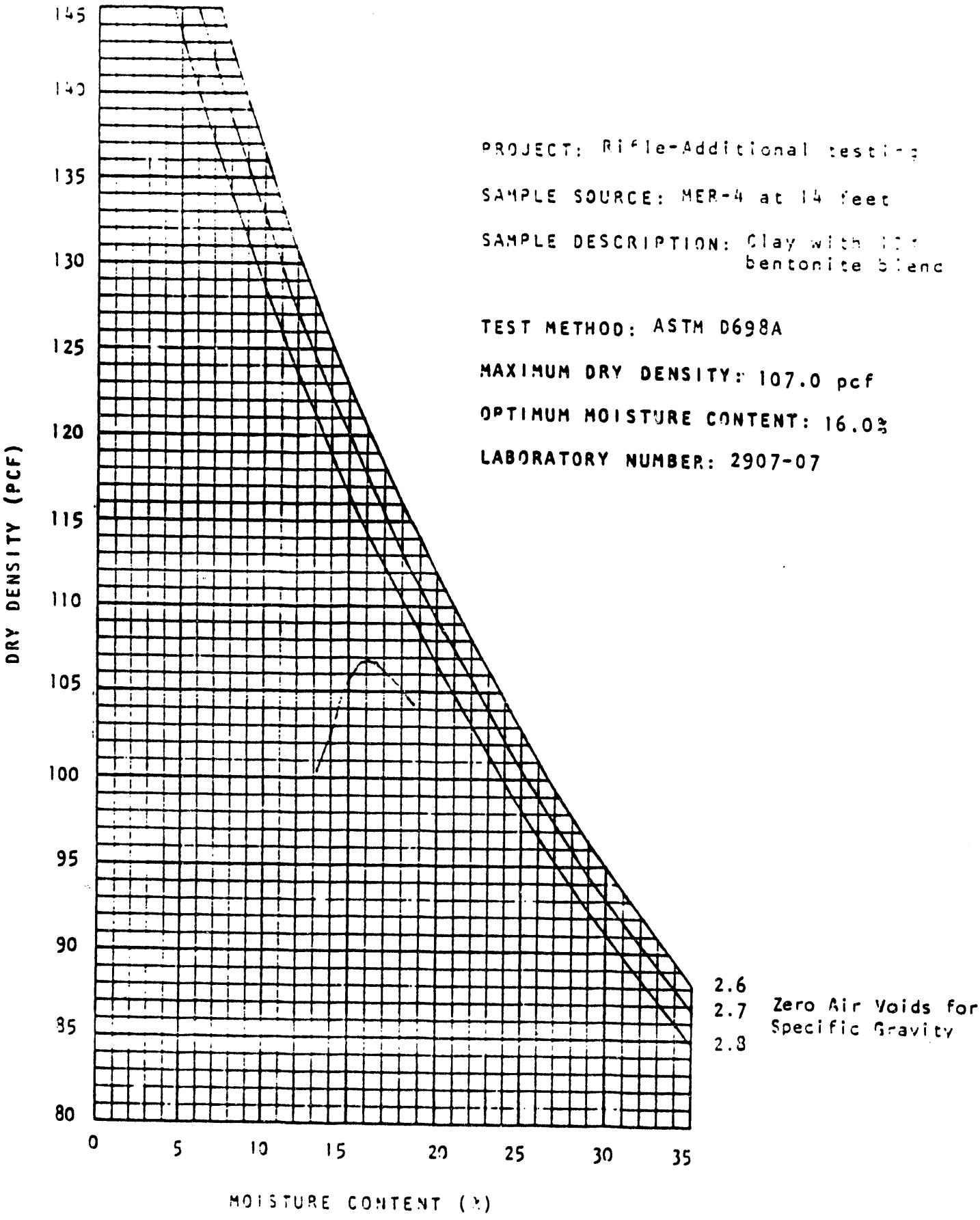
Lambert and Associates

Project No:	[illegible]
Date:	
Figure:	[illegible]



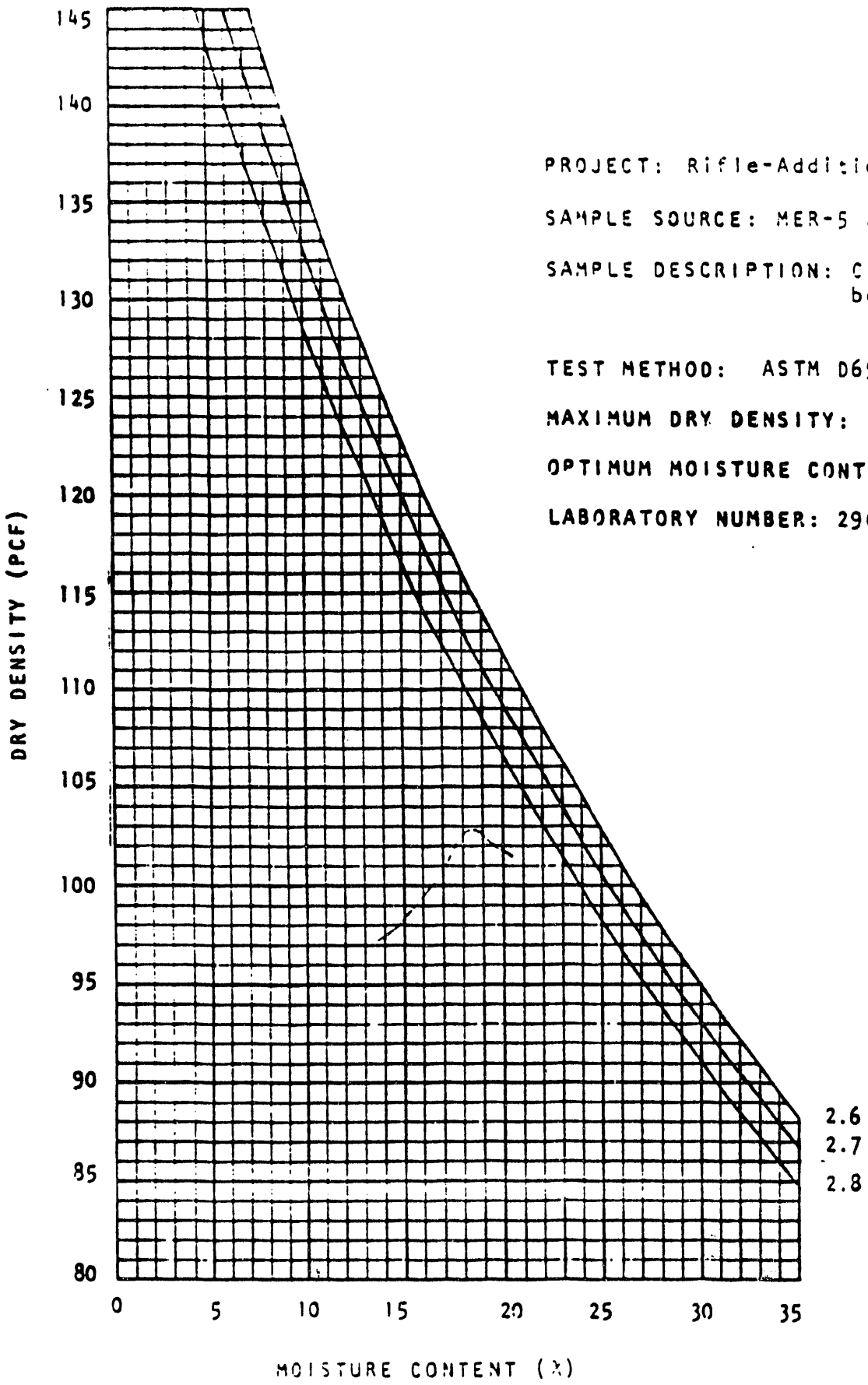
Lambert and Associates

Project No.:	M3905-5E
Date:	
Figure:	823



Lambert and Associates

Project No.:	M3905-43E
Date:	
Figure:	82



PROJECT: Rifle-Additional testing

SAMPLE SOURCE: MER-5 at 5 feet

SAMPLE DESCRIPTION: Clay with [illegible] bentonite blend

TEST METHOD: ASTM D698A

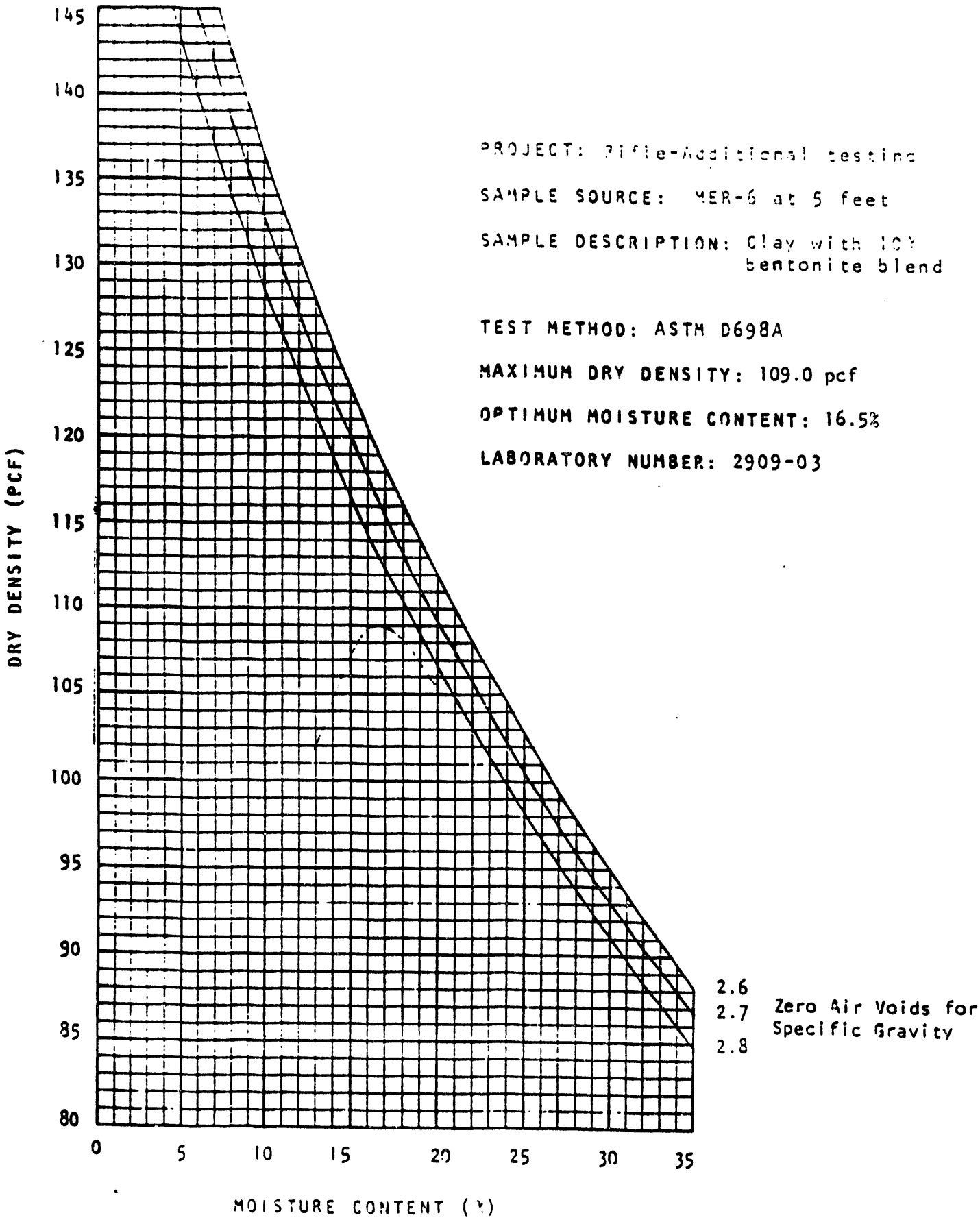
MAXIMUM DRY DENSITY: 103.0 pcf

OPTIMUM MOISTURE CONTENT: 18.5%

LABORATORY NUMBER: 2908-03

Lambert and Associates

Project No.:	M8905-GE
Date:	
Figure:	B25



Lambert and Associates

Project No.:	M89054GE
Date:	
Figure:	8.2b

Lambert and Associates

CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

TEST RESULTS

PROJECT Rifle PROJECT NO. M8905437E DATE 5 10 89

LOCATION RFL-8701 SOURCE MER-1 @ 2 feet

SAMPLE NO. 2934-01 SPECIFICATION*

ATTERBERG LIMITS RESULTS

Liquid Limit: 55

Plastic Limit: 14

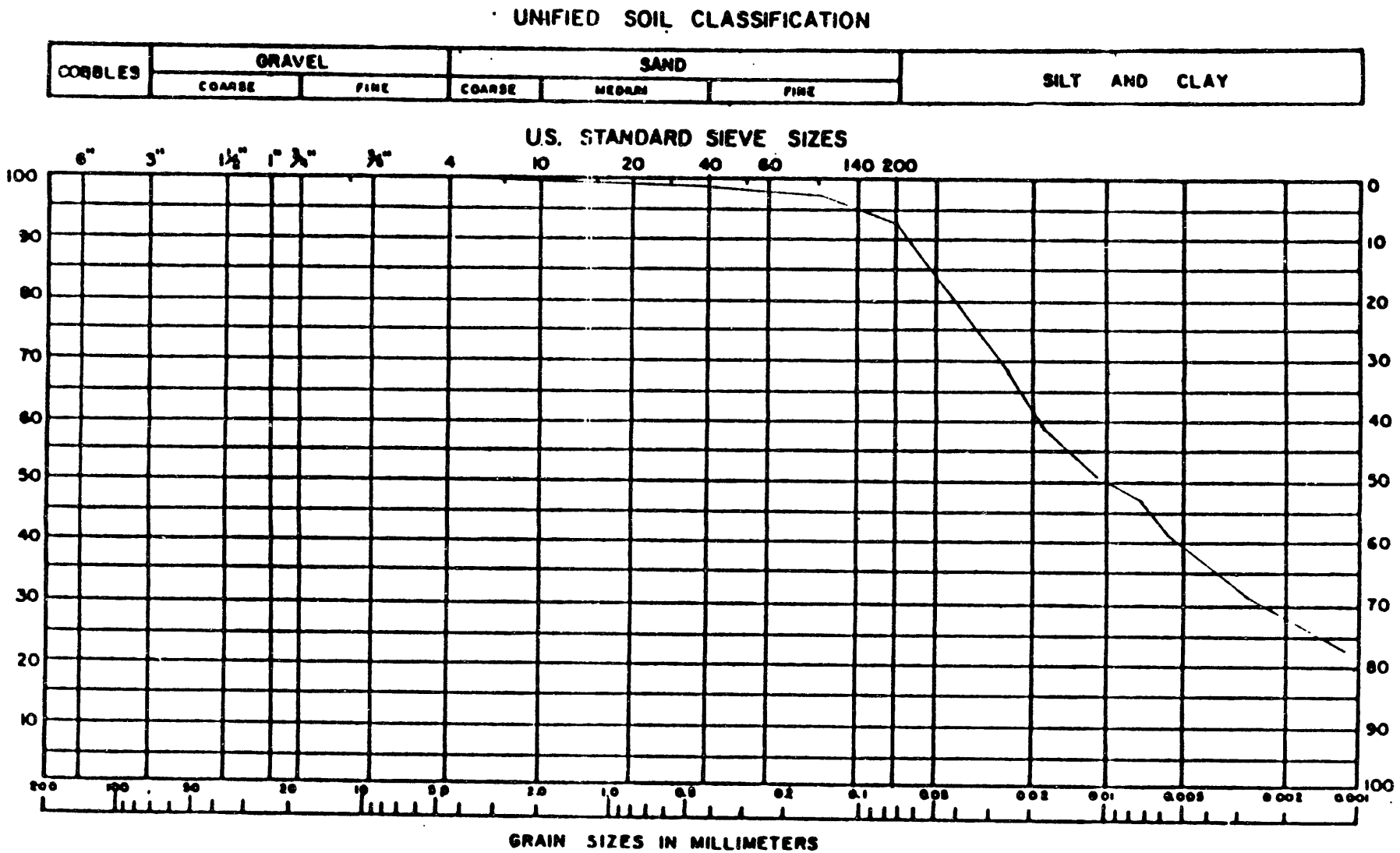
Plasticity Index: 41

Figure B27

Project: RFL-8701

Job Number: M89054GE

GRAIN SIZE DISTRIBUTION CURVES



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-1	5	42	27	2.740	10.5	2904-02
CLASSIFICATION						

Fig

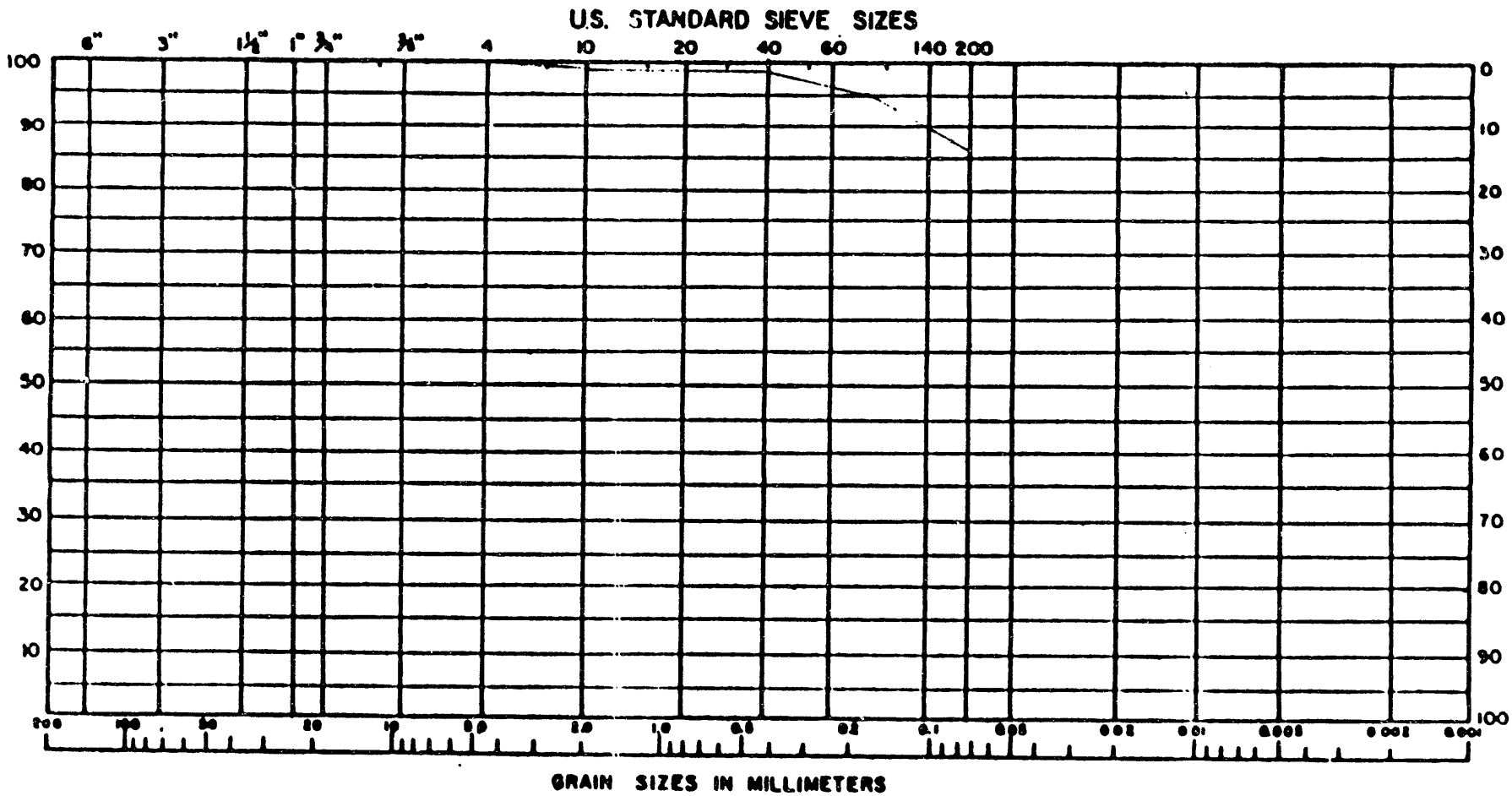
Project: RFL-8701
Job Number: M89054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig: 829

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



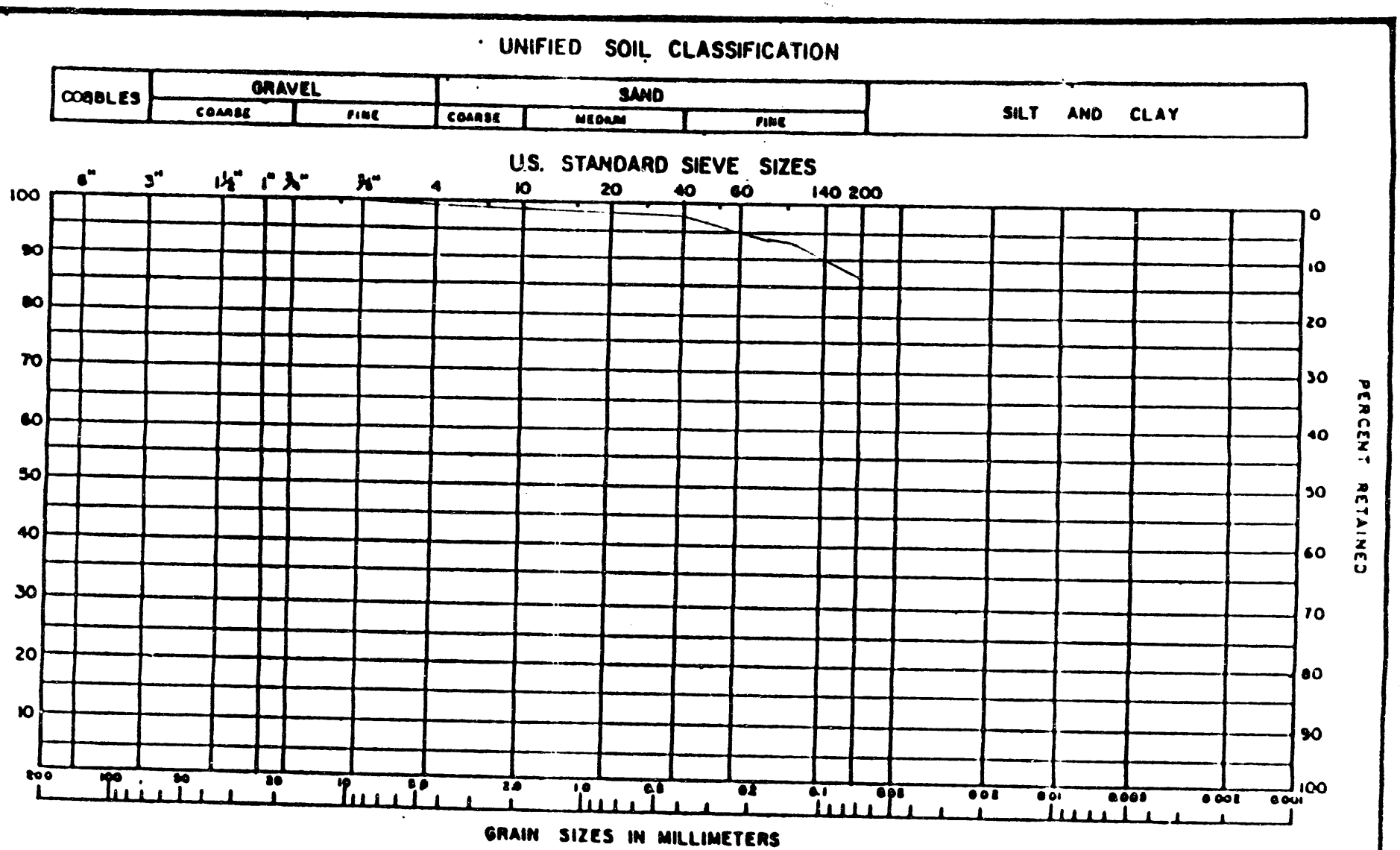
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-1	8	50	35	2.663	7.7	2904-4
CLASSIFICATION						

Project: RFL-8701

Job Number: M89054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig: B30

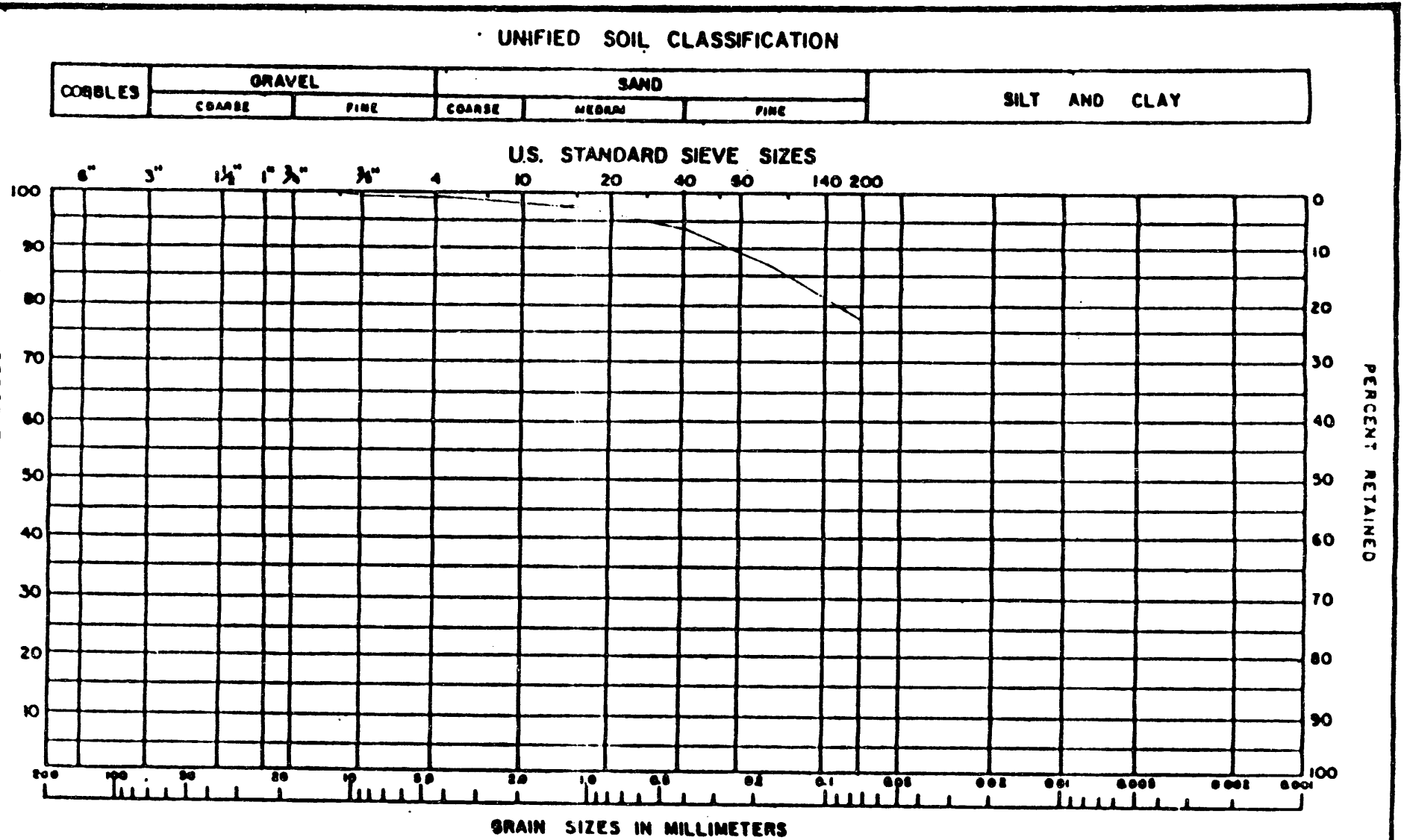


TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-1	15	56	41		10.1	2904-08
CLASSIFICATION						

Project: RFL-8701

Job Number: M89054GE

GRAIN SIZE DISTRIBUTION CURVES



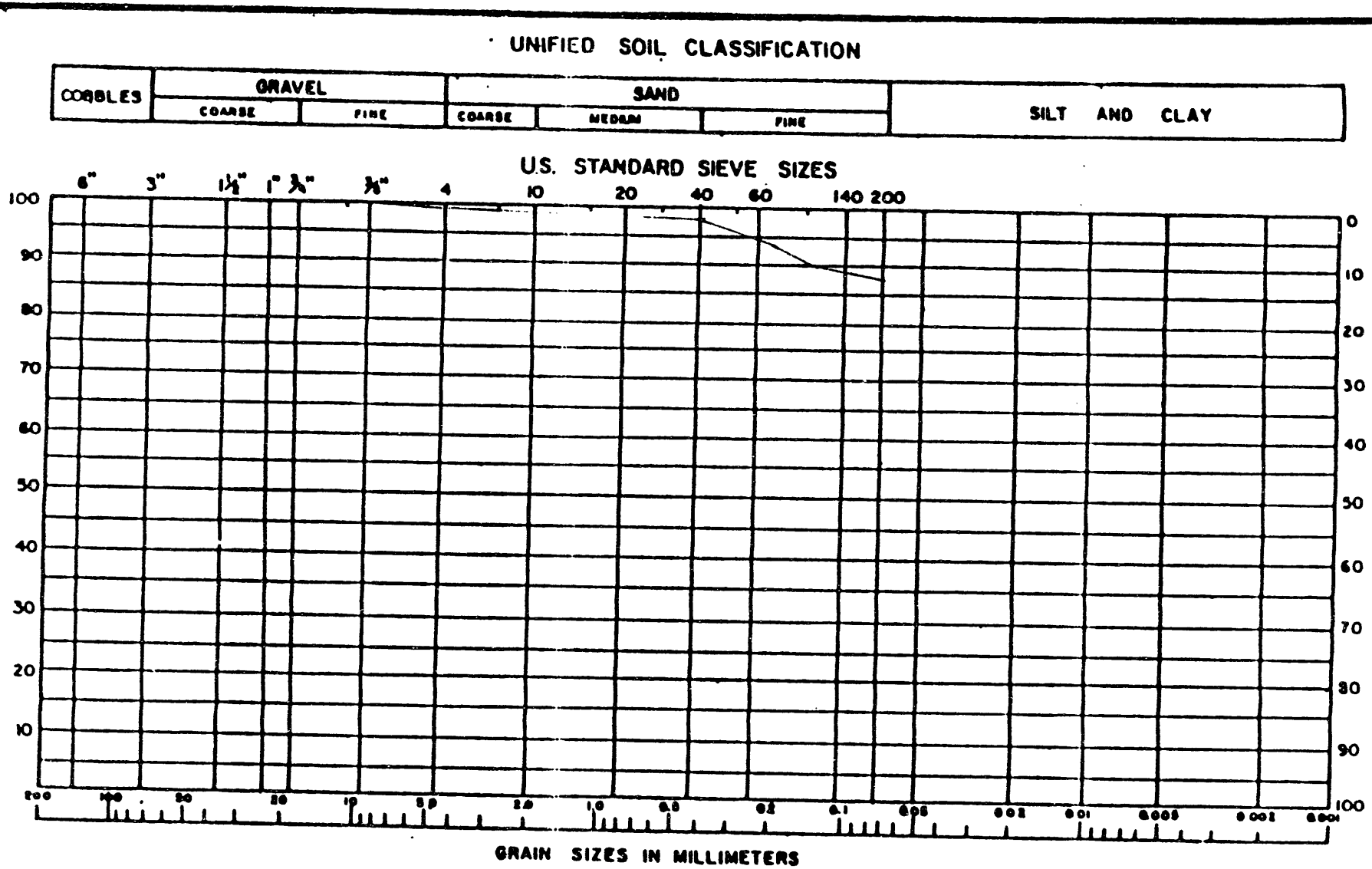
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-2	3	57	43		8.6	2905-01
CLASSIFICATION						

Fig. B31

Project: RFL-8701

Job Number: M89054GE

GRAIN SIZE DISTRIBUTION CURVES

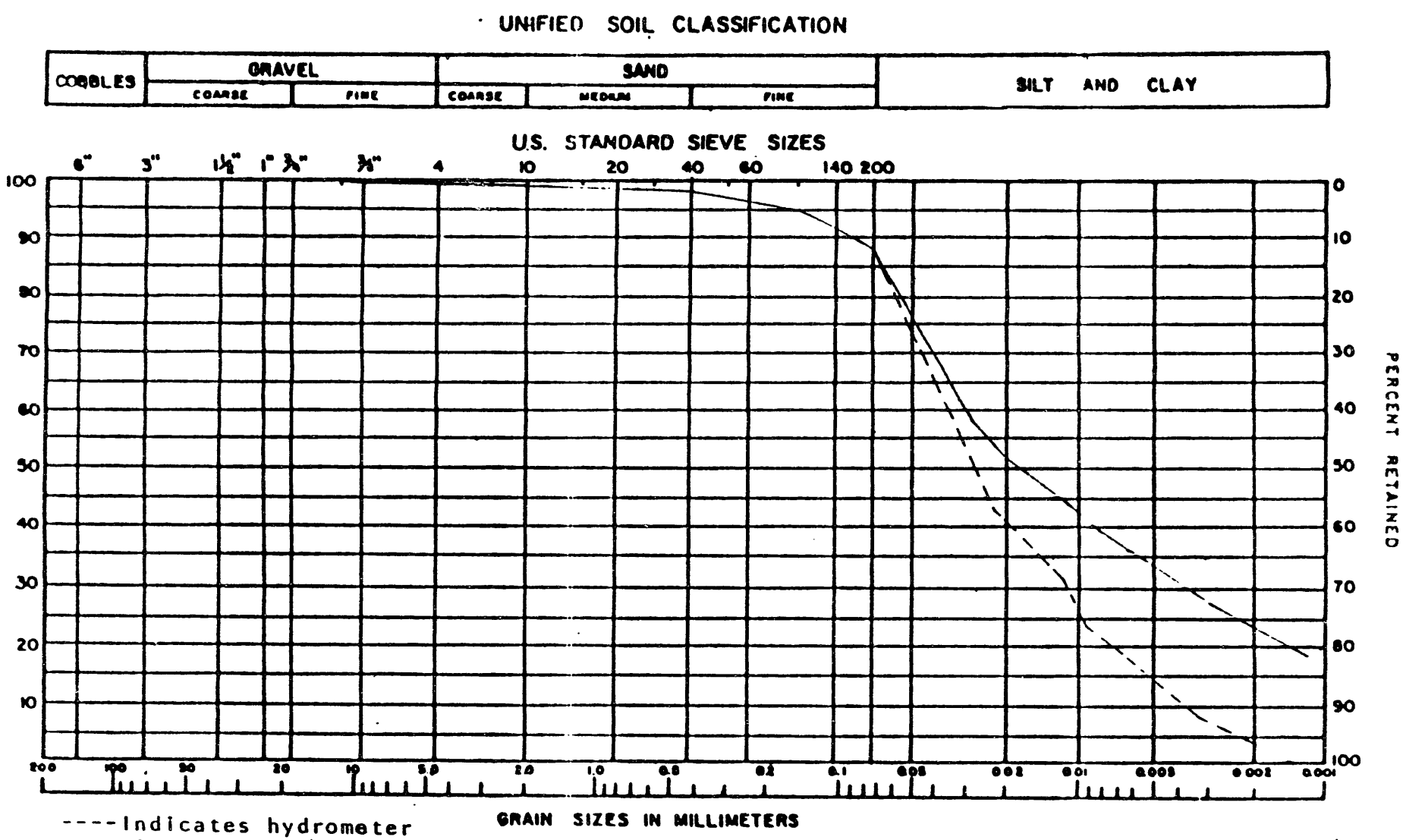


TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-2	5	49	36		8.3	2905-03
CLASSIFICATION						

Fig. B32

Project: RFL-8701
Job Number: M8905456

GRAIN SIZE DISTRIBUTION CURVES



----Indicates hydrometer without dispersing agent

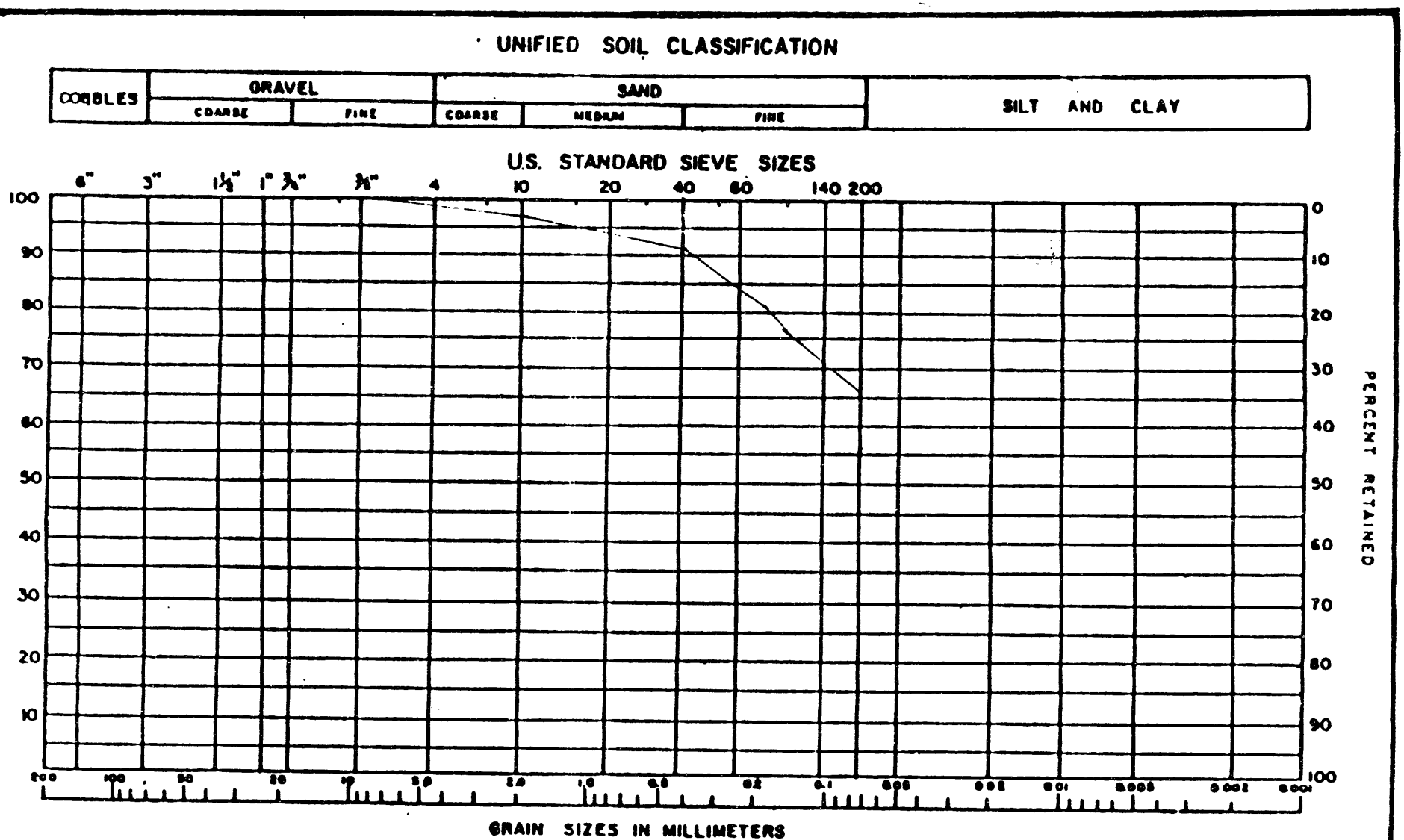
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-2	8	49	34	2.715	10.4	2905-05
CLASSIFICATION						

Fig. B33

Project: RFL-8701
Job Number M89054GE

GRAIN SIZE DISTRIBUTION CURVES

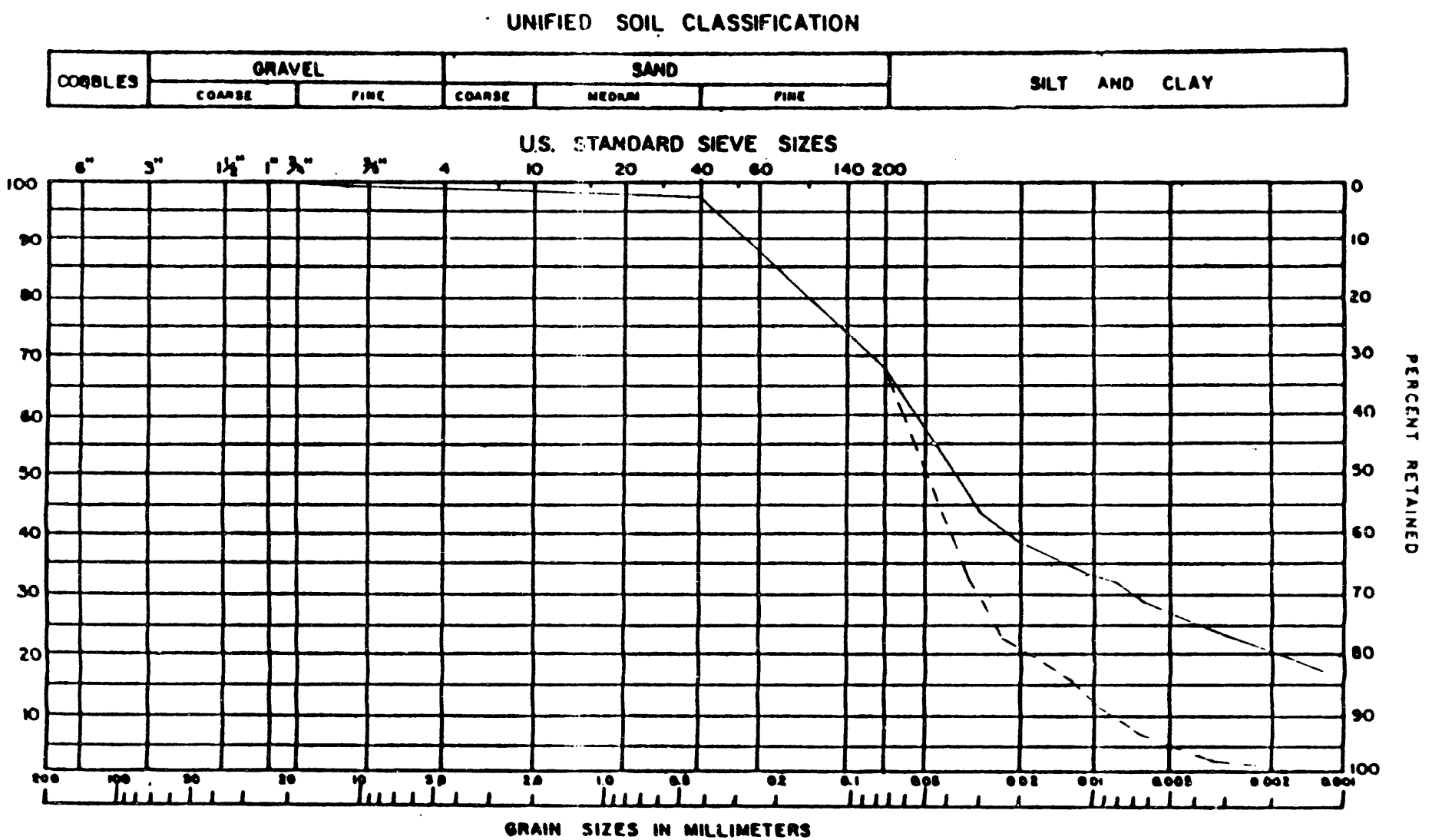
Fig. B3



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-2	10	51	39		8.9	2905-07
CLASSIFICATION						

Project: RFL-8701
Job Number M9905406

GRAIN SIZE DISTRIBUTION CURVES



----Indicates hydrometer without dispersing agent

TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-3	2 1/2	43	28	2.749	7.9	2906-01
CLASSIFICATION						

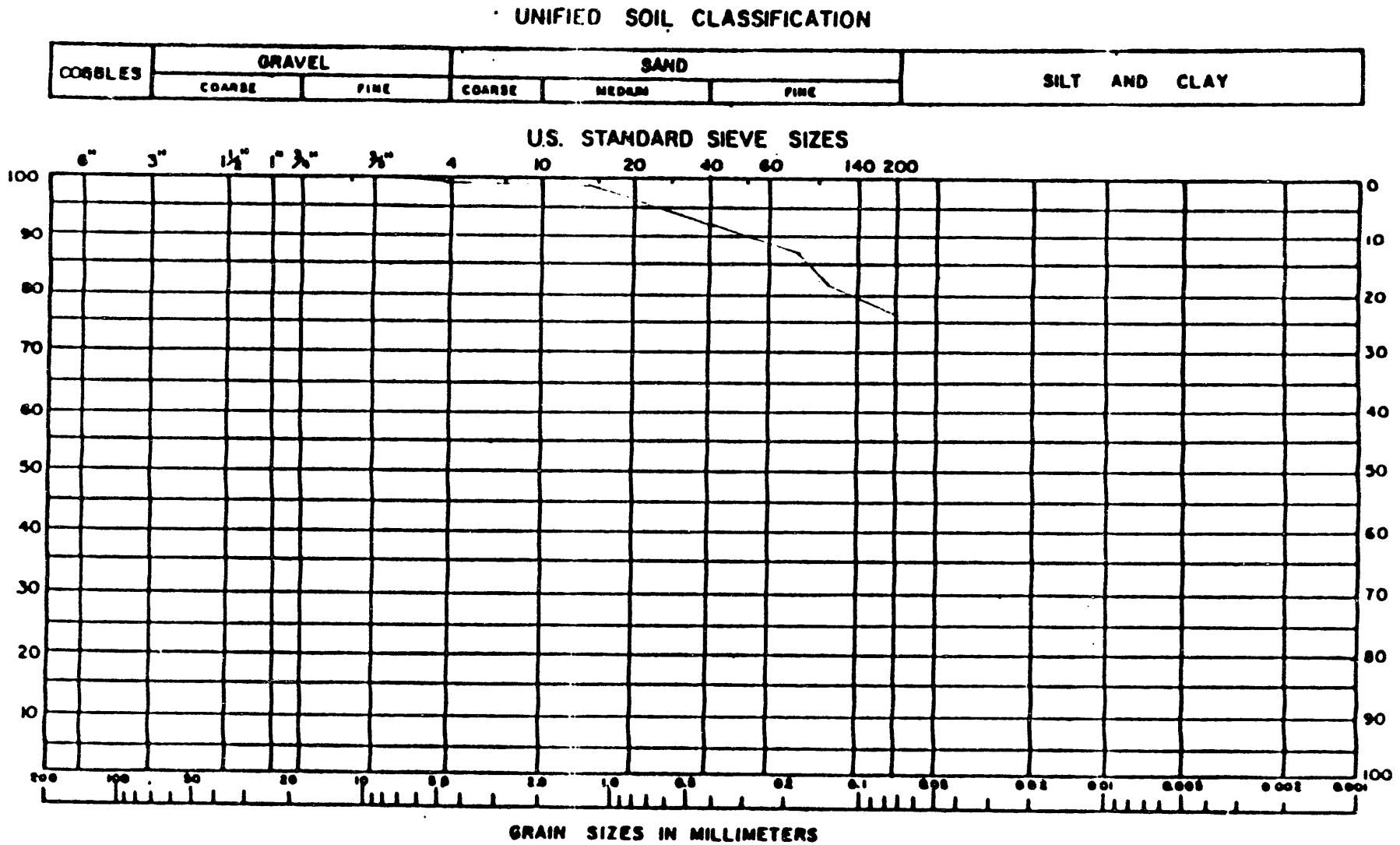
Fig. B35

Project: RFL-8701

Job Number: M8905488

GRAIN SIZE DISTRIBUTION CURVES

Fig. B36

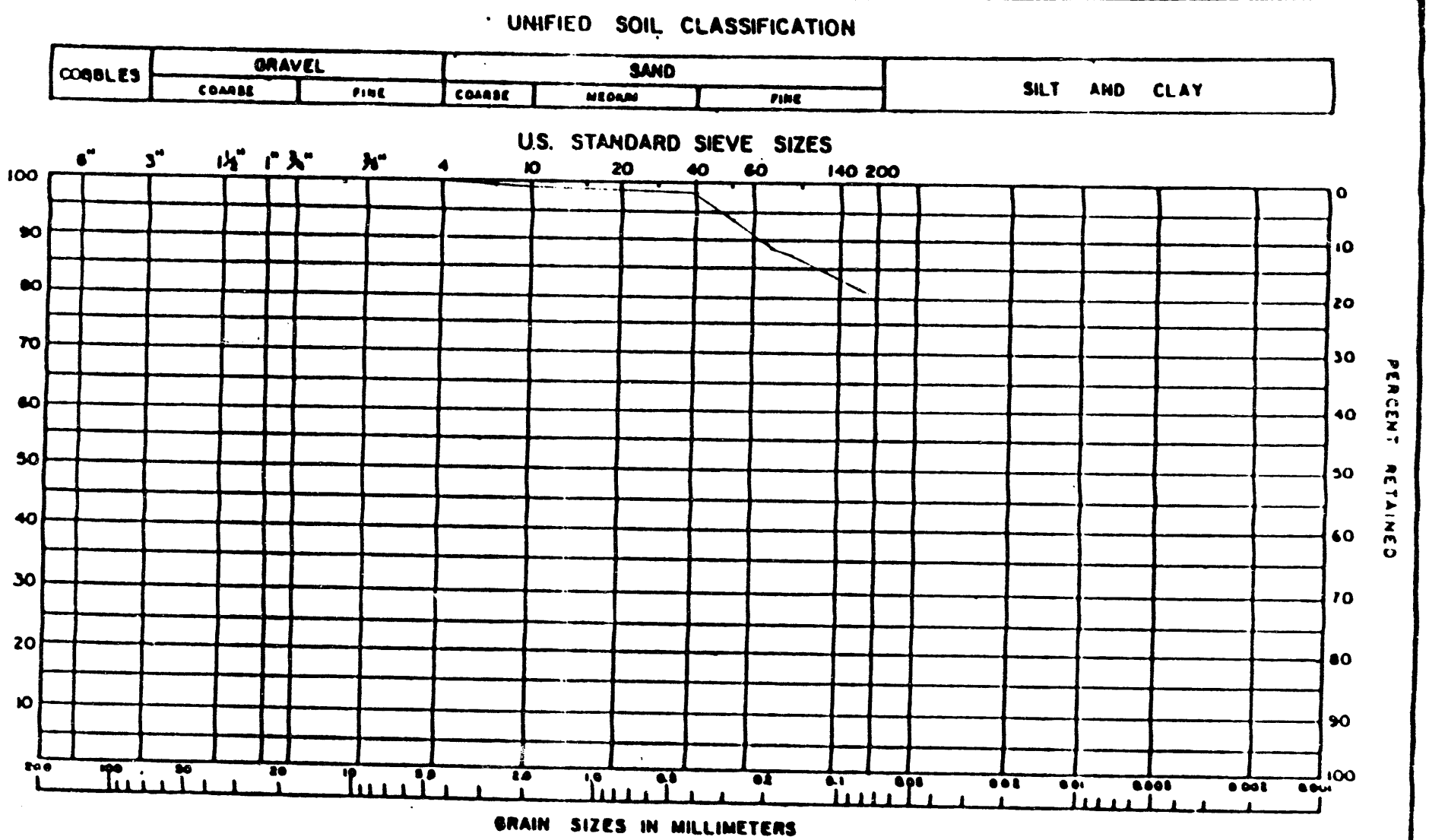


TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-3	8	43	29	2.762	5.4	2906-05
CLASSIFICATION						

Project: RFL-3701

Job Number M89054GE

GRAIN SIZE DISTRIBUTION CURVES



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-3	12	37	22		6.8	2906-08
CLASSIFICATION						

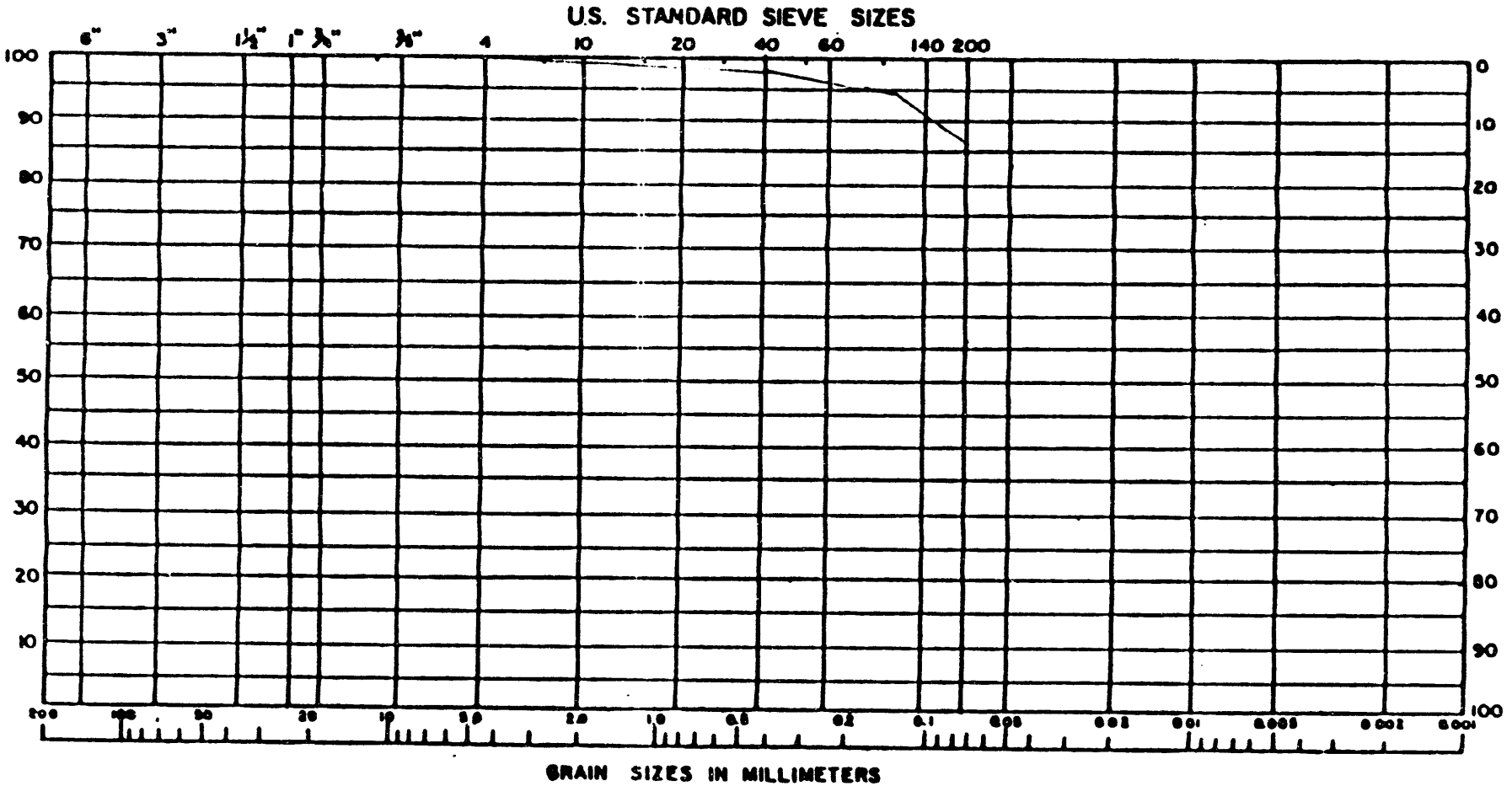
Fig. B37

Project: RFL-8701
Job Number M83054 GE

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

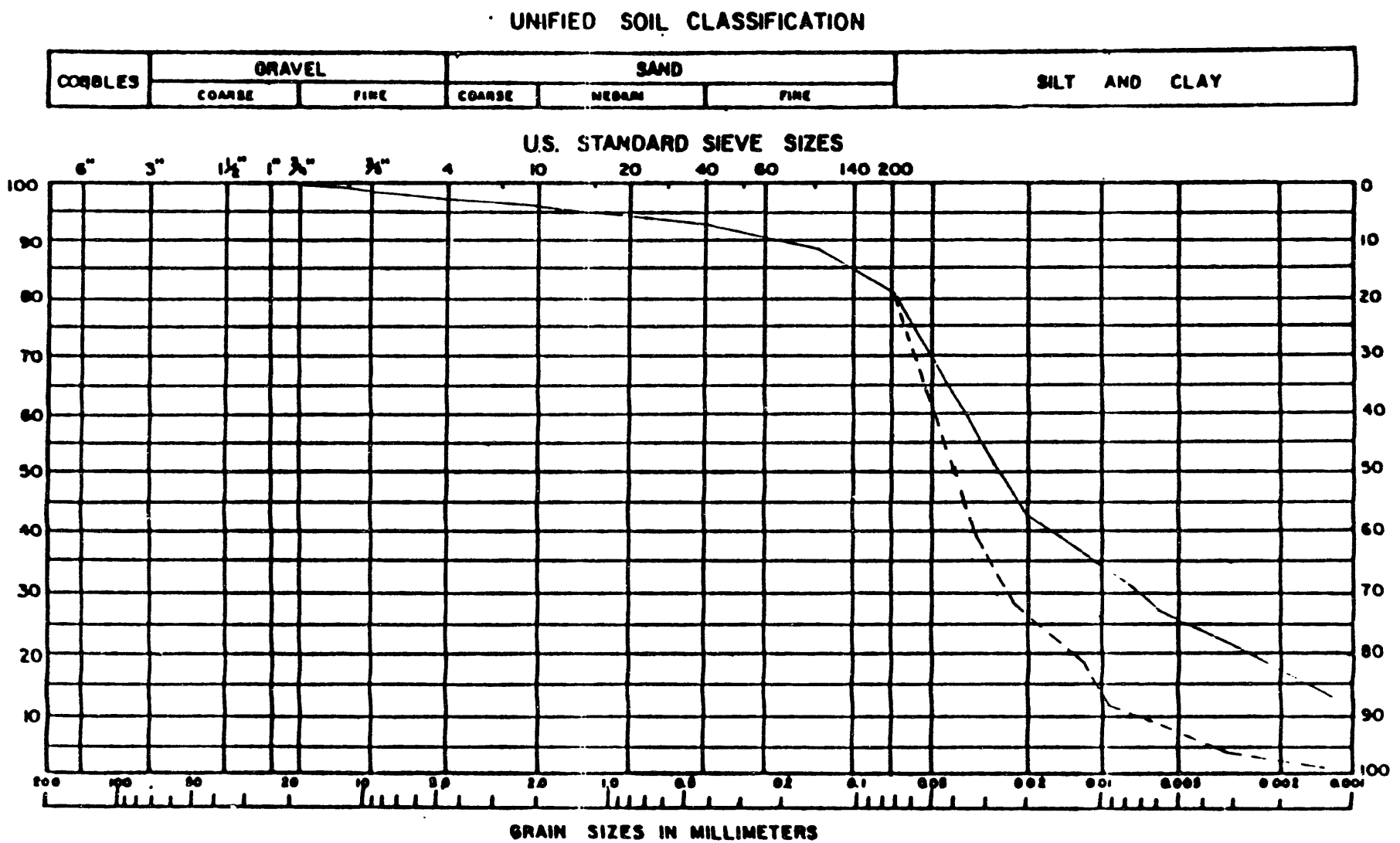


TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-4	6 1/2	39	26		8.6	2907-04
CLASSIFICATION						

Fig. B33

Project: RFL-8701
Job Number M89054GE

GRAIN SIZE DISTRIBUTION CURVES



----Indicates hydrometer without dispersing agent

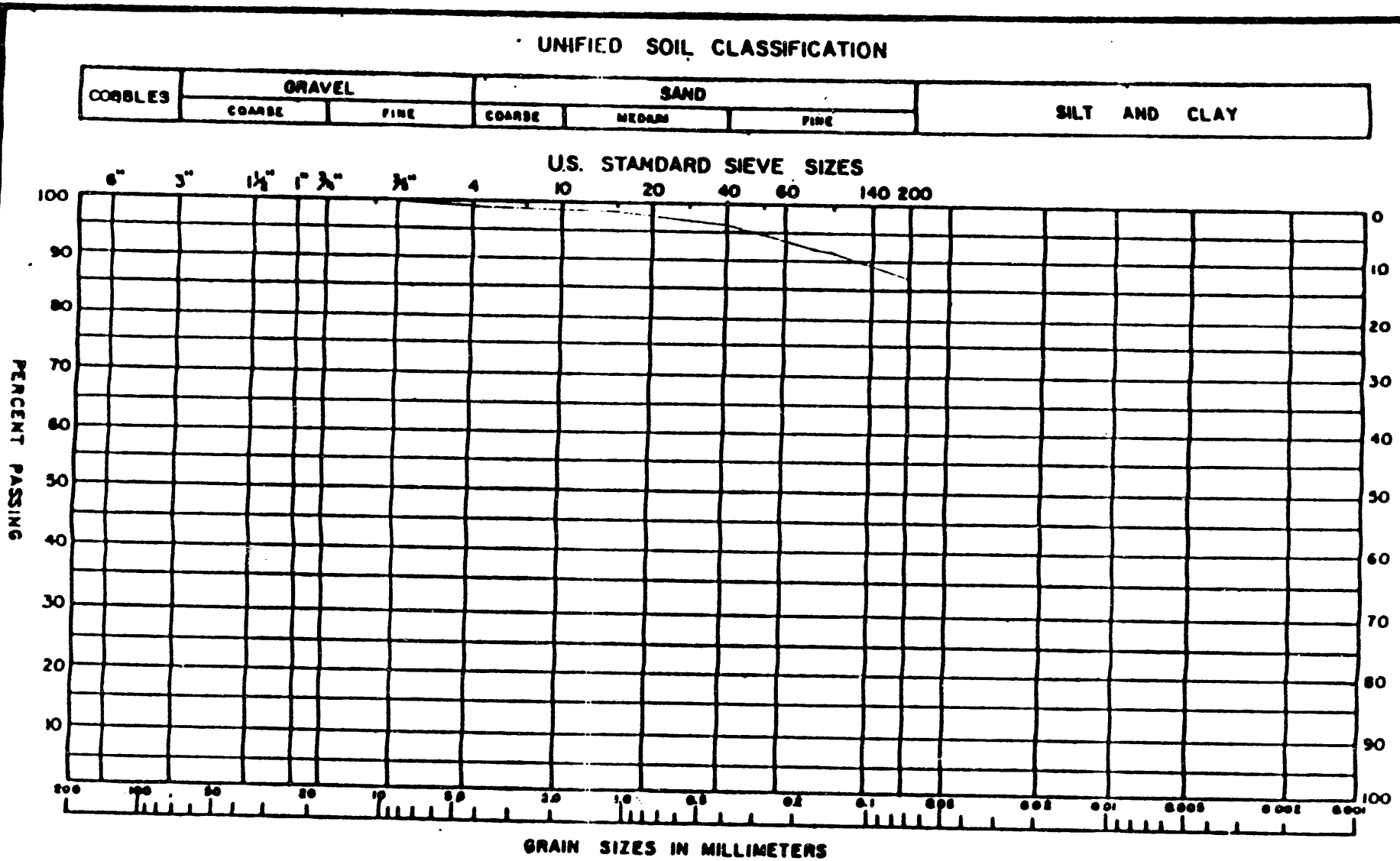
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-4	14	42	28	2.725	7.5	2907-07
CLASSIFICATION						

Fig. B39

Project: RFL-8701

Job Number M89054GE

GRAIN SIZE DISTRIBUTION CURVES



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-5	2	36	22		11.4	2908-01
CLASSIFICATION						

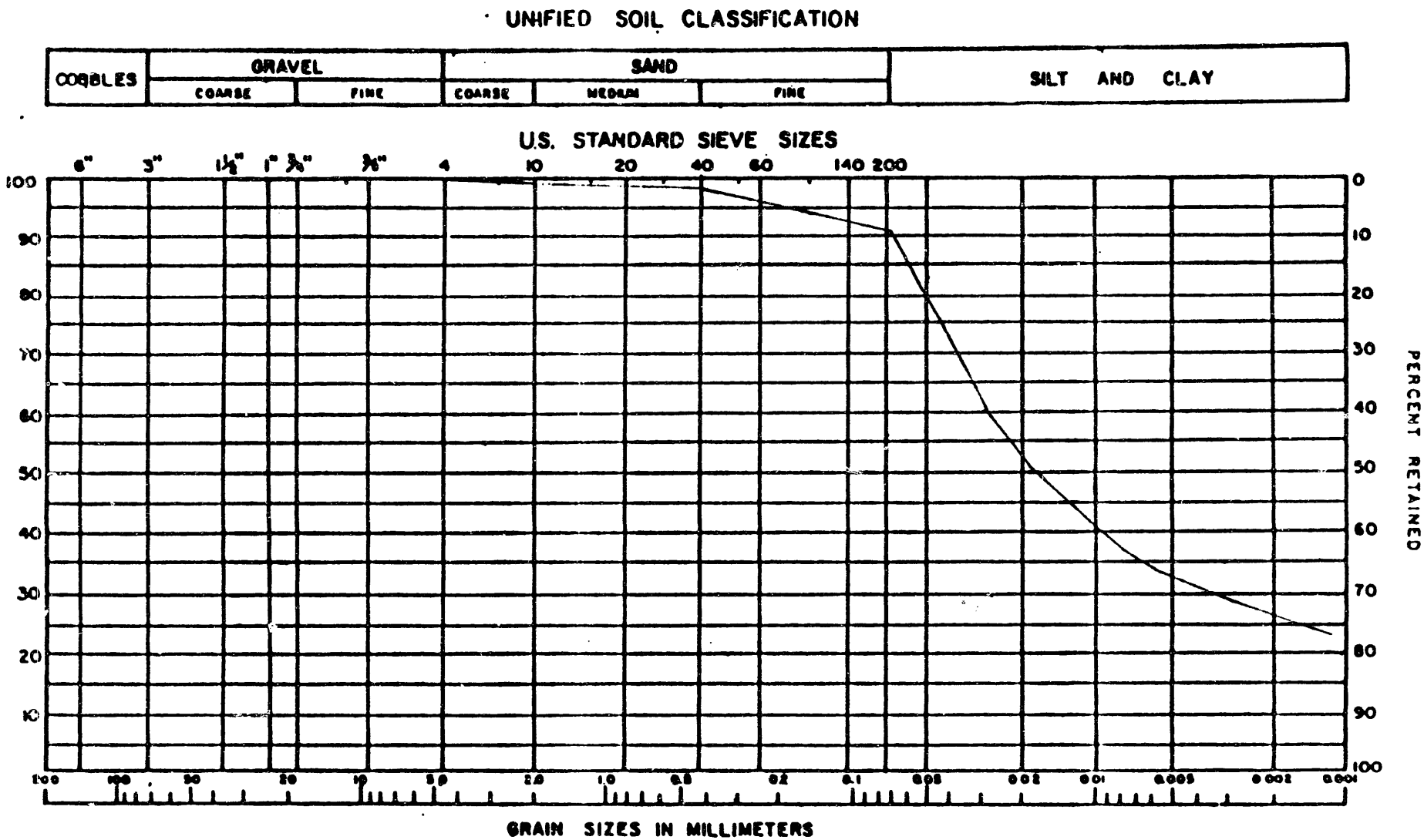
Fig. B40

Project: RFL-8701

Job Number: M83054GE

GRAIN SIZE DISTRIBUTION CURVES

Fig: 941

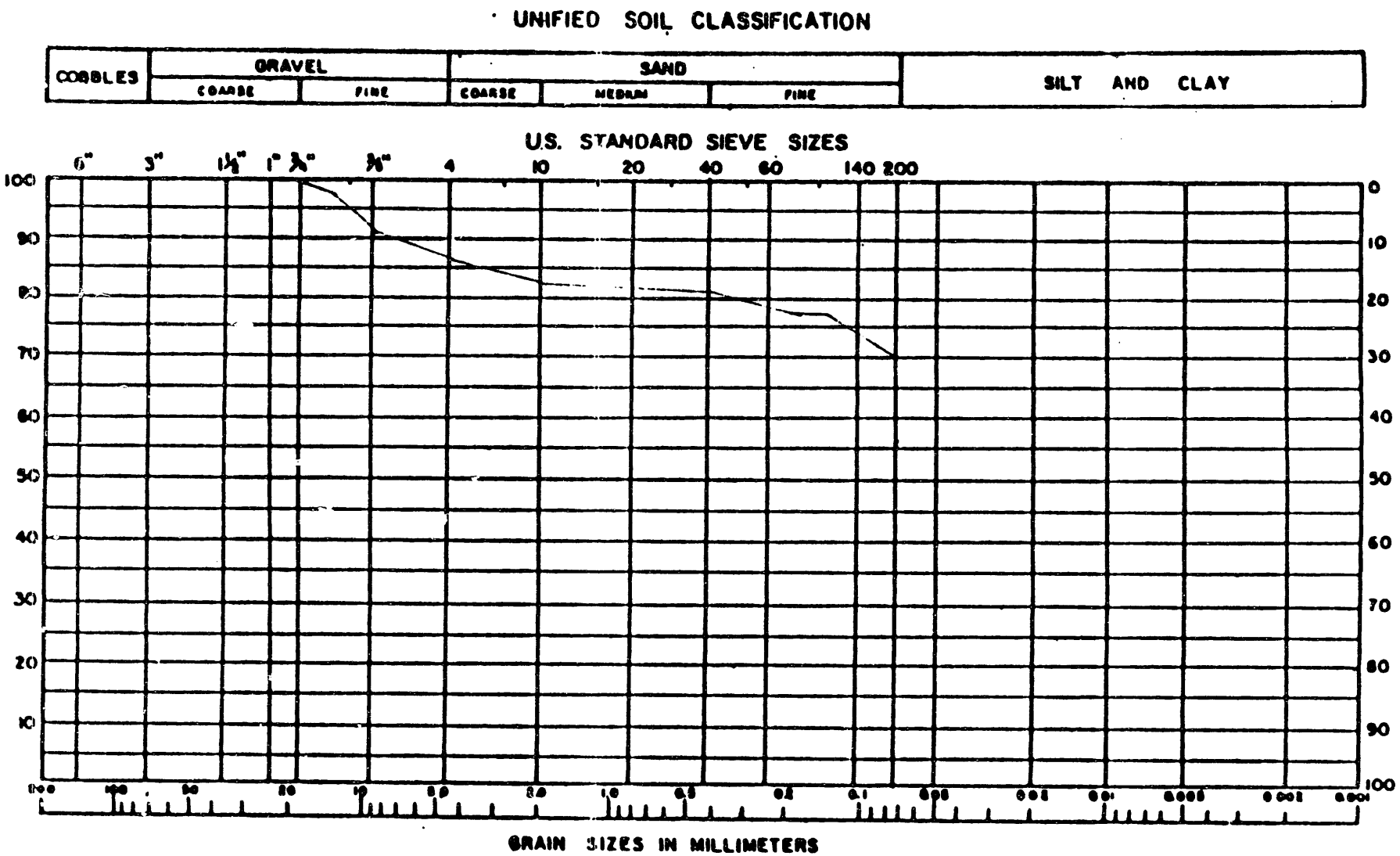


TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-5	5	44	28	2.715	9.8	2908-03
CLASSIFICATION						

Project: RFL 8701
Job Number: M890546E

GRAIN SIZE DISTRIBUTION CURVES

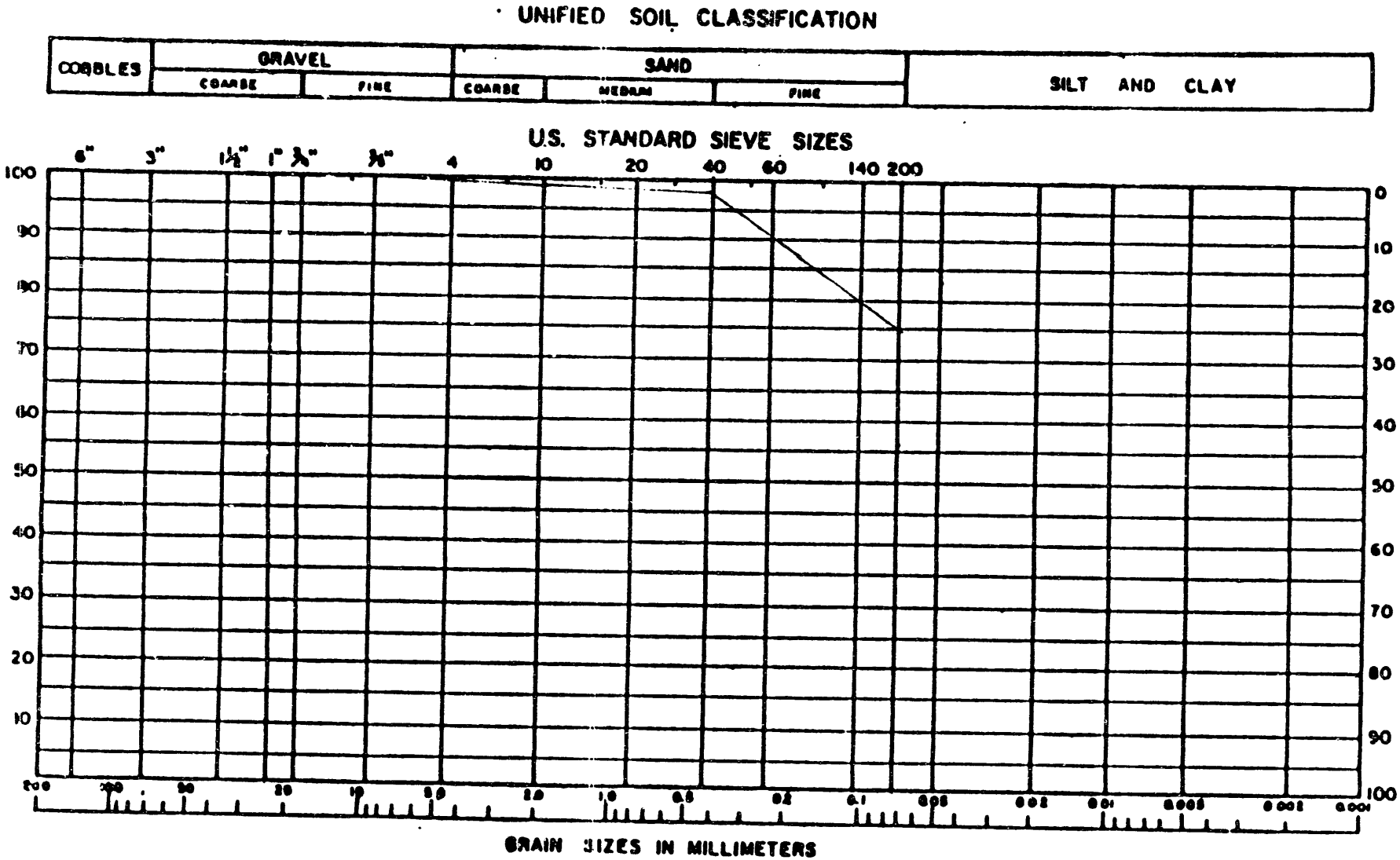
Fig: 842



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-5	8				10.5	2908 06
CLASSIFICATION						

Project: RFL-8701
Job Number: M89054GE

GRAIN SIZE DISTRIBUTION CURVES

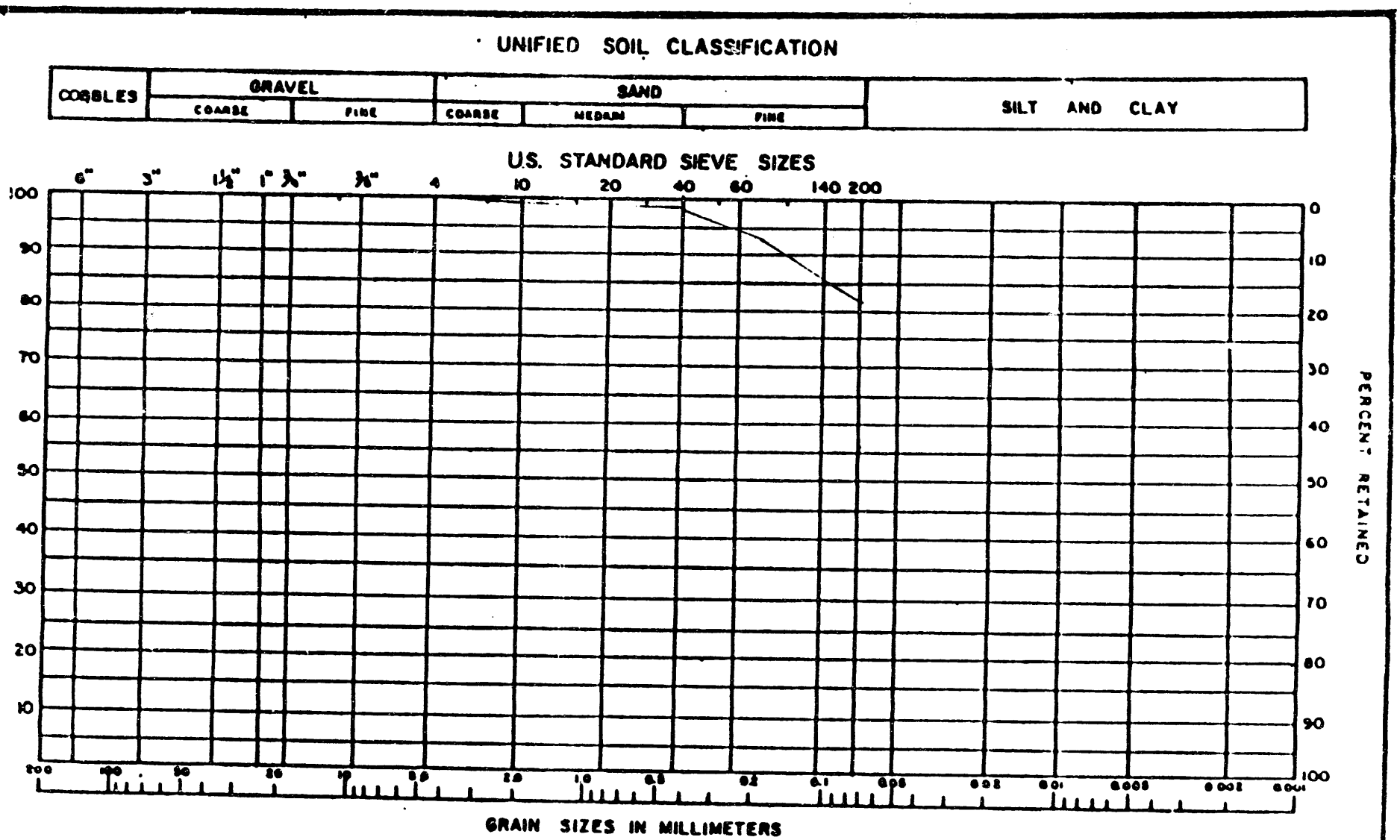


TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-5	12				10.2	2908-08
CLASSIFICATION						

Fig. B43

Project: RFL-8701
Job Number M39054GE

GRAIN SIZE DISTRIBUTION CURVES



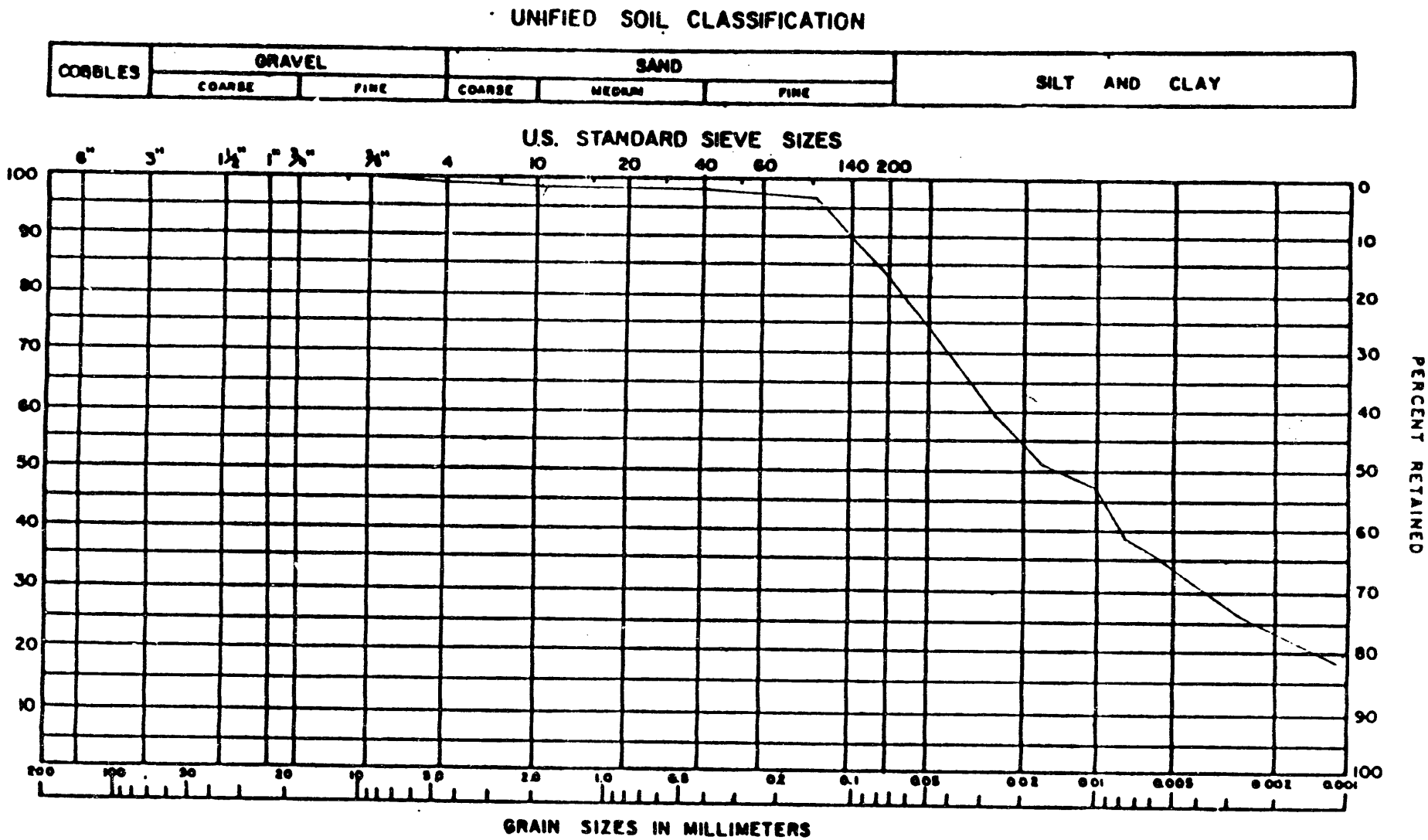
TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-6	2 1/2				10.1	2909-02
CLASSIFICATION						

Fig. B44

Project: RFL-8701

Job Number 4390546

GRAIN SIZE DISTRIBUTION CURVES



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-6	5	53	37	2.857	8.9	2909-03
CLASSIFICATION						

Fig. B-5

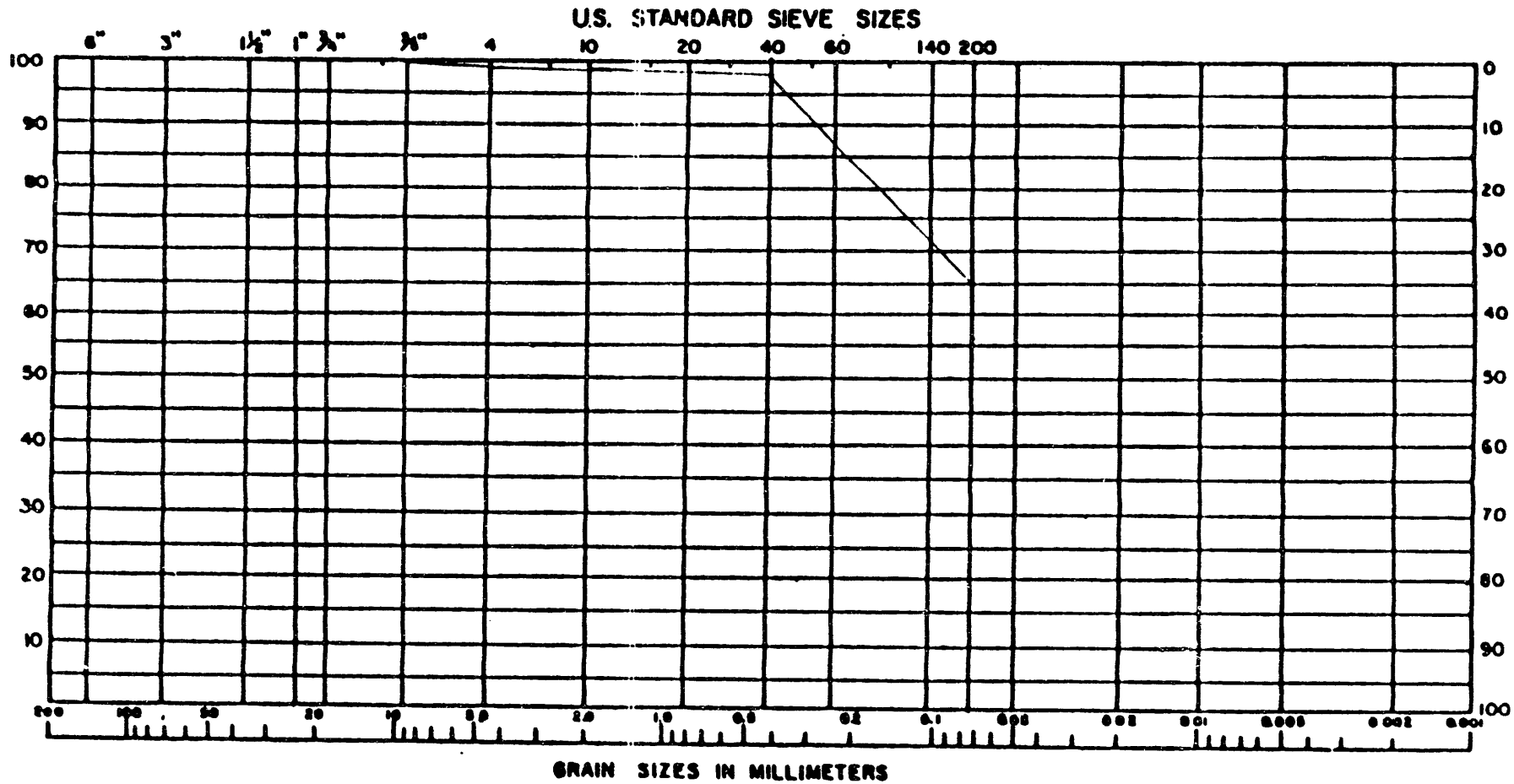
Project: RFL-8701

Job Number: M8905465

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



TEST HOLE NO.	DEPTH (FEET)	LL	PI	SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LABORATORY NUMBER
MER-6	7 1/2	56	40		8.8	2909-05
CLASSIFICATION						

Fig. 8-46

ADDENDUM D8

LABORATORY TEST DATA FROM MKF INVESTIGATION, 1987
(RIPRAP TESTS)

MKE DOCUMENT NO. 5025-RFL-L-09-00907-00 GGC

Lambert and Associates

CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

December 22, 1987

M.K. Ferguson
180 Howard Street
San Francisco, CA 94105

PN: M87054GE

Attention: Mr. Grant Cherrington

Subject: Laboratory Test Results for Potential Rip Rap Sources, Rifle UMTRA Project, Rifle, Colorado

Mr. Cherrington:

This report presents the results of our laborabory testing program for the proposed Rip Rap sources for the Rifle UMTRA project. Hand specimen petrology, microscopic thin section petrology, X-ray diffraction analysis, sizing and laboratory crushing, Los Angeles Abrasion tests, sodium sulfate soundness tests and specific gravity tests were all performed on each of the proposed source samples.

The hand specimen and thin section petrology consisted of descriptive as well as qualitative studies of the various rock types. The petrologic assessment was performed in general accordance with ASTM C295. Igneous rock classifications were based on the International Union of Geological Sciences classification system.

The X-ray diffraction analysis utilized a Phillips model XRG-2600 X-ray diffraction equipment. The purpose of the analysis was to determine the presence of smectite.

RECEIVED·MKE
JAN 11 1988
UMTRA·S.F.

Attachment: 5025-RFL-C-09-00908-00

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GRAND JUNCTION, CO 81502
(303) 245-6506

P.O. BOX 0045
MONTROSE, CO 81402
(303) 249-2154

463 TURNER, 104 A
DURANGO, CO 81301
(303) 259-5095

Additional information is also provided on the graphs of the test results.

The samples were sized and crushed in the laboratory to appropriate proportions to conduct Los Angeles Abrasion, sodium sulfate soundness, and specific gravity and absorption.

The Los Angeles Abrasion tests were performed in general accordance with ASTM C131 as requested. Grading A, which is the coarsest grading outlined in the test method, was used for all of the samples. The amount of loss of material was determined after 100 and 500 revolutions of the Los Angeles Abrasion machine. A Forney Model LA-850 Los Angeles Abrasion machine was used in performing the tests.

The specific gravity and absorption of the materials tested was performed in general accordance with ASTM C127. The test portions consisted of washed material which was all retained on a #4 screen. The measurements consisted of dry weight in air, saturated surface dry weight in air and submerged weight. The results presented in this report represent the average test results of a minimum of three (3) test trials.

The sodium sulfate soundness testing was conducted in general accordance with ASTM C88. The prepared samples were soaked in a solution of sodium sulfate for sixteen (16) to eighteen (18) hours prior to oven drying. This process

was repeated five (5) times. After the final cycle the samples were washed free of the solution, dried, sieved, and weighed to determine the amount of loss.

If you have any questions, or if we may provide additional services, please contact us.

Respectfully submitted,

LAMBERT AND ASSOCIATES

David L. Trautner
Geologist

Reviewed by:

Dennis D. Lambert, P.E
Principal Geotechnical Engineer

Norman W. Johnston, P.E.
Manager Geotechnical Engineering

DLT/nr

PETROGRAPHIC ANALYSIS AND ASSOCIATES
TESTING FOR POTENTIAL RIP-RAP SOURCES

Project: Rifle UMTRA Project Number: M87054GE

Sample Designation: Casey No. 1 Date: 11/10/87

Sample Recovery Method: Bulk sample, hand picked, M.K. Ferguson

DISCUSSION

The Casey No. 1 potential source for Rip-Rap consisted of nine (9) boulders, representing six (6) different rock types. Each of the different rock types were classified based on hand specimen observations. The percent by weight of each rock type was determined and is presented on the hand specimen data presentation sheets, Figures 1 through 6. Selection of rock types for microscopic thin section observations and X-ray diffraction analysis was based on the abundance and character of each rock type and a telephone conversation with Mr. Bob Hennicks, M.K. Ferguson. Microscopic observations of the thin sections are presented on Figures 7 and 8. X-ray diffraction data is presented on Figure 9.

After selection of the rock type for petrographic studies each cobble was measured and weighed. The size and weight distribution of the cobbles, with notes of associated rock types are presented on Figure 10. The entire sample was then crushed for additional laboratory testing. The final crushed sample consisted of approximately the same proportions of each rock type. A tabulation of the rock

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type and general shape of crushed pieces is presented on Figure 11. The laboratory test results for Los Angeles Abrasion, sodium soundness and specific gravity and absorption tests are presented on Figure 12.

PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle- UMTRA Project Number: M87054GE

Sample Desination: Casey No. 1-A Date: 11/10/87

Sample Type: Boulders

Percentage of Total, this classification: 119.79 lbs, 39.4%

General Size and Shape of Sample Portions: Sample consists of three (3) somewhat flattened disk-like cobbles, approximately twelve (12) to fifteen (15) inches in maximum dimension and five (5) inches minimum dimension.

MINEROLOGY/PETROLOGY

Crystal or grain sizes: Phaneritic fine grained (less than 2 mm)

Crystal or grain relationships (fabric): Isotropic, equant grains

Degree of crystal face development: Anhedral

Rock Texture/morphology: Granular/xenomorphic

Alteration or weathering products: Some secondary deposits, hematite stain

Unique Properties: Very slight foliation evident in one specimen

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Quartz	90
Groundmass	5
Plagioclase	2

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Alteration/secondary deposits	3

Rock Classification: Quartzite

Note: The classification presented here is based on hand specimen observations only.

Microscopic petrology (thin section) performed also

Figure 1

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Casey No. 1-B Date: 11/10/87

Sample Type: Boulders

Percentage of Total, this classification: 89.13 lbs, 29.3%

General size and shape of sample portions: Sample consisted of one (1) elongated boulder approximately sixteen (16) inches by five (5) inches and one (1) flattened spheroidal boulder approximately twelve (12) inches by seven (7) inches

MINEROLOGY/PETROLOGY

Crystal or grain sizes: Aphanitic, too small to distinguish with hand lens

Crystal or grain relationships (fabric): N/A

Degree of crystal face development: N/A

Rock Texture/morphology: N/A

Alteration or weathering products: Some alteration on surface of cobble.

Unique Properties: Massive, difficult to fracture boulders

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE

Could not determine mineralogy in hand specimen due to particle size

ACCESORY MINERALS	ESTIMATED PERCENTAGE
N/A	

Rock Classification: Very fine grained sandstone

Note: The classification presented here is based on hand specimen observations only.

Microscopic petrology and x-ray diffraction tests performed also

Figure 2

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Desingation: Casey No. 1-C Date: 11/10/87

Sample Type: Boulders

Percentage of total, this classification: 44.74 lbs, 14.7%

General size and shape of sample portions: Sample consisted of one (1) flattened spheroidal boulder approximately twelve (12) inches by seven (7) inches.

MINEROLOGY/PETROLOGY

Crystal or grain sizes: Phaneritic medium grained, (approximately 5 mm)

Crystal or grain relationships (fabric): Isotropic fabric, inequant grains

Degree of crystal face development: Subhedral to euhedral

Rock Texture/morphology: Seriate texture, hypidiomorphic

Alteration or weathering products: Some chloritization evident

Unique properties: Isolated phenocrysts of hornblende

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Quartz	45
Plagioclase	35
orthoclase	10

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Hornblende	5
and other alteration	5

Rock Classification: Granidiorite

Note: The classification presented here is based on hand specimen observations only.

Figure 3

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Desingation: Casey No. 1-D Date: 11/10/87

SAmple Type: Boulder

Percentage of total, this classification: 20 lbs, 6.6%

General size and shape of sample portions: Sample consists of one (1) flattened cobble approximately eleven (11) by four (4) inches.

MINEROLOGY/PETROLOGY

Crystal of grain sizes: Phaneritic fine grained (less than 2 mm)

Crystal or grain relationships (fabric): Isotropic fabric, equant grained

Degree of crystal face development: Subhedral

Rock Texture/morphology: Slight secondary stains, could not determine type in hand specimen

Unique properties: Recognition of muscovite dependent on angle of fracture with regard to crystal orientation.

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Quartz	60*
Orthoclase	20
Plagioclase	10

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Mica	5
Alteration	5

Rock Classification: Quartzite

Note: The classification presented here is based on hand specimen observations only.

*Percentages were difficult to estimate due to fine grained nature of the hand specimen.

Figure 4

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Casey No.1-E Date: 11/10/87

Sample Type: Boulder

Percentage of total, this classification: 17.72 lbs, 5.8%

General size and shape of sample portions: Sample consists of irregular shaped boulder approximately ten (10) by four (4) inches

MINEROLOGY/PETROLOGY

Crystal or grain sizes: Phaneritic fine to medium grained (2-5 mm)

Crystal or grain relationships (fabric): Isotropic equant

Degree of crystal face development: Subhedral

Rock Texure/morphology: Somewhat felty texture, hypidiomorphic

Alteration or weathering products: Chloritization of biotite evident

Unique properties:

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Quartz	40
Plagioclase	35

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Biotite	15
Chlorite	10

Rock Classification: Trondhjemite

Note: The classification presented here is based on hand specimen observations only.

Figure 5

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Casey No. 1-F Date: 11/10/87

Sample Type: Cobble

Percentage of total, this classification: 12.75 lbs, 4.2%

General size and shape of sample portions: Sample consist of one (1) spheroidal cobble approximately nine (9) by four (4) inches.

MINEROLOGY/PETROLOGY

Crystal or grain sizes: Phaneritic fine grained (less than 2 mm)

Crystal or grain relationships (fabric): Equant isotropic

Degree of crystal face development: Subhedral to anhedral

Rock Texture/morphology: Apilitic hypidiomorphic to xenomorphic

Alteration or weathering products: Some chloritization

Unique properties: Some natural fractures have secondary hematite deposits.

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Quartz	15
Plagioclase	20
Potassium feldspars (orthoclase and sanidine)	20

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Chlorite	3
Hematite	2
groundmass	4

Rock Classification: Quartz monzonite

Note: The classification presented here is based on hand specimen observations only.

Figure 6

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PETROGRAPHIC ANALYSIS

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Casey No. 1-A Date: 12/1/87

THIN SECTION/MICROSCOPIC OBSERVATIONS

Petrographic Scope: Olympus 207680 (40-400X)

Thin Section Orientation: Perpendicular to slight foliation

Serrated boundaries of equant grains were common. Quartz grains were all approximately the same dimension with smaller particles of lithic fragments and plagioclase sparse. The slight foliation which could be observed in the hand specimen could not be readily observed in the hand specimen. Some thin bands of slightly larger quartz grains were observed which may have caused a foliated appearance in the hand specimen.

DATA

CONSTITUENT	MEASURED DIMENSIONS	ESTIMATED PERCENTAGE
Quartz	1-2mm	93
Lithic Fragments	0.5-1.0mm	5
Pagioclase	0.3-0.8mm	1
Secondary stain	N/A	1

Classification: Quartzite (Or orthoquarzite)

Figure 7

PETROGRAPHIC ANALYSIS

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Casey NO. 1-B Date: 12/1/87

THIN SECTION/MICROSCOPIC OBSERVATIONS

Petrographic Scope: Olympus 207680 (40-400X)

Thin Section Orientation: No particular orientation

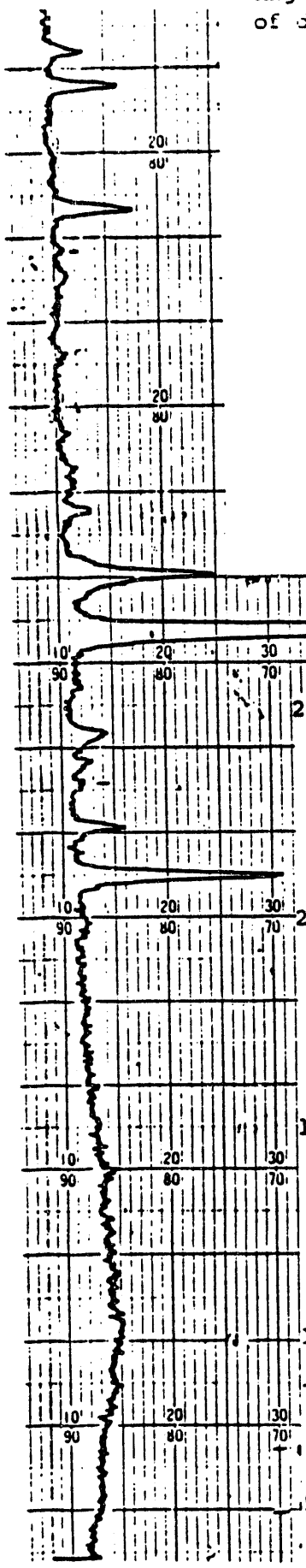
Microaphanitic grains dominated the thin section. Some small lithic fragments and quartz were recognized, however the particle sizes were so small that actual mineral and petrographic identification was not possible. Secondary hematite deposits was the only recognizeable alteration or constituent. A very slight band was noticed in the thin section which could not be identified in the hand specimen.

DATA

Constituent size and percent could not reliably be estimated due to particle size. Maximum measureable grains were approximately 0.1 mm or less. A reddish groundmass, possibly of hematite stain was dominant.

Classification: Very fine grained sandstone.

Figure 8



Angle (2 θ) of Diffraction	Distance Between Crystal Lattice Å	Mineral
40	2.23	Quartz
	2.27	Quartz
	2.45	Quartz
35		
30		
	3.17	Hematite
	3.35	Quartz
25		
	3.64	Hematite
	4.07	Plagioclase
20	4.23	Quartz
15		
10		
7.4		
5.9		

If montmorillonite group clay minerals (smectite) were present, peaks would be observed in this range.

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Project No.:
Date:
Figure: 9

SIZE DISTRIBUTION OF COBBLES IN SAMPLE

NUMBER OF COBBLES	GENERAL SHAPE	DIMENSIONS MAXIMUM (INCHES)	DIMENSIONS MINIMUM (INCHES)	PERCENT OF TOTALS	ROCK TYPE SAMPLE I.D.
1	Elongated	16	5	12.3	Siltstone Casey No. 1-B
2	Flattened Spheroidal	15	6	30.9	Quartzite Casey No. 1-A
3	Flattened Spheroidal	12	7	31.7	Siltstone Casey No. 1-B Granidiorite Casey No. 1-C
1	Spheroidal disk shape	12	5	8.5	Quartzite Casey No. 1-A
1	Flattened S Spheroidal	11	4	6.6	Quartzite Casey No. 1-D
1	Irregular Spheroidal	10	4	5.8	Trondhjemite Casey No. 1-E
1	Spheroidal	9	4	4.2	Quartz-Monzonite Casey No. 1-F

Figure 10

NOTES AND OBSERVATIONS OF ROCK SHAPES AFTER CRUSHING

Rock Type and Sample I.D.	Discussion
Quartzite Casey No. 1-A	The general shapes caused by crushing was blocks and wedges. Fractures terminated with moderated rounded angles.
Very fine grained sandstone Casey No. 1-B	Relatively flat, angular shapes were caused by crushing. Fracture terminations were very sharp and angular.
Granidiorite Casey No. 1-C	Small blocks were the dominant shape caused by crushing. Smaller pieces appeared more angular. Fractures terminated in moderate to sharp angles.
Quartzite Casey No. 1-D	Angular wedges with sharp edges particularly on smaller fragments were common. Fractures terminated in sharp angles.
Trondhjemite Casey No. 1-E	A wide variety of shapes were produced, wedges and small angular pieces were common. Fractures terminated in moderate angles.
Quartz-Monzonite Casey No. 1-F	Flat, somewhat tabular pieces were common. Small fractures terminated in very sharp edges while others had moderated angles and rounded edges.

None of the various rock types represented in this sample appeared to fracture in a fashion which was dependent on the rock structure or texture.

It should be noted that a variety of shapes were produced by crushing in all of the rock types. The discussion above is intended to give the reader a general description only. Different crushers and crushing techniques could change shape characteristics drastically.

Figure 11

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TEST RESULTS

PROJECT Rifle-UMTRA PROJECT NO. M87054GE DATE 11/16/87

LOCATION Casey No. 1 SOURCE

SAMPLE NO. 9110 SPECIFICATION* Grading A

LOS ANGELES ABRASION RESULTS

100 Revolutions: 5.9% Loss

500 Revolutions: 24.2% Loss

SULFATE SOUNDNESS RESULTS

SIEVE IZE	WT. OF TEST SAMPLE BEFORE TEST	WT. OF TEST SAMPLE AFTER TEST	PERCENTAGE LOSS BASED ON DESIGNATED SIEVE	SAMPLE GRADING (%)	WEIGHTED PERCENTAGE LOSS BASED ON SAMPLE GRADING
3/8"-#4	300.1	296.7	1.1	4.0	0.04
1/2"-3/8"	332.5				
3/4"-1/2"	675.8	998.4	1.0	13.4	0.13
1"-3/4"	506.1				
1½"-1¼	1016.9	1511.2	0.8	20.2	0.16
2"-1½"	1840.0				
2½"=2"	2869.8	4691.4	0.4	62.5	0.25
			TOTAL WEIGHTED PERCENT LOSS		0.6

SPECIFIC GRAVITY AND ABSORPTION RESULTS

Bulk Specific Gravity (average): 2.618

Bulk Specific Gravity (SSD) average: 2.637

Apparent Specific Gravity: 2.668

Absorption (average): 0.71%

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Figure 12

PETROGRAPHIC ANALYSIS AND ASSOCIATED
TESTING FOR POTENTIAL RIP-RAP SOURCES

Project: Rifle-UMTRA Project Number: M87054GE

SAmple Designation: Corn No. 1 Date: 11/18/87

Sample Recovery Method: Bulk, hand sampled

DISCUSSION

The Corn Construction potential source for Rip-Rap consisted of ten (10) boulders, representing six (6) different rock types. Each of the different rock types were classified based on hand specimen observations. The percent by weight of each rock type was determined and is presented on the hand specimen data presentation sheets, Figures 1 through 6. Selection of rock types for microscopic thin section observations and X-ray diffraction analysis was based on the abundance and character of each rock type and a telephone conversation with Mr. Bob Hennicks, M.K. Ferguson. Microscopic observations of the thin sections are presented on Figure 7. X-ray diffraction data is presented on Figure 8.

After selection of the rock type for petrographic studies each cobble was measured and weighed. The size and weight distribution of the cobbles, with notes of associated rock types are presented on Figure 9. The entire sample was then crushed for additional laboratory testing. The final crushed sample consisted of approximately the same proportions of each

rock type. A tabulation of the rock type and general shape of the crushed pieces is presented on Figure 10. The laboratory test results for the Los Angeles Abrasion, sodium soundness and specific gravity and absorption are presented on Figure 11.

PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Corn No. 1-A DAte: 11/18/87

Sample Type: Boulders

Percentage of total, this classification: 101.0 lbs, 26%

General size and shape of sample portions: The sample consisted of two (2) spheroidal boulders approximately ten (10) inches by six (6) inches.

MINEROLOGY/PETROLOGY

Crystal or grain sizes: Phaneritic medium to coarse, approximately (2 mm and larger)

Crystal or grain relationships (fabric): Anisotropic, megacrystic

Degree of crystal face development: Subhedral

Rock Texture/morphology: Gneissose and schistose structure, hypidiomorphic

Alteration or weathering products: Chlorite, isolated

Unique properties: Gneiss with bards of amphibolite, gives both gneissose and schistose structure

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTATE
Amphibole	80
Plagioclase	10
Orthoclase	5

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Chlorite	3
Quartz	2

Rock Classification: Amphibolite Gneiss

Note: The classification presented here is based on hand specimen observations only.

Figure 1

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Corn No. 1-B Date: 11/18/87

Sample type: Boulders

Percentage of total, this classification: 97.33 lbs, 25.1%

General size and shape of sample portions: The sample consisted of two (2) flattened spheroidal boulders approximately fifteen (15) by six (6) inches.

MINEROLOGY/PETROLOGY

Crystal or grain sizes: Phanerite medium (2-5 mm)

Crystal or grain relationships (fabric): Isotropic, inequant grains

Degree of crystal face development: Subhedral to anhedral

Rock Texture/morphology: Seriate texture, hypidiomorphic

Alteration or weathering products: Some chloritization

Unique properties: Isolated phenocrysts of hornblende

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Quartz	45
plagioclase	35
Orthoclase	10

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Hornblende	5
Chlorite	5

Rock Classification: Granidiorite

Note: The classification presented here is based on hand specimen observations only.

This specimen and Casey No. 1-C are from the same source material.

Figure 2

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Corn No. 1-C Date: 11/18/87

Sample Type: Boulders

Percentage of total, this classification: 51.5 lbs, 13.3%

General size and shape of sample portions: The sample consisted of one (1) elongated boulder approximately thirteen (13) by six (6) inches.

MINEROLOGY/PETROLOGY

Crystal or grain sizes: Phaneritic medium (2-5mm)

Crystal or grain relationships (fabric): Isotropic equant grains

Degree of crystal face development: Subhedral

Rock Texture/morphology: Hypidiomorphic

Alteration or weathering products: Chloritization of mafic ground mass and biotite common

Unique properties:

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Plagioclase	33
Potassium fieldspar	32
Quartz	15

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Mafic groundmass	10
Biotite	5
Chlorite	5

Rock Classification: Quartz monzonite

Note: The classification presented here is based on hand specimen observations only.

Figure 3

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Corn No.1-D Date: 11/18/87

Sample type: Boulders

Percentage of total, this classification: 46.0 lbs, 11.8%

General size and shape of sample portions: The sample was a flattened boulder approximately fifteen (15) inches by eight (8) inches.

MINEROLOGY/PETROLOGY

Crystal or grain sizes: Phaneritic fine grained (less than 2mm)

Crystal or grain relationships (fabric): Isotropic, equant grains

Degree of crystal face development: anhedral

Rock texture/morphology: Granular/xenomorphic

Alteration or weathering products: Some secondary deposits

Unique Properties:

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Quartz	90
Groundmass	5
Plagioclase	2

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Alteration products	3

Rock Classification: Quartzite

Note: The classification presented here is based on hand specimen observations only.

This sample and Casey No. 1-A are from the same source.

Figure 4

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Corn No. 1-E Date: 11/18/87

Sample Type: Boulder

Percentage of total, this classification: 48.5 lbs, 12.5%

General size and shape of sample portions: The sample consisted of one (1) flattened boulder approximately forteen (14) inches by seven (7) inches.

MINEROLOGY/PETROLOGY

Crystal or grain sizes: Phaneritic fine to medium (2-5mm)

Crystal or grain relationships (fabric): Isotropic equant

Degree of crystal face development: Subhedral

Rock Texture/morphology: Somewhat felty texture, hypidiomorphic

Alteration or weathering products: Chloritization of biotite

Unique properties:

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Quartz	40
Plagioclase	35

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Biotite	15
Chlorite	10

Rock Classification: Trondhjemite

Note: The classification presented here is based on hand specimen observations only.

This sample and Casey No. 1-E are from the same source material.

Figure 5

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PETROGRAPHIC ANALYSIS

HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA **Project Number:** M87054GE

Sample Designation: Corn No. 1-F **Date:** 11/18/87

Sample Type: Boulder

Percentage of total, this classification: 44 lbs, 11.3%

General size and shape of sample portions: Sample consisted of one (1) elongated boulder approximately twenty three (23) inches by four (4) inches.

MINEROLOGY/PETROLOGY

Crystal or grain sizes: Aphanitic

Crystal or grain relationships (fabric): N/A

Degree of crystal face development: N/A

Rock texture;morphology: N/A

Alteration or weathering products: Some surface alteration product

Unique properties:

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Could not determine minerology in hand specimen due to particle size	

Rock Classification: Very fine grained sandstone

Note: The classification presented here is based on hand specimen observations only.

Figure 6

PETROGRAPHIC ANALYSIS

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Corn No. 1-A

THIN SECTION/MICROSCOPIC OBSERVATIONS

Petrographic Scope: Olympus 207680

Thin Section Orientation: Perpendicular to schistose structure

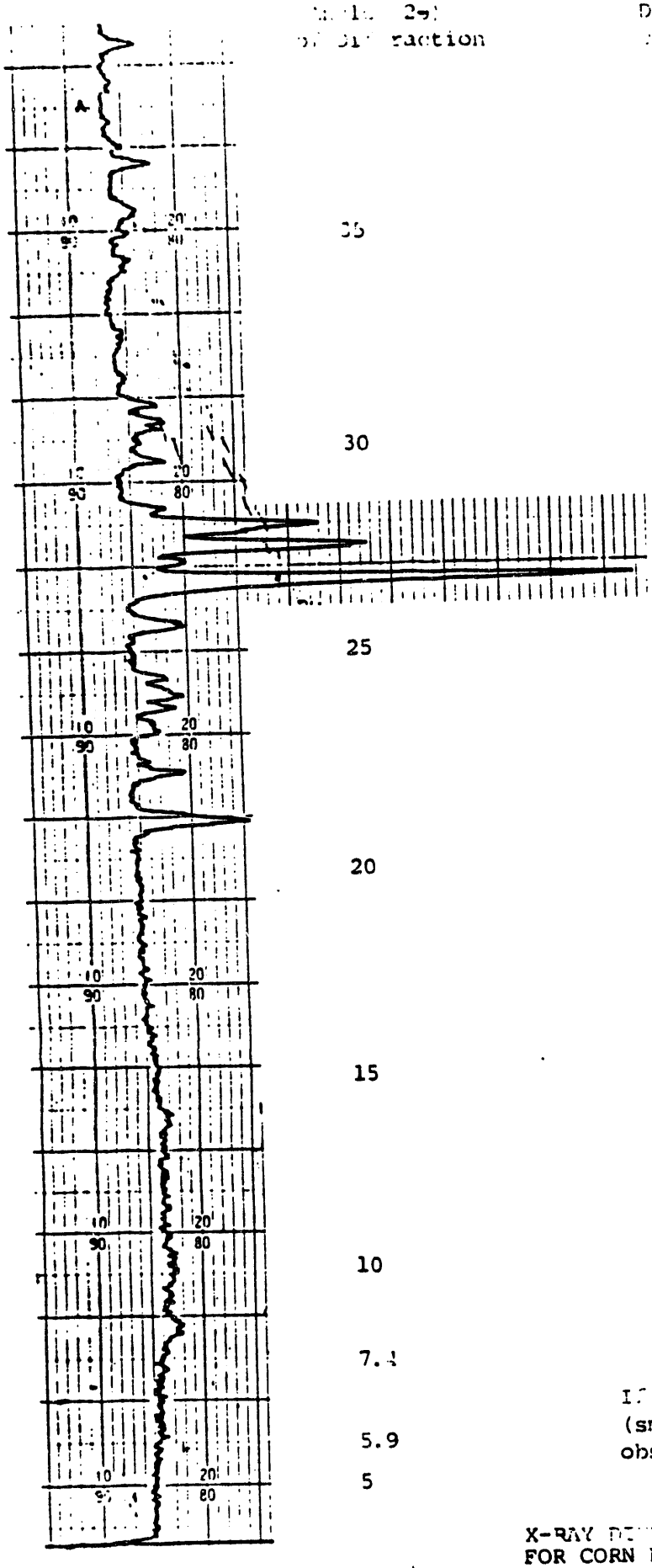
Microcline, quartz and sodic plagioclase crystals were easily recognized in a fine grained groundmass of hornblende, biotite, which showed considerable alteration to chlorite and opaque hematite were observed in minor amounts. Gridiron structure, or cross twinning was observed in the microcline crystals and albite twinning was observed in the sodic plagioclase. No microstructures were observed in the thin section, however the hand specimen showed both gneissose and schistose structures.

DATA

CONSTITUENT	MEASURED DIMENSIONS	ESTIMATED PERCENTAGE
Hornblende	less than 2mm	50
quartz	1-3mm	15
Na-Plagioclase	1-3mm	10
Microcline	2-4mm	15
Biotite and chlorite	0.5-1.5mm	5
Hematite	1-2mm	5

Classification: Amphibolite Gneiss or schistose amphibolite

Figure 7



Angle 2θ of diffraction	Distance between crystal lattice (Å)	Mineral
	2.12	Quartz
35		
	2.60	Biotite
	2.93	Microcline
30	3.03	Microcline
	3.18	Plagioclase (oligoclase)
	3.25	Microcline
	3.34	Quartz
25		
	3.48-4.25	Microcline
	4.02	Plagioclase (oligoclase)
	4.25	Quartz & microcline
20		
15	6.46	Plagioclase (oligoclase)
10		
	10.16	Biotite
7.4		
5.9		
5		

If montmorrillonite group clay minerals (smectite) were present, peaks would be observed in this range.

X-RAY DIFFRACTION TEST RESULTS
FOR CORN NO. 1 RIP RAP SOURCE

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Project No.:	
Date:	
Figure:	8

SIZE DISTRIBUTION OF COBBLES IN SAMPLE

NUMBER OF COBBLES	GENERAL SHAPE	DIMENSIONS MAXIMUM (INCHES)	DIMENSIONS MINIMUM (INCHES)	PERCENT OF TOTAL	ROCK TYPE SAMPLE I.D.
1	Spheroidal	10	6	26.0	Amphibolite Corn No. 1-A
2	Elongated irregular spheroidal	15	6	25.1	Granidiorite Corn No. 1-B
1	Elongated spheroidal	13	7	13.3	Quartz, Monzonite Corn No. 1-C
1	Flattened spheroidal	15	8	12.5	Quartzite Corn No. 1-D
1	Flattened spheroidal	14	7	11.8	Tronhjemite Corn No. 1-E
1	Elongated	23	4	11.3	Very fine grained sandstone Corn No. 1-F

Figure 9

NOTES AND OBSERVATIONS OF ROCK SHAPES AFTER CRUSHING

Rock Type and Sample I.D.	Discussion
Amphibolite Gneiss Corn No. 1-A	Blocks and wedges with fractures paralleling the internal rock texture and crystal boundries were the dominant shapes
Granidiorite Corn No. 1-B	Small blocks and angular pieces were common with sharper angles belonging to the smaller pieces.
Quartz-Monzonite Corn No. 1-C	Somewhat elongated and flattened pieces, some with sharp angles were common. Some fractures terminated in flattened edges.
Quartzite Corn No. 1-D	Angular pieces with small fracture angles terminating in sharp edges were common.
Trondhjemite Corn No. 1-E	Several shapes were observed with smaller wedges having sharp angles.
Fine grained sandstone Corn No. 1-F	Flat angular wedges with very sharp fracture terminations were dominant.

Corn No. 1-A was the only sample which fractured in a pattern which seemed to be influenced by the rocks internal structures. The other samples showed no preferred orientation of fracturing during the crushing.

It should be noted that a variety of shapes were produced by crushing in all of the rock types. The discussion above is intended to give the reader a general descripiton only. Different crushers and crushing techniques could change shape characteristics drastically.

Figure 10

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

TEST RESULTS

PROJECT Rifle-UMTRA PROJECT NO. M87054GE DATE 11/16/87

LOCATION Corn No. 1 SOURCE

SAMPLE NO. 9109 SPECIFICATION* Grading A

LOS ANGELES ABRASION RESULTS

100 Revolutions: 7.04% Loss

500 Revolutions: 23.7% Loss

SULFATE SOUNDNESS RESULTS

SIEVE SIZE	WT. OF TEST SAMPLE BEFORE TEST	WT. OF TEST SAMPLE AFTER TEST	PERCENTAGE LOSS BASED ON DESIGNATED SIEVE	SAMPLE GRADING (%)	WEIGHTED PERCENTAGE LOSS BASED ON SAMPLE GRADING
3/8"-#4	300.4	290.0	3.5	4.0	0.14
1/2"-3/8"	333.7				
3/4"-1/2"	660.8	981.5	1.3	13.1	0.17
1"-3/4"	500.5				
1½"-1"	1010.0	1500.4	0.7	19.9	0.14
2"-1½"	1960.0				
2½"-2"	2834.4	4778.3	0.3	63.1	0.19
			TOTAL WEIGHTED PERCENT LOSS		0.6

SPECIFIC GRAVITY AND ABSORPTION RESULTS

Bulk Specific Gravity (average): 2.633

Bulk Specific Gravity (SSD) average: 2.651

Apparent Specific Gravity (average: 2.683

Absorption (average): 0.7

Figure 11

PETROGRAPHIC ANALYSIS AND ASSOCIATED
TESTING FOR POTENTIAL RIP-RAP SOURCES

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Glenwood Springs, No. 1 Date: 11/30/87

Sample Recovery Method: Bulk ledge rock sample

DISCUSSION

The Glenwood Springs potential source for Rip-Rap consisted of ledge rock pieces, representing one (1) rock type. A description of the hand specimens is presented on Figure 1. Microscopic observations of the thin section is presented on Figure 2. X-ray diffraction data is presented on Figure 3.

A representative portion of the sample was crushed for additional laboratory testing. The laboratory test results for the Los Angeles abrasion, sodium soundness and specific gravity and absorption are presented on Figure 4.

PETROGRAPHIC ANALYSIS

Project: Rifle-UMTRA Project Number: M87054GE

Sample Desingation: Glenwood Springs, No. 1 Date: 11/30/87

Sample type: Ledge rock sample, bulk

General size and shape of sample portions: Most of the large rock samples were approximately ten (10) to twelve (12) inch pieces. Most of the samples were relatively blocky in appearance.

HAND SPECIMEN/MICROSCOPIC OBSERVATIONS

The material consists of massive aphanitic grained limestone. Fracture and joint patterns are common. Fractures are highlighted by secondary calcite deposits. Some surface weathering was observed on the surface of some of the samples. Some localized areas were porous in appearance, possibly from secondary calcite formation. No distinct directional fracture pattern was observed, however most fractures were at angles greater than about thirty (30) degrees and less than about sixty (60) degrees to each other. Some fractures intersected bedding planes, which were not distinct, at angles close to ninety (90) degrees.

No mineralogic or other petrologic data could be determined in the hand specimen due to the fine grained nature of the specimen.

Figure 1

PETROGRAPHIC ANALYSIS

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Glenwood Springs, No. 1 Date: 12/1/87

THIN SECTION/MICROSCOPIC OBSERVATIONS

Petrograhic Scope: Olympus 207 680

Thin Section Orientation: No particular orientation

Shell fragments were observed in a groundmass of micrite. No lithic fragments, minerals, or sparry calcite were observed. No microstructure or fracture patterns were observed in the thin section.

DATA

CONSTITUENT	MEASURED DIMENSIONS	ESTIMATED PERCENTAGE
Micrite	N/A	70
Pelecypods	2-3mm	10
Unidentifiable shell fragments	N/A	10
Fussilinids	1-2mm	5
Brachipods	1-2mm	5

Classification: Biomicrite Limestone

Figure 2

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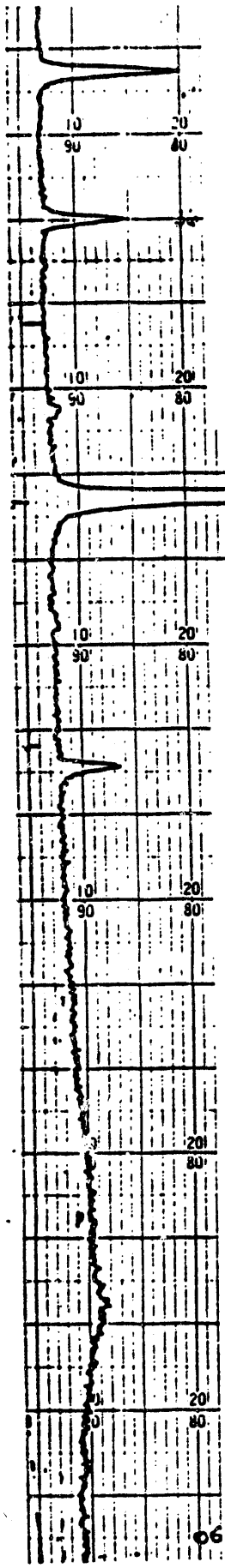

Angle (2θ) of Diffraction	Distance Between Crystal Lattice (Å)	Mineral
40	2.28	Calcite
	2.49	Calcite
35		
	3.02	Calcite
24		
	3.84	Calcite
20		
15		
10		
7.4		
5.9		
5		

If montmorillonite group clay minerals (smectite) were present, peaks would be observed in the range.

X-Ray Diffraction Test Results for Glenwood Springs No. 1 Rip-Rap Source

Lambert and Associates

Project No.:
Date:
Figure: 3

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TEST RESULTS

PROJECT Rifle-UMTRA PROJECT NO. M3705 GE DATE 11/20/87

LOCATION Glenwood Springs No. 1 SOURCE

SAMPLE NO. 9108 SPECIFICATION* Grading A

LOS ANGELES ABRASION RESULTS

100 Revolutions: 6.9% Loss

500 Revolutions: 29.8% Loss

SULFATE SOUNDNESS RESULTS

SIEVE SIZE	WT. OF TEST SAMPLE BEFORE TEST	WT. OF TEST SAMPLE AFTER TEST	PERCENTAGE LOSS BASED ON DESIGNATED SIEVE	SAMPLE GRADING (%)	WEIGHTED PERCENTAGE LOSS BASED ON SAMPLE GRADING
3/8"-#4	300.1	287.7	4.1	3.8	0.2
1/2"-3/8"	330.0				
3/4"-1/2"	670.1	968.1	3.2	12.8	0.4
"-3/4"	507.9				
½"-1"	1022.9	1492.6	2.5	19.6	0.5
"-1½"	2037.0				
½"-2"	2958.3	4917.1	1.6	63.8	1.0
			TOTAL WEIGHTED PERCENT LOSS		2.1

SPECIFIC GRAVITY AND ABSORPTION RESULTS

Bulk Specific Gravity (average): 2.683

Bulk Specific Gravity (SSD) average: 2.688

Apparent Specific Gravity (average): 2.697

Absorption (average): 0.2%

MKE DOCUMENT NO. 5025-RFL-L-09-01064-00

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CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

March 3, 1988

M.K. Engineers
180 Howard Street
SAn Francisco, CA 94105

PN: M87054GE

Attention: Grant Cherrington

Mr. Cherrington:

This letter presents the results of the additional testing program for the rip rap materials for the Rifle UMTRA project.

The sieve analysis tests were performed in general accordance with ASTM Test Method C136. The sodium sulfate soundness tests were performed in general accordance with ASTM Test Method C88. The Los Angeles Abrasion tests were performed in general accordance with ASTM Test Method C131. The specific gravity and absorption tests were performed in accordance with ASTM Test Method C127.

The petrographic analysis of the materials are in progress at this time. The petrographic analysis information will be submitted as soon as it becomes available.

If you have any questions please contact us.

Repsectfully submitted,

LAMBERT AND ASSOCIATES

Reviewed by:

Norman W. Johnston, P.E.
Manager Geotechnical Engineer

Dave Trautner
Manager Durango Office

attachments: 5025-RFL-C-09-01065-00

DLT/nr

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(303) 245-6506

P.O. BOX 0045
MONTROSE, CO 81402
(303) 249-2154

463 TURNER, 104 A
DURANGO, CO 81301
(303) 259-5095

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TEST RESULTS

PROJECT Rifle-RFL-87-01 PROJECT NO. M87054GE DATE 2/13/88

LOCATION _____ SOURCE _____

SAMPLE NO. 9162 SPECIFICATION* _____

SULFATE SOUNDNESS

SIEVE SIZE	WT. OF TEST SAMPLE BEFORE TEST	WT. OF TEST SAMPLE AFTER TEST	PERCENTAGE LOSS BASED ON DESIGNATED SIEVE	ORIGINAL SAMPLE GRADING	WEIGHTED PERCENT LOSS
2½"-2"	2942.8	4909.5	0.4	64	0.2
2"-1½"	1984.9				
1½"-1"	1008.5	1492.0	1.1	19	0.2
1"-3/4"	499.7				
3/4"-1/2"	668.1	988.9	0.9	13	0.1
1/2"-3/8"					
3/8"-#4	300.6	293.5	2.4	4	0.1
				TOTAL WEIGHTED PERCENT LOSS	0.6

Glenwood Springs light limetone

LOS ANGELES ABRASION RESULTS

100 Revolutions: 5.8% Loss

500 Revolutions: 29.0% Loss Ratio: 0.20

SPECIFIC GRAVITY AND ABSORPTION RESULTS

Bulk Specific Gravity (average): 2.682

Bulk Specific Gravity (SSD) average: 2.693

Apparent Specific Gravity (average): 2.712

Absorption (average): 0.4%

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TEST RESULTS

PROJECT Rifle-RFL-87-01 PROJECT NO. M87054GE DATE 2/13/88

LOCATION _____ SOURCE _____

SAMPLE NO. 9163 SPECIFICATION# _____

SULFATE SOUNDNESS

SIEVE SIZE	WT. OF TEST SAMPLE BEFORE TEST	WT. OF TEST SAMPLE AFTER TEST	PERCENTAGE LOSS BASED ON DESIGNATED SIEVE	ORIGINAL SAMPLE GRADING	WEIGHTED PERCENT LOSS
2½"-2"	2864.3	4901.5	0.3	64	0.2
2"-1½"	2050.0				
1½"-1"	1011.6	1495.7	0.8	19	0.2
1"-3/4"	496.1				
/4"-1/2"	675.0	990.9	0.9	13	0.1
1/2"-3/8"	325.3				
3/8"-#4	300.0	294.8	1.7	4	0.1
				TOTAL WEIGHTED PERCENT LOSS	0.6

Glenwood Springs dark limestone

LOS ANGELES ABRASION RESULTS

100 Revolutions: 6.3 % Loss

500 Revolutions: 30.3% Loss Ratio: 0.208

SPECIFIC GRAVITY AND ABSORPTION RESULTS

Bulk Specific Gravity (average): 2.683

Bulk Specific Gravity (SSD) average: 2.696

Apparent Specific Gravity (average): 2.718

Absorption (average: 0.5

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TEST RESULTS

PROJECT Rifle-RFL-87-01 PROJECT NO. M8705463 DATE 2/10/88

LOCATION _____ SOURCE _____

SAMPLE NO. 9164 SPECIFICATION* _____

SULFATE SOUNDNESS

SIEVE SIZE	WT. OF TEST SAMPLE BEFORE TEST	WT. OF TEST SAMPLE AFTER TEST	PERCENTAGE LOSS BASED ON DESIGNATED SIEVE	ORIGINAL SAMPLE GRADING	WEIGHTED PERCENT LOSS
2½"-2"	2978.9	4941.5	0.4	64	0.3
2"-1½"	1983.5				
1½"-1"	1050.1	1529.4	0.3	20	0.1
1"-3/4"	484.4				
3/4"-1/2"	671.0	992.1	0.9	13	0.1
1/2"-3/8"	330.6				
3/8"-#4	300.8	276.4	8.1	4	0.3
				TOTAL WEIGHTED PERCENT LOSS	0.8

*Glenwood Springs Combined light and dark

LOS ANGELES ABRASION RESULTS

100 Revolutions: 6.1% Loss

500 Revolutions: 28.5% Loss Ratio: 0.21

SPECIFIC GRAVITY AND ABSORPTION RESULTS

Bulk Specific Gravity (average): 2.683

Bulk Specific Gravity (SSD) average: 2.693

Apparent Specific Gravity (average): 2.710

Absorption (average): 0.3

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TEST RESULTS

PROJECT Rifle-RFL-87-01 PROJECT NO. M87054GE DATE 2/17/88

LOCATION _____ SOURCE _____

SAMPLE NO. 9165 SPECIFICATION* _____

SULFATE SOUNDNESS

SIEVE SIZE	WT. OF TEST SAMPLE BEFORE TEST	WT. OF TEST SAMPLE AFTER TEST	PERCENTAGE LOSS BASED ON DESIGNATED SIEVE	ORIGINAL SAMPLE GRADING	WEIGHTED PERCENT LOSS
2½"-2"	3017.6	4921.8	17	64	1.1
2"-1½"	1987.1				
1½"-1"	996.5	1493.5	0.3	19	0.1
1"-3/4"	501.7				
3/4"-1/2"	669.1	991.5	0.8	13	0.1
1/2"-3/8"	330.7				
3/8"-#4	300.2	298.0	0.7	4	0.0
				TOTAL WEIGHTED PERCENT LOSS	1.3

Rifle Gap Quarry

LOS ANGELES ABRASION RESULTS

100 Revolutions: 16.5% Loss

500 Revolutions: 38.7% Loss Ration: 0.427

SPECIFIC GRAVITY AND ABSORPTION RESULTS

Bulk Specific Gravity (average): 2.690

Bulk Specific Gravity (SSD) average: 2.700

Apparent Specific Gravity (average): 2.718

Absorption (average): 0.4

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TEST RESULTS

PROJECT Rifle-RFL-87-01 PROJECT NO. M87054GE DATE 2/16/88

LOCATION: SOURCE

SAMPLE NO. 9166 SPECIFICATION:

SULFATE SOUNDNESS

SIEVE SIZE	WT. OF TEST SAMPLE BEFORE TEST	WT. OF TEST SAMPLE AFTER TEST	PERCENTAGE LOSS BASED ON DESIGNATED SIEVE	ORIGINAL SAMPLE GRADING	WEIGHTED PERCENT LOSS
-2"	2992.5	4999.5	0.3	64	0.2
-1½"	2019.7				
-1"	988.6	1489.5	0.4	19	0.7
-3/4"	496.2				
-1/2"	671.0	997.2	0.4	13	0.5
2"-3/8"	330.0				
"-#4	300.0	288.3	3.9	4	0.2
				TOTAL WEIGHTED PERCENT LOSS	1.6

i Pit

LOS ANGELES ABRASION RESULTS

100 Revolutions: 5.4% Loss

500 Revolutions: 25.1% Loss Ratio: 0.215

SPECIFIC GRAVITY AND ABSORPTION RESULTS

Bulk Specific Gravity (averate): 2.773

Bulk Specific Gravity (SSD) average: 2.790

Apparent Specific Gravity (average): 2.822

Absorption (average): 0.6%

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TEST RESULTS

PROJECT Rifle-RFL-87-01 PROJECT NO. M87054GE DATE 2.15.88

LOCATION _____ SOURCE _____

SAMPLE NO. 9167 & 9168 SPECIFICATION# _____

SULFATE SOUNDNESS

SIEVE SIZE	WT. OF TEST SAMPLE BEFORE TEST	WT. OF TEST SAMPLE AFTER TEST	PERCENTAGE LOSS BASED ON DESIGNATED SIEVE	ORIGINAL SAMPLE GRADING	WEIGHTED PERCENT LOSS
2½"-2"	3006.9	4993.6	0.2	64	0.1
2"-1½"	1995.7				
1½"-1"	999.8	1494.4	0.0	19	0.0
1"-3/4"	494.6				
"-1/2"	672.0	996.8	0.3	13	0.0
1/2"-3/8"	327.9				
3/8"-#4	299.6	292.0	2.5	4	0.1
				TOTAL WEIGHTED PERCENTLOSS	0.2

Casey combined 1 & 2

LOS ANGELES ABRASION RESULTS

100 Revolutions: 4.8% Loss

500 Revolutions: 21.2% Loss Ratio: 0.227

SPECIFIC GRAVITY AND ABSORPTION RESULTS

Bulk Specific Gravity (average): 2.684

Bulk Specific Gravity (SSD) average: 2.699

Apparent Specific Gravity (average): 2.724

Absorption (average): 0.6%

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TEST RESULTS

PROJECT Rifle-RFL-87-01 PROJECT NO. M87054GE DATE 2/15/88

LOCATION _____ SOURCE Frei Pit

SAMPLE NO. 9166 SPECIFICATION* ASTM D1140, D422

SIEVE ANALYSIS

U. S. STD. SIEVE SIZE	CUMULATIVE PERCENT PASSING
7"	100
6"	91
5"	84
4"	43
3"	3
2½"	0
Rocks	

*It is our understanding that the noted specification is the project specification.

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TEST RESULTS

PROJECT Rifle-RFL-87-01 PROJECT NO. M87054GE DATE 2/15/88

LOCATION _____ SOURCE Casey #1

SAMPLE NO. 9167 SPECIFICATION* ASTM D422, D1140

SIEVE ANALYSIS

U. S. STD. SIEVE SIZE	CUMULATIVE PERCENT PASSING
8"	100
5"	65
4"	61
3"	35
2½"	26
2"	16
1½"	13
1"	10
3/4"	9
1/2"	7
3/8"	6
No. 4	6
No. 8	5
No. 10	5
No. 16	5
No. 30	4
No. 50	3
No. 100	2
No. 200	1.4

Pit run, gray

MOISTURE CONTENT

Moisture Content: 0.6%

*It is our understanding that the noted specification is the project specification.

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TEST RESULTS

PROJECT Rifle-RFL-87-01 PROJECT NO. M87054GE DATE 2/15/88

LOCATION _____ SOURCE Casey Pit #2

SAMPLE NO. 9168 SPECIFICATION* ASTM D422, D1140

SIEVE ANALYSIS

U. S. STD. SIEVE SIZE	CUMULATIVE PERCENT PASSING
3"	100
2½"	88
2"	65
1½"	44
1"	16
3/4"	2
1/2"	0

3 inch minus

*It is our understanding that the noted specification is the project specification.

PETROGRAPHIC ANALYSIS

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Glenwood Springs Dark Date: 3/14/88

THIN SECTION/MICROSCOPIC OBSERVATIONS

Petrographic Scope: Bausch & Lomb 7483 LD

Thin Section Orientation: No orientation

A microaphanitic groundmass (micrite) was dominant in the thin section. Secondary microspar and sparry calcite growths were often observed filling voids near fossils. Small vein-like structures were observed which consisted of microspar.

No microstructures or petrographic features were observed which indicate poor physical character of the material.

DATA

CONSTITUENT	MEASURED DIMENSIONS	ESTIMATED PERCENTAGE
Micrite	N/A	60
Fossils	1.0-1.5mm	20
Sparry Calcite (Secondary)	N/A	10
Ooliths	0.5-1.0mm	10

Classification: Oomicritic Limestone or Biomicrite Limestone

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Glenwood Springs Dark Date: 3/14/88

Sample Type: Ledge rock

Percentage of Total, this classification: 100%

General size and shape of sample portions: Approximately eight (8) to ten (10) inch blocky angular rocks made up the sample.

MINERALOGY/PETROLOGY

Crystal or grain sizes: Aphanitic, too fine grained for specimen data

Crystal or grain relationships (fabric): N/A

Degree of crystal face development: N/A

Rock Texture/Morphology: N/A

Alteration or weathering products: Surface alteration, white

Unique properties: Cut surfaces show white vein like structures

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Probably 100% calcite	

Rock Classification: Limestone

Note: The classification presented here is based on hand specimen observations only.

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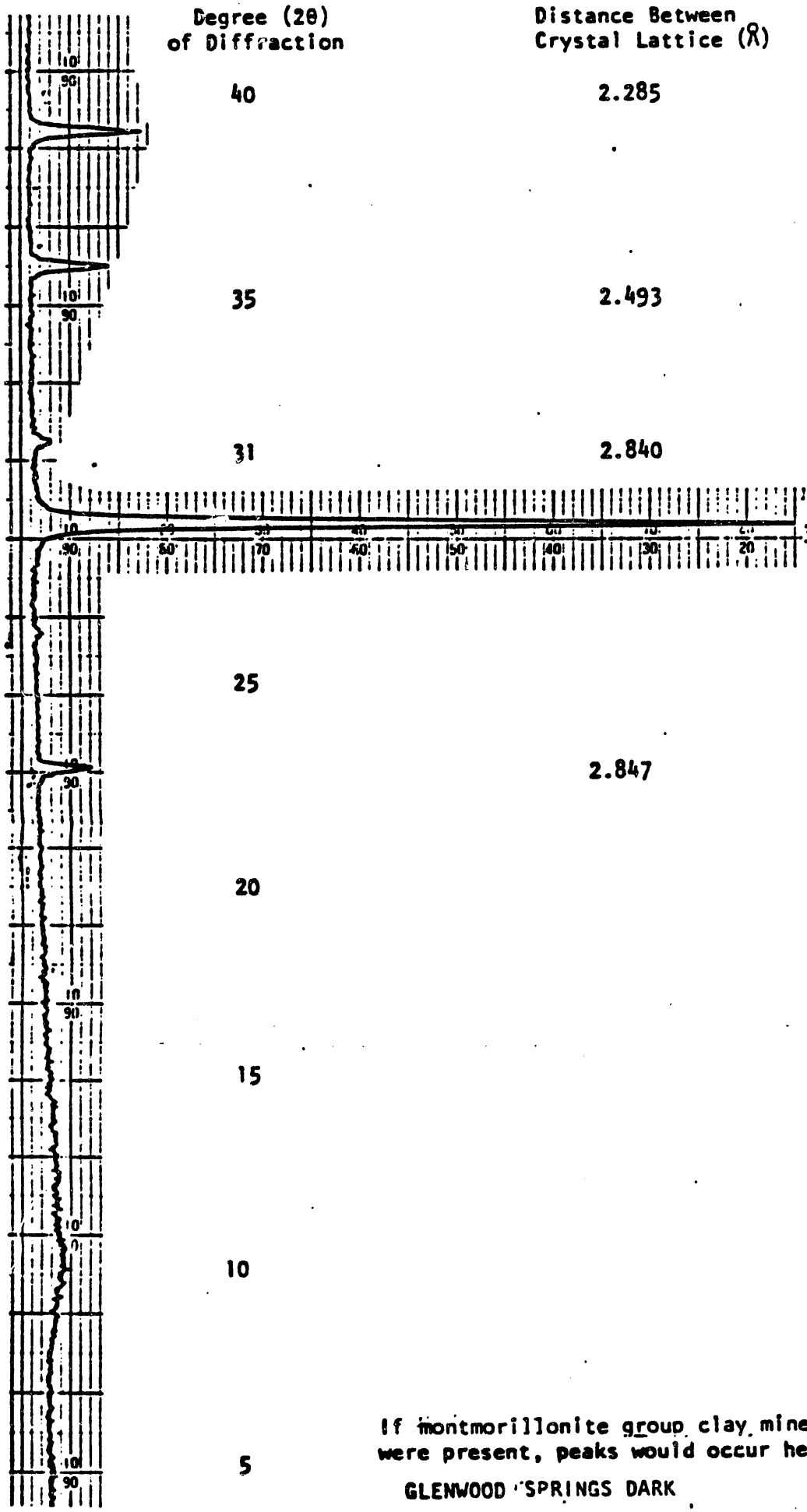

Degree (2θ) of Diffraction	Distance Between Crystal Lattice (Å)	Mineral
40	2.285	Calcite
35	2.493	Calcite
31	2.840	Calcite
	3.035	Calcite
25		
	2.847	Calcite
20		
15		
10		
5		

If montmorillonite group clay minerals (smectite) were present, peaks would occur here

GLENWOOD SPRINGS DARK

Lambert and Associates

Project No.: M3/054GE
Date:
Figure:

PETROGRAPHIC ANALYSIS

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Glenwood Springs Light Date: 3/14/88

THIN SECTION/MICROSCOPIC OBSERVATIONS

Petrographic Scope: Bausch & Lomb 7483 LD

Thin Section Orientation: None

Micrite with sparry calcite as a secondary mineral was common in the thin section. Ooliths with micrite boundaries and sparry calcite centers were observed throughout the sample. Vein-like structures which consist of microspar were observed in the thin section.

No microstructures or petrographic features were observed which indicate poor physical character of the material.

DATA

CONSTITUENT	MEASURED DIMENSIONS	ESTIMATED PERCENTAGE
Micrite	N/A	50
Fossils	1.0-1.5mm	25
Ooliths	0.5-1.0mm	15
Sparry Calcite (secondary)	N/A	10

* One Brachiopod shell fragment measured approximately 5 to 7 millimeters. Areas of the ledge rock with a high percentage of fossils this large may have poorer physical characteristics.

Classification: Oomicrite Limestone or Biomicrite Limestone

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Glenwood Springs Light Date: 3/14/88

Sample Type: Ledge rock

Percentage of total, this classification: 100%

General size and shape of sample portions: Approximately eight (8) to ten (10) inch blocky cobbles made up the sample.

MINERALOGY/PETROLOGY

Crystal or grain sizes: Aphanitic, too fine grained for hand specimen mineralogic data.

Crystal or grain relationships(fabric): N/A

Degree of crystal face development: N/A

Rock Texture/morphology: N/A

Alteration or weathering products: Surface alteration, white

Unique properties: Cut surfaces show white vein like structures

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Probably 100% calcite	

Rock Classification: Limestone

Note: The classification presented here is based on hand specimen observations only.

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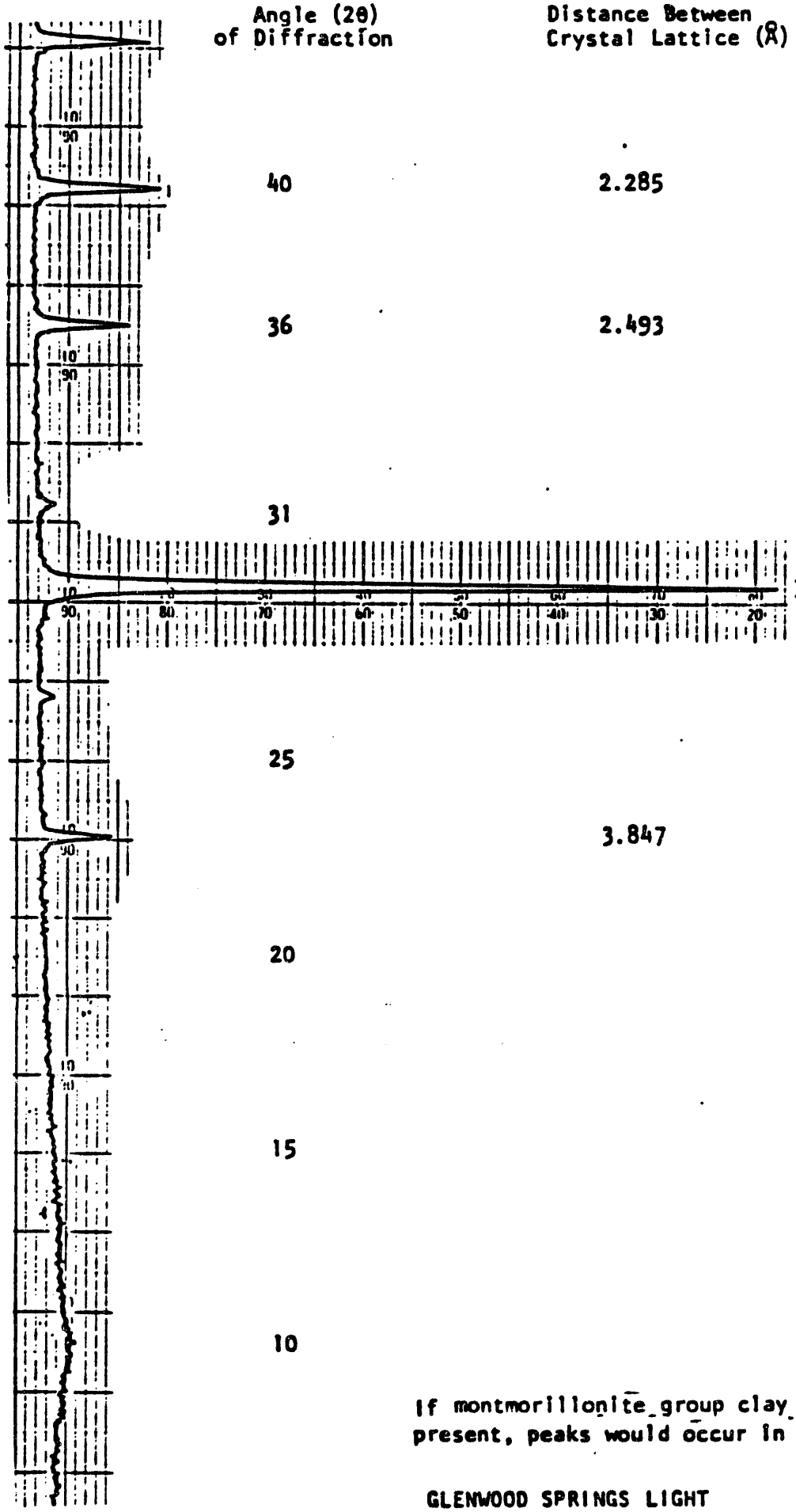

Angle (2θ) of Diffraction	Distance Between Crystal Lattice (Å)	Mineral
40	2.285	Calcite
36	2.493	Calcite
31		
	3.035	Calcite
25		
	3.847	Calcite
20		
15		
10		

If montmorillonite group clay minerals were present, peaks would occur in this range

GLENWOOD SPRINGS LIGHT

Lambert and Associates

Project No.: M87054GE

Date:

Figure:

PETROGRAPHIC ANALYSIS

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Rifle Gap Date: 3/14/88

THIN SECTION/MICROSCOPIC OBSERVATIONS

Petrographic Scope: Bausch & Lomb 7483LD

Thin Section Orientation: None

Small ooliths and fossils in a micritic calcite groundmass was the dominant character of the thin section. The fossils, consisted mostly of brachniopods and pelcypods. Most of the ooliths nuclei consisted of microspar with finer grained micrite at the boundaries. Small vein-like structures were observed which consisted of microspar, or possibly aragonite.

No microstructures or petrographic features were observed which indicate poor physical character of the material.

DATA

CONSTITUENT	MEASURED DIMENSIONS	ESTIMATED PERCENTAGE
Micrite	N/A	50
Sparry Calcite (secondary)	N/A	20
Fossils	1.0-1.3mm	20
Ooliths	0.5-1.0mm	10

Classification: Oomicritic Limestone or Biomicrite Limestone

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Rifle Gap Date: 3/14/88

Sample Type: Ledge Rock

Percentage of total, this classification: 100%

General size and shape of sample portions: Six (6) to eight (8) inch blocky and angular rocks comprised the sample.

MINERALOGY/PETROLOGY

Crystal or grain sizes: Aphanitic, too fine grained for detailed hand specimen minerologic data

Crystal or grain relationships(fabric): N/A

Degree of crystal face development: N/A

Rock texture/morphology: N/A

Alteration or weathering products: Surface alteration

Unique properties: Some fossils were recognized on cut surface, although they were obscure.

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Probably 100% calcite	

Rock Classification: Limestone

Note: The classification presented here is based on hand specimen observations only.

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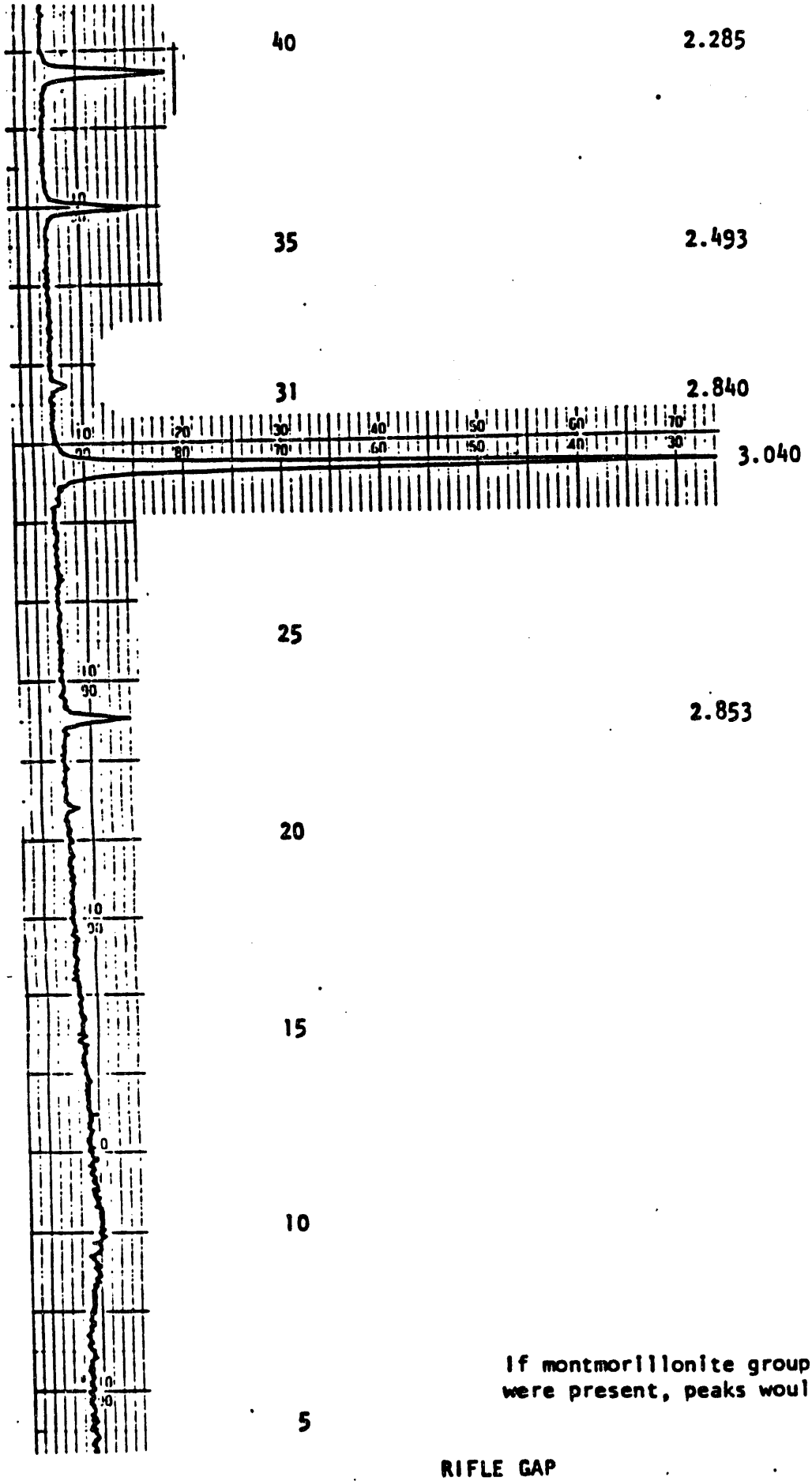

Angle (2θ) of Diffraction	Distance Between Crystal Lattice (Å)	Mineral
40	2.285	Calcite
35	2.493	Calcite
31	2.840	Calcite
	3.040	Calcite
25		
	2.853	Calcite
20		
15		
10		
5		

If montmorillonite group clay minerals (smecti
were present, peaks would occur in this range

RIFLE GAP

Lambert and Associates

Project No.: M87054GE
Date:
Figure:

PETROGRAPHIC ANALYSIS

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Casey Date: 3/14/88

THIN SECTION/MICROSCOPIC OBSERVATIONS

Petrographic Scope: Bausch & Lomb

Thin Section Orientation: None

Sericite or possibly Kaolinite, was commonly observed as an alteration product of the feldspars in the thin section. The sericite occured in small shreds and fine aggregates as part of the feldspar cyrstals. This feature did not permit the determination of the optical properties of the feldspars, therefore no actual feldspar classifications could be assigned. Chloritization of the host minerals (probably hornblende or biotite) was complete, no parent minerals were observed.

With time further alteration of the mineral will occur. No actual time constraints can be placed on the additional potential alteration, however considering that approximately 20 to 30 percent of the alteration has occurred since the rock was formed it would be a safe assumption that several thousands of years would be required to allow a significant amount of additional alteration.

DATA

CONSTITUENT	MEASURED DIMENSIONS	ESTIMATED PERCENTAGE
*Feldspars	0.8-1.2mm	65
Quartz	0.2-0.7mm	15
Chlorite	0.2-0.5mm	15
Sericite	N/A	**
Hematite	0.1-0.3mm	5

*Feldspar types could not be determined due to alteration

**Sericite percentage is included in the fedspar percent

Classification: Quartz Monzonite

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Casey Pit Date: 3/14/88

Sample Type: Gravel sample

Percentage of total, this classification: Estimate 10%

General Size and shape of sample portions: Rounded cobbles and gravels comprised the sample.

MINERALOGY/PETROLOGY

Crystal or grain sizes: Phaneritic, medium grained (2-5mm)

Crystal or grain relationships(fabric): Equigranular

Degree of crystal face development: Subhedral

Rock texture/morphology: Hypidiomorphic, granular

Alteration or weathering products: Some chloritization observed on fractured faces.

Unique properties: None

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Plagioclase	30-35
Orthoclase	30-35
Quartz	10-15

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Biotite	5-10
Chlorite	5-10

Rock Classification: Quartz Monzonite

Note: The classification presented here is based on hand specimen observations only.

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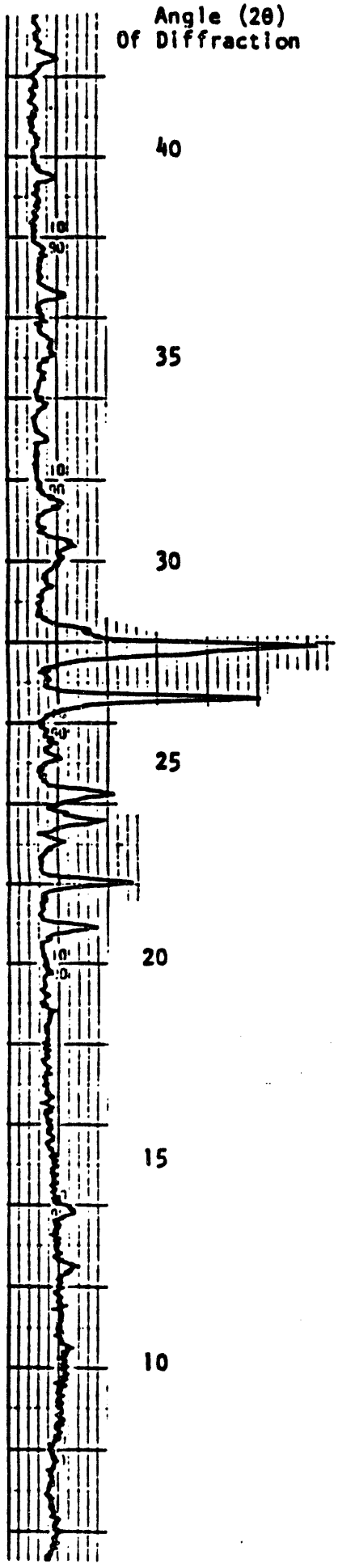

Angle (2θ) Of Diffraction	Distance Between Crystal Lattice (Å)	Mineral
40		
35	2.460	Quartz, Orthoclase & Oligoclase
30	2.938	Orthoclase & Chlorite
	3.195	Hornblende, Oligoclase
	3.348	Quartz, Orthoclase Chlorite
25	3.545	Kaolinite (Sericite
	3.662)	
	3.767)	Oligoclase
	3.850	Orthoclase
	4.020	Orthoclase & Oligoclase
20	4.247	Quartz & Orthoclase
15		
	6.411	Orthoclase & Oligoclase
	7.075	Kaolinite (Sericite
10	8.418	Chlorite

If montmorillonite group clay minerals (Smectite) were present, peaks would occur in the range

CASEY PIT

Lambert and Associates

Project No.: M87054GE
Date:
Figure:

PETROGRAPHIC ANALYSIS

Project: Rifle-UMTEA Project Number: M87054GE

Sample Designation: Frei Pit Date: 3/14/88

THIN SECTION/MICROSCOPIC OBSERVATIONS

Petrographic Scope: Bausch & Lomb 7483LD

Thin Section Orientation: None

Alteration of the feldspar minerals in the thin section was extensive. Actual distinction of the type of feldspars could not be done due to the alteration. Sericite was the chief product of the alteration. Some Kaolinite may also exist, however distinguishing it from sericite in the thin section is not always possible. It should be noted that Kaolinite is a clay mineral, though it is not part of the smectite group. Under their current condition the materials have good physical characteistics.

DATA

CONSTITUENT	MEASURED DIMENSIONS	ESTIMATED PERCENTAGE
*Feldspars	1.0-1.5mm	50
Quartz	0.5-1.0mm	20
Sericite	N/A	**
Biotite	1.0-1.5mm	15
Opaque Minerals (Hematite?)	0.2-0.5mm	5
Tourmaline	0.3-0.6mm	5
Chlorite	N/A	5

*Feldspar types could not be determined due to alteration
**Sericite percentage is included in the feldspar percent

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Classification: Granite

With time further alteration of the mineral will occur. No actual time constraits can be placed on the additional potential alteration, however considering that approximately 20 to 30 percent of the alteration has occurred since the rock was formed it would be a safe assumption that several thousands of years would be required to allow a significant amount of additional alteration.

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PETROGRAPHIC ANALYSIS
HAND SPECIMEN DATA PRESENTATION SHEET

Project: Rifle-UMTRA Project Number: M87054GE

Sample Designation: Frei Pit Date: 3/14/88

Sample Type: Cobbles & Gravels

Percentage of total, this classification: Estimate 10%

General size and shape of sample portions: The sample is comprised of rounded cobbles and gravel.

MINERALOGY/PETROLOGY

Crystal or grain sizes: Phaneritic, medium (2-5mm)

Crystal or grain relationships(fabric): Equigranular

Degree of crystal face development: Subhedral to Euhedral

Rock testure/morphology: Hypidiomorphic, seriate texture

Alteration or weathering products: Winnowing of mica mineral observed on rock surfaces.

Unique properties: None

ESSENTIAL MINERALS (FOR CLASSIFICATION)	ESTIMATED PERCENTAGE
Quartz	25-30
Plagioclase	25-30
Orthoclase(?)	25-30

ACCESSORY MINERALS	ESTIMATED PERCENTAGE
Hornblende(?)	5-10
Biotite	5-10
Chlorite	less than 5

Note: The classification presented here is based on hand specimen observations only.

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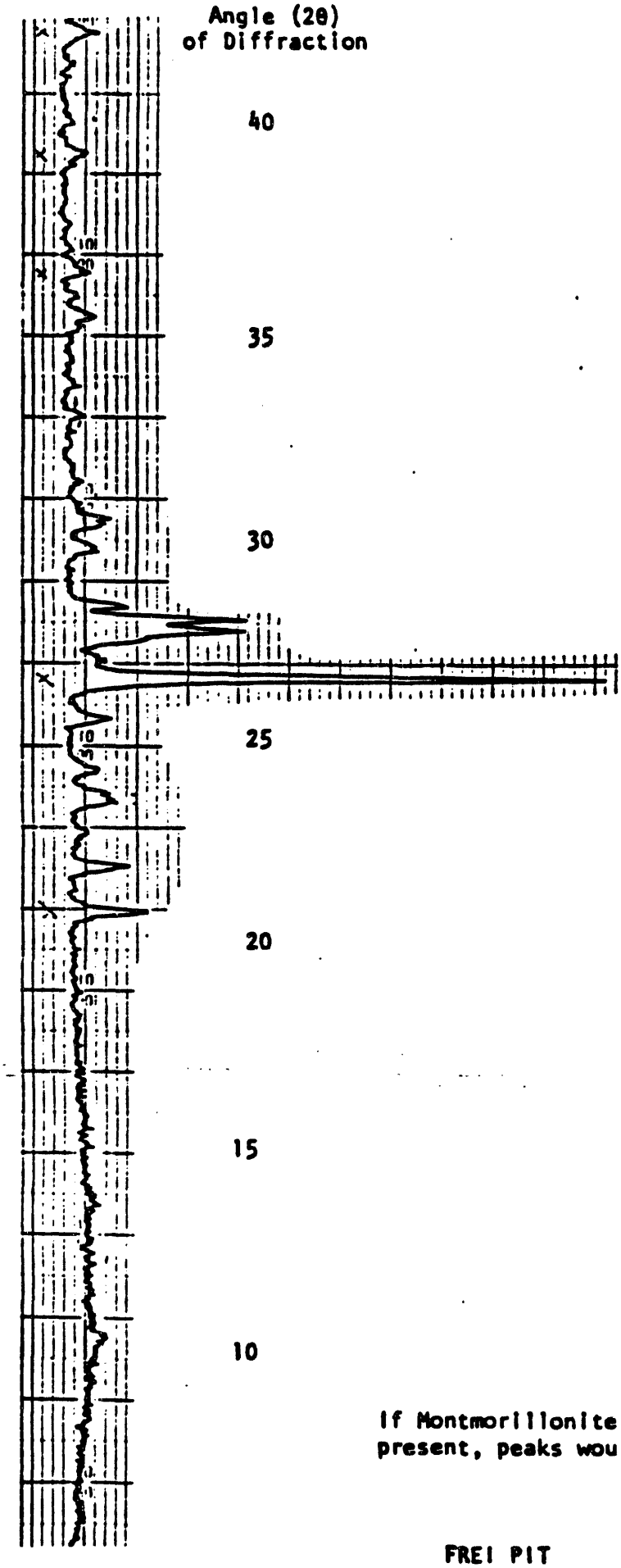

Angle (2θ) of Diffraction	Distance Between Crystal Lattice (Å)	Mineral
40	2.279	Quartz & Biotite
35	2.527	Oligoclase Orthoclase Biotite
	2.657	Biotite
30		
	3.173	Oligoclase, Orthoclase & Biotite
	3.206	Oligoclase
	3.348	Quartz & Biotite
25	3.468	Oligoclase
	3.645	Oligoclase
	3.767	Orthoclase
	4.019	Oligoclase
20	4.247	Quartz
15		
	6.458	Oligoclase
10	8.418	Chlorite(?)

If Montmorillonite group clay minerals (Sectite) were present, peaks would occur in the range

FREI PIT

Lambert and Associates

Project No.: M87054GE
Date:
Figure:

CONSULTING GEOTECHNICAL ENGINEERING AND MATERIAL TESTING

PROJECT: RFL-87-01 PROJECT NUMBER: M87054GE DATE SAMPLED: _____

LOCATION: _____ SAMPLE SOURCE: Glenwood Springs LAB SAMPLE NO: _____

SAMPLE DESCRIPTION: Light Limestone DATE TESTED: 4/9/88 TESTED BY: Johnston

BRAZIL TENSILE STRENGTH TEST

SPECIMEN NUMBER	SPECIMEN THICKNESS (INCH)	SPECIMEN DIAMETER (INCH)	SPECIMEN MOISTURE CONTENT	STRESS RATE (LB/SEC)	ORIENTATION OF AXIS OF LOADING TO ANISOTROPY	MODE OF FAILURE	TEST DURATION (MIN)	MAXIMUM LOAD (LB)	TENSILE STRENGTH (MPa)
A	1.063	1.938	Less than 1%	48	Anisotropy not identifiable in Laboratory specimen	Vertical Split	75 sec.	3575	4.876
B	1.000	1.938	"	37	"	Existing Fracture	20 sec.	740	1.073
C	1.000	1.938	"	47	"	Vertical Split	60 sec.	2825	4.096
D	1.031	1.938	"	49	"	"	60 sec.	2950	4.149
E	.969	1.938	"	47	"	"	60 sec.	2825	4.227
F	.969	1.938	"	47	"	"	75 sec.	3500	5.237
G	1.063	1.938	"	53	"	"	80 sec.	4225	5.763
H	1.000	1.938	"	46	"	"	55 sec.	2540	3.698
I	1.031	1.938	"	52	"	"	55 sec.	2880	4.050
J	1.031	1.938	"	50	"	"	70 sec.	3475	4.887
K	1.063	1.938	"	45	"	"	90 sec.	4075	5.558
L	1.031	1.938	"	50	"	"	71 sec.	3575	5.028
						AVERAGE		3099	*4.688
									**4.387

*Does not include Sample B

**Include sample B

PROJECT: RFL-87-01 PROJECT NUMBER: M87054GE DATE SAMPLED: _____

LOCATION: _____ SAMPLE SOURCE: Glenwood Springs LAB SAMPLE NO: _____

SAMPLE DESCRIPTION: Dark Limestone DATE TESTED: 3/5/88 TESTED BY: Johnston

BRAZIL TENSILE STRENGTH TEST

SPECIMEN NUMBER	SPECIMEN THICKNESS (INCH)	SPECIMEN DIAMETER (INCH)	SPECIMEN MOISTURE CONTENT	STRESS RATE (LB/SEC)	ORIENTATION OF AXIS OF LOADING TO ANISOTROPY	MODE OF FAILURE	TEST DURATION (MIN)	MAXIMUM LOAD (LB)	TENSILE STRENGTH (MPa)
A	1.00	1.938	Less than 1%	30	Anisotropy not identifiable in Laboratory specimen	Vertical Split	80 sec.	2225	3.226
B	.969	1.938	"	31	"	"	65 sec.	2000	2.993
C	1.00	1.938	"	33	"	"	100 sec.	3250	4.712
D	1.00	1.938	"	34	"	"	125 sec.	4225	6.126
E	1.016	1.938	"	50	"	"	80 sec.	4000	5.708
F	1.00	1.938	"	34	"	"	86 sec.	2950	4.277
G	.969	1.938	"	32	"	Diagonal Split	90 sec.	2875	4.302
H	1.031	1.938	"	37	"	Vertical Split	114 sec.	4225	5.942
I	1.063	1.938	"	41	"	Ver/Dia Split	70 sec.	2900	3.956
J	1.000	1.938	"	41	"	Vertical	70 sec.	2850	4.132
K	1.031	1.938	"	49	"	Vertical Horizont	70 sec.	3400	4.782
						AVERAGE		3219	4.560

CONSULTING GEOTECHNICAL ENGINEERS AND MATERIAL TESTING

PROJECT: RFL-87-01 PROJECT NUMBER: M87054GE DATE SAMPLED: _____

LOCATION: _____ SAMPLE SOURCE: Rifle Gap Quarry LAB SAMPLE NO: _____

SAMPLE DESCRIPTION: Limestone DATE TESTED: 4/20/88 TESTED BY: Briggs

BRAZIL TENSILE STRENGTH TEST

SPECIMEN NUMBER	SPECIMEN THICKNESS (INCH)	SPECIMEN DIAMETER (INCH)	SPECIMEN MOISTURE CONTENT	STRESS RATE (LB/SEC)	ORIENTATION OF AXIS OF LOADING TO ANISOTROPY	MODE OF FAILURE	TEST DURATION (MIN)	MAXIMUM LOAD (LB)	TENSILE STRENGTH (MPa)
A	1.016	1.938	Less than 1%	65	Anisotropy not identifiable in Laboratory sample	Vertical Split	55 sec	3600	5.138
B	1.031	1.938	"	56	"	"	58 sec	3260	4.585
C	1.001	1.938	"	51	"	"	50 sec	2550	3.694
D	1.063	1.938	"	47	"	"	90 sec	4200	5.729
E	1.031	1.938	"	53	"	"	45 sec	2400	3.375
F	1.031	1.938	"	47	"	"	75 sec	3500	4.922
G	1.031	1.938	"	63	"	"	55 sec	3500	4.922
H	1.031	1.938	"	54	"	"	50 sec	2700	3.797
I	1.047	1.938	"	57	"	"	52 sec	2950	4.085
					AVERAGE			3184	4.472

* Test performed on nine (9) specimens only due to limited material.

DATE
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6/28/93