REMEDIATION PLAN

Energy, Minerals and Natural Resources Department

Revised 1-1-89

OIL CONSERVATION DIVISION

310 Old Santa Fe Trail, Room 206
Santa Fe, New Mexico 87503

DISTRICT I
P.O. Box 1980, Hobbs, NM 88240

DISTRICT II
P.O. Drawer DD, Artesia, NM 88210

DISTRICT III
1000 Rio Brazos Rd., Aztec, NM 87410

WELL API NO. N/A

5. Indicate Type of Lease N/A STATE ☐ FEE ☐

6. State Oil & Gas Lease No. N/A

SUNDRY NOTICES AND REPORTS ON WELLS

(DO NOT USE THIS FORM FOR PROPOSALS TO DRILL OR TO DEEPEN OR PLUG BACK TO A DIFFERENT RESERVOIR. USE "APPLICATION FOR PERMIT" (FORM C-101) FOR SUCH PROPOSALS.)

7. Lease Name or Unit Agreement Name

1. Type of Well: OIL WELL ☐ GAS WELL ☐ OTHER Pipe Line

2. Name of Operator: Arco Pipe Line Company

8. Well No. N/A

3. Address of Operator: 15600 J.F. Kennedy Blvd, Suite 300, Houston, TX 77032

9. Pool name or Wildcat N/A

4. Well Location: Release from pipe line location

Unit Letter _____ : _____ Feet From The _____ Line and _____ Feet From The _____ Line

Section 2 Township 20S Range 36E NMPM LEA County

10. Elevation (Show whether DF, RKB, RT, GR, etc.)

11. Check Appropriate Box to Indicate Nature of Notice, Report, or Other Data

NOTICE OF INTENTION TO:				SUBSEQUENT REPORT OF:			
PERFORM REMEDIAL WORK	☒	PLUG AND ABANDON	☐	REMEDIAL WORK	☐	ALTERING CASING	☐
TEMPORARILY ABANDON	☐	CHANGE PLANS	☐	COMMENCE DRILLING OPNS.	☐	PLUG AND ABANDONMENT	☐
PULL OR ALTER CASING	☐			CASING TEST AND CEMENT JOB	☐		
OTHER:	☐			OTHER:			☐

12. Describe Proposed or Completed Operations (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work) SEE RULE 1103.

Pipe Line operator (ARCO) proposes to perform on site remediation of crude oil impacted soils by landfarming. Refer to "Remediation Work Plan, Monument Release Site, Monument NM" which is attached.

OCD HOBBS OFFICE OCT 15 1996 RECEIVED

I hereby certify that the information above is true and complete to the best of my knowledge and belief.

SIGNATURE Jack Amberg TITLE EH&S Advisor DATE 10-10-96

TYPE OR PRINT NAME Jack Amberg TELEPHONE NO. (713) 986-5408

(This space for State Use)

APPROVED BY _____ TITLE _____ DATE _____

CONDITIONS OF APPROVAL, IF ANY:

ARCO Pipe Line Company

Houston, Texas

ENSR®

Remediation Workplan
Monument Release Site
Monument, NM

FINAL

ENSR Consulting and Engineering

October 1996

Document Number 0480-E89

Called Jack Ambat
10/15/96
5.1 needs to read
non-Exempt
5.1 - OK now P

ARCO Pipe Line Company

Houston, Texas

Remediation Workplan
Monument Release Site
Monument, NM

ENSR Consulting and Engineering

October 1996

Document Number 0480-E89

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(Cont'd)

APPENDICES

LIST OF FIGURES

1.0 INTRODUCTION

The objective of this workplan is to provide guidance for remediating soils impacted with crude oil originating from a pipe line release. The 4" line is owned by Arco Pipe Line Company (APL) and is located on private property approximately 3 miles west of the town of Monument, New Mexico. The objective of this work scope is to remediate the impacted soils in accordance with requirements of the State of New Mexico Oil Conservation Division (NMOCD) "Guidelines for Remediation of Leaks, Spills, and Releases" dated August 13, 1993. The NMOCD is the state agency which administers remedial actions at oil exploration and production sites.

The remediation objective shall be accomplished by removing the impacted soil that contains petroleum hydrocarbon constituents (PHCs) above regulatory standards, landfarming that soil in a controlled area on the subject site such that the contaminants are degraded, and replacing the treated soil into the excavation. Pursuant to the NMOCD guidelines, this scope of work has been prepared for the remedial action.

2.0 NOTICE OF LEAK

The information presented in this Section is the Notification information required pursuant to OCD Rule 116.

2.1 Responsible Party and Local Contact

The responsible party for this site is:

Mr. Hussan Ahmadvand
ARCO Pipe Line Company
P.O. Box 960
Denver City, Texas
806/592-3765

2.2 Facility Location

The release site is located approximately 3 miles west of Monument, New Mexico. It is in the southwest quarter of Section 2, Township 20S, Range 36E. The site location is shown in Figure 2-1.

2.3 Time of Incident

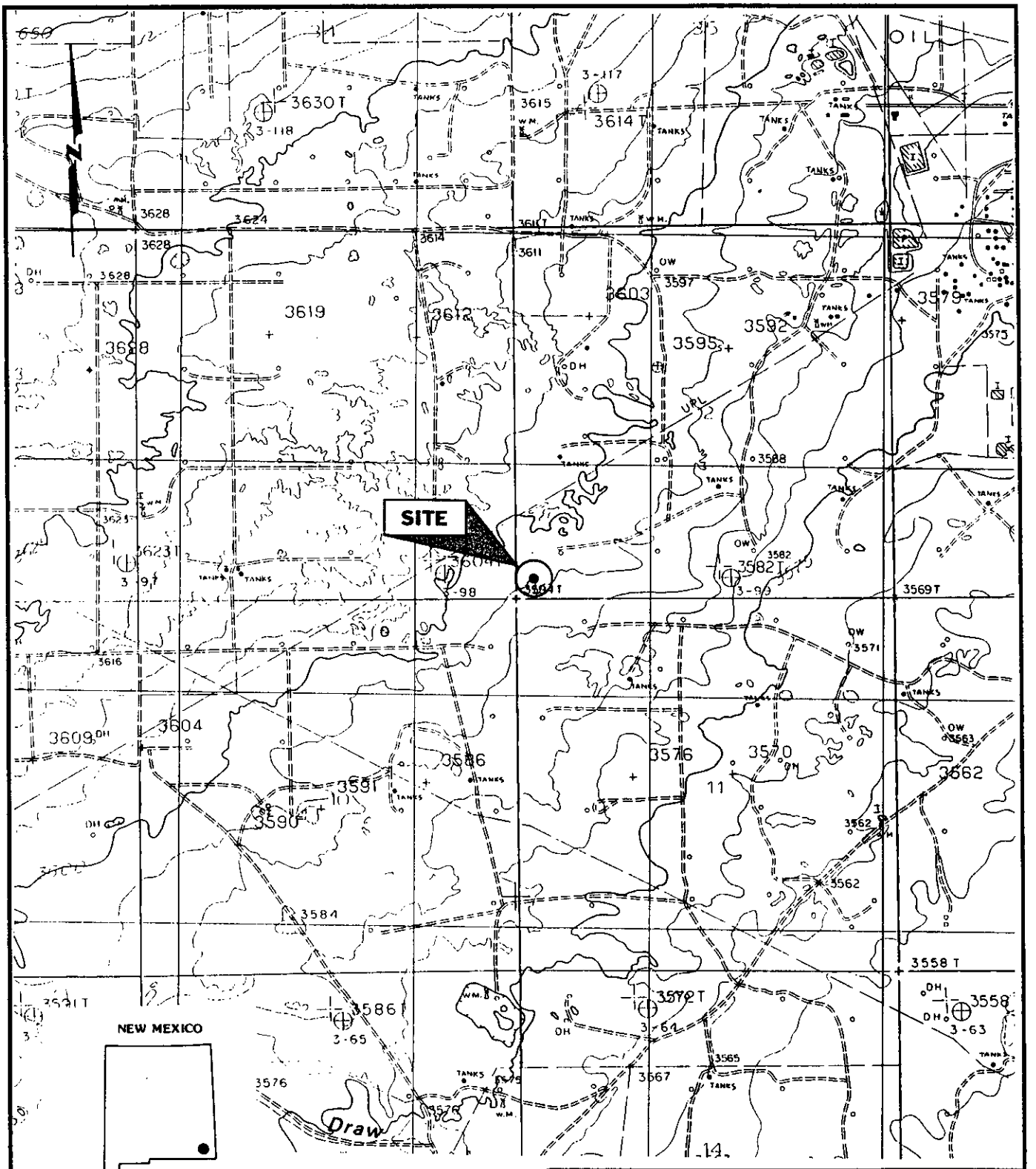
The release occurred on August 8, 1996, at approximately 10:30 am during a line maintenance operation. The release was noticed immediately, the purging operation was stopped, and steps were taken to collect the released crude.

2.4 Discharge Event

The source of the discharge was a 4" crude pipe line that was being serviced. While it was being purged, the contractor observed a sudden pressure drop. A survey of the line indicated that the release point was 300' from the purging point.

2.5 Type of Discharge

The material released was crude oil.



QUADRANGLE LOCATION

SITE LOCATION — SW, SW, T20S, R36E

0 2000 4000

SCALE IN FEET

REFERENCE: USGS 7.5 Minute Topographic Quadrangle Map for Monument South, New Mexico, 1985.

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FIGURE 2-1
SITE LOCATION MAP
MONUMENT RELEASE SITE
ARCO PIPE LINE CO.
MONUMNET, NEW MEXICO

DRAWN:	SJF	DATE:	9-13-96	PROJECT NUMBER:	0480-E89
APPV'D:	WTB	REVISED:			

2.6 Quantity

Approximately 10 barrels of crude oil were released, 3 barrels were recovered.

2.7 Site Characteristics

The site is located 3 miles west of Monument, NM on privately owned property. The site is located on semi arid land, with an estimated annual regional rainfall of approximately 14 inches. No water courses or surface water is located within 1,000 feet of the release site. There are no private or public water wells within 200' of the release site.

The surface soils at the site consists of silty sand and colleche. Groundwater is reportedly at 27 feet below ground surface.

2.8 Immediate Corrective Actions

The release occurred when the line was being purged by an APL contractor. The contractor observed that the line suddenly lost pressure. The purging operation was stopped, and the line was surveyed for a leak. The release site was found 300' from the purging point, where it was exposed. The release site was excavated and the impacted soils were stockpiled on site. Approximately 10 barrels of crude were released, with three barrels being recovered. The line was then emptied and is currently idled.

An area measuring approximately 12' by 8' by 4' deep was excavated to remove the impacted soils. Impacted soil was removed from the bottom of the excavation until visual observations indicated that it was clean. This generated approximately 15 cubic yards of impacted soil, which was stockpiled on site.

A spill report was filed with the OCD on August 9.

3.0 INITIAL RESPONSE ACTIONS

3.1 Source Elimination and Site Security

As soon as the release was observed, the purging operations were suspended, free crude oil was recovered and the impacted soil was excavated from the release site and stockpiled.

The release site is in a remote location away from county roads. An orange barricade fence was set up around the excavation to prevent accidental entry.

3.2 Containment and Site Stabilization

The free oil present at the release site was collected and removed from the site. The impacted soils were excavated and covered with plastic sheeting. These soils presently remain on site pending remediation.

4.0 SITE ASSESSMENT

The site has not been assessed to determine the extent of impact. However, at the time of the release, impacted soils were immediately excavated from the release area and stockpiled. The resulting excavation measures approximately 12' x 8' x 4' deep.

4.1 General Site Characteristics

4.1.1 Depth to Groundwater

The groundwater at the subject site is reported to be approximately 27' below ground, according to OCD records.

4.1.2 Well Head Protection Area

According to APL personnel, there are no domestic or private water wells within 200 feet of the release site.

4.1.3 Distance to Nearest Surface Water Body

There are no visible surface water bodies within 1,000 feet of the release site.

4.2 Soil/Waste Characteristics

The soils at the site were characterized by the collection of a representative sample. That sample was analyzed for TCLP volatiles, TCLP semivolatiles, reactivity, corrosivity, and ignitability. The results of these analyses indicate that the excavated soils are not hazardous under RCRA Subtitle C. These results are presented in Appendix A.

4.3 Soil and Water Remediation Action Levels

4.3.1 Soils

4.3.1.1 Ranking of Site

Based on the information provided in the previous sections relating to depth to groundwater, wellhead protection area, and distance to nearest surface water body, the ranking for the site is 20. A New Mexico Crude Oil Leak Site Closure Work Sheet is attached in Appendix B.

4.3.1.2 Recommended Remediation Action Levels

The total ranking score for the site is 20, which places it into the most stringent remediation category. The OCD recommended cleanup levels are as follows:

- Benzene - 10 ppm
- BTEX - 50 ppm
- TPH - 100 ppm

4.3.2 Groundwater

Based on field observations at the time of the release and the expedited excavation of the impacted soils, it is not anticipated that this release affected the groundwater at the site. If there are any observations that indicate potential impact to groundwater, then the extent of impact to the groundwater will be assessed and evaluated.

4.4 Soil and Groundwater Sampling Procedures

Any soil and groundwater samples necessary to complete this remediation will be collected in conformance with the protocols set forth the "Guidelines for Remediation of Leaks, Spills, and Releases" which was published by the OCD in August 1993. Soil samples will be collected of the sidewalls and bottom of the excavation when the impacted soils have all been removed. These samples will be analyzed for BTEX and TPH.

In the event that a groundwater investigation is necessary, it will be conducted according to OCD approved industry standards or other OCD approved procedures. Monitor well installation, construction, development and sampling procedures shall be in accordance with the OCD requirements set forth in the "Guidelines for Remediation of Leaks, Spills, and Releases".

5.0 REMEDIATION

5.1 Soil Remediation

The impacted soils that have been removed from the release area are RCRA subtitle C non-exempt due to the origin of the release. Highly contaminated soils/saturated soils will be excavated from the ground until a representative sample from the walls and the bottom of the excavation is below the contaminant specific remediation level discussed in Section 4.3.1.2. In the event that site conditions limit the extent of soil removal, then the impacted soils will be removed to the maximum depth and horizontal extent practicable. On reaching this limit, a sample will be collected from the walls and bottom of the excavation to determine the remaining levels of soil contaminants.

5.2 Soil Management

The excavated soils will be managed by landfarming on location. The impacted soils will be placed on a plastic liner within a bermed area on site in 6 to 12 inch lifts and tilled and watered to promote natural biodegradation of the crude oil constituents. Nutrients (fertilizer) may be added as necessary to promote and accelerate the treatment process. This will continue until sample analysis indicates that the soils have been treated to below the site specific cleanup levels discussed in Section 4.3.1.2. After the soils have been treated to these levels, they will be used to backfill the excavation.

The general procedures for landfarming the impacted soil are set forth in the attached document "Guidance for Bioremediation of Small Quantities of Hydrocarbon Contaminated Soils", Appendix C. The procedures described in this document are in conformance with those set forth by the NMOCD.

5.3 Groundwater Remediation

It is not anticipated that groundwater remediation will be required at this site for the following reasons:

- The spill was quickly contained and the free product was recovered,
- The spill was a small quantity (10 barrels), and
- The impacted soils in the vicinity of the release were immediately excavated.

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- The spill was quickly contained and the free product was recovered,
- The spill was a small quantity (10 barrels), and
- The impacted soils in the vicinity of the release were immediately excavated.

If any groundwater investigation and/or remediation activities are required, they will be reviewed and approved by the OCD prior to implementation.

6.0 TERMINATION OF REMEDIAL ACTION

6.1 Soil

Impacted soils requiring remediation will be treated by landfarming so that residual contaminant concentrations are below the recommended soil remediation action levels discussed in Section 4.3.1.2. If these soil action levels cannot practicably be attained, a risk evaluation may be performed as necessary and submitted to the OCD for review.

6.2 Groundwater

It is not anticipated that any groundwater remediation will be required at this site. If required, groundwater remediation will be performed in accordance with OCD guidelines and procedures.

6.3 Final Closure of Area

Upon conclusion of any required remedial actions, the area of the release will be closed by backfilling the excavated areas with the landfarmed soils. The site will then be contoured to provide positive drainage away from the site, and revegetated as necessary.

6.4 Final Report

Upon completion of remedial activities, a final report describing all actions taken to mitigate environmental damage related to this release will be provided to the OCD for approval.

Appendix A

Soil Characterization Data

CARDINAL LABORATORIES

PHONE (915) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240
PHONE (505) 326-4669 • 118 S. COMMERCIAL AVE. • FARMINGTON, NM 87401
PHONE (806) 796-2800 • 5292 34th ST. • LUBBOCK, TX 79407

ANALYTICAL RESULTS FOR
CJR CONTRACTORS
ATTN: JEFF HAM
401 W. BROADWAY
DENVER CITY, TEXAS 79323
FAX TO:

Receiving Date: 09/18/96
Reporting Date: 09/27/96
Project Number: NOT GIVEN
Project Name: ARCO PIPELINE
Project Location: MONUMENT LEAK
Lab Number: H2652-1
Sample ID: MONUMENT LEAK

Analysis Date: 09/26/96
Sampling Date: 09/18/96
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: GP
Analyzed By: BC

TCLP VOLATILES (ppm)	EPA LIMIT	Sample Result H2652-1	Method Blank	QC	%IA	True Value QC
Vinyl Chloride	0.20	<0.005	<0.005	0.104	104	0.100
1,1-Dichloroethylene	0.7	<0.005	<0.005	0.099	99	0.100
Methyl Ethyl Ketone	200	0.012	<0.005	0.091	91	0.100
Chloroform	6.0	<0.005	<0.005	0.099	99	0.100
1,2-Dichloroethane	0.5	<0.005	<0.005	0.102	102	0.100
Benzene	0.5	0.272	<0.005	0.099	99	0.100
Carbon Tetrachloride	0.5	<0.005	<0.005	0.097	97	0.100
Trichloroethylene	0.5	<0.005	<0.005	0.097	97	0.100
Tetrachloroethylene	0.7	<0.005	<0.005	0.095	95	0.100
Chlorobenzene	100	<0.005	<0.005	0.098	98	0.100
1,4-Dichlorobenzene	7.5	<0.005	<0.005	0.095	95	0.100

	% RECOVERY
Dibromofluoromethane	91
Toluene-d8	122
Bromofluorobenzene	117

METHODS: EPA SW 846-8260

Burgess J. A. Cooke, Ph. D.

9/27/96
Date

CARDINAL LABORATORIES

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PHONE (505) 326-4669 • 118 S. COMMERCIAL AVE. • FARMINGTON, NM 87401
PHONE (806) 794-2800 • 5282 34th ST. • LUBBOCK, TX 79407

ANALYTICAL RESULTS FOR
CJR CONTRACTORS
ATTN: JEFF HAM
401 W. BROADWAY
DENVER CITY, TEXAS 79323
FAX TO:

Receiving Date: 09/18/96
Reporting Date: 09/19/96
Project Number: NOT GIVEN
Project Name: ARCO PIPELINE
Project Location: MONUMENT LEAK
Lab Number: H2652-1
Sample ID: MONUMENT LEAK

Analysis Date: 09/19/96
Sampling Date: 09/18/96
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: GP
Analyzed By: BC

TCLP SEMIVOLATILES (ppm)	EPA LIMIT	Sample Result H2652-1	Method Blank	QC	%IA	True Value QC
Pyridine	5.00	<0.008	<0.002	0.047	94	0.050
1,4-Dichlorobenzene	7.50	<0.008	<0.002	0.050	100	0.050
o-Cresol	200	<0.008	<0.002	0.049	98	0.050
m, p-Cresol	200	<0.008	<0.002	0.050	100	0.050
Hexachloroethane	3.00	<0.008	<0.002	0.049	98	0.050
Nitrobenzene	2.00	<0.008	<0.002	0.051	102	0.050
Hexachloro-1,3-butadiene	0.500	<0.008	<0.002	0.049	98	0.050
2,4,6-Trichlorophenol	2.00	<0.008	<0.002	0.051	102	0.050
2,4,5-Trichlorophenol	400	<0.008	<0.002	0.049	98	0.050
2,4-Dinitrotoluene	0.130	<0.008	<0.002	0.053	106	0.050
Hexachlorobenzene	0.130	<0.008	<0.002	0.051	102	0.050
Pentachlorophenol	100	<0.008	<0.002	0.053	106	0.050

	% RECOVERY	RELATIVE PERCENT DIFFERENCE
Fluorophenol	43	2
Phenol-d5	32	2
Nitrobenzene-d5	60	3
2-Fluorobiphenyl	72	3
2,4,6-Tribromophenol	64	1
Terphenyl-d14	68	11

METHODS: EPA SW 846-8270
MI - Matrix Interference

Burgess J. A. Cooke, Ph. D.

9/19/96
Date

CARDINAL LABORATORIES

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PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240
PHONE (505) 326-4669 • 118 S. COMMERCIAL AVE. • FARMINGTON, NM 87401
PHONE (806) 796-2600 • 5282 34th ST. • LUBBOCK, TX 79407

ANALYTICAL RESULTS FOR
CJR CONTRACTORS
ATTN: JEFF HAM
401 W. BROADWAY
DENVER CITY, TEXAS 79323
FAX TO:

Receiving Date: 09/18/96
Reporting Date: 09/27/96
Project Number: NOT GIVEN
Project Name: ARCO PIPELINE
Project Location: MONUMENT LEAK

Sampling Date: 09/18/96
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: GP
Analyzed By: WL

TCLP METALS

LAB NUMBER	SAMPLE ID	As ppm	Ag ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm
ANALYSIS DATE:		9/23/96	9/20/96	9/26/96	9/20/96	9/19/96	9/20/96	9/25/96	9/20/96
EPA LIMITS:		5	5	100	1	5	5	0.2	1
H2852-1	MONUMENT LK.	<0.1	<0.1	<5	<0.1	<1	<1	<0.002	<0.1
Quality Control		51.7	0.499	4.71	0.529	1.067	0.96	102.1	43.5
True Value QC		50.0	0.500	5.00	0.500	1.000	1.00	100.0	50.0
% Accuracy		103.4	99.8	95.4	105.8	106.7	96	102.1	87
Relative Percent Difference		6.9	4.8	3.4	2.1	1.8	3.1	7.7	14.3
METHODS: EPA 1311, 600/4-91/		200.7	200.7	200.7	200.7	200.7	200.7	245.1	200.7

Wei Li
Wei Li, Chemist

09/27/96
Date

CARDINAL LABORATORIES

PHONE (915) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240
PHONE (505) 326-4669 • 118 S. COMMERCIAL AVE. • FARMINGTON, NM 87401
PHONE (806) 796-2800 • 5282 34th ST. • LUBBOCK, TX 79407

ANALYTICAL RESULTS FOR
CJR CONTRACTORS
ATTN: JEFF HAM
401 W. BROADWAY
DENVER CITY, TEXAS 79323
FAX TO:

Receiving Date: 09/18/96
Reporting Date: 09/24/96
Project Number: NOT GIVEN
Project Name: ARCO PIPELINE
Project Location: MONUMENT LEAK

Sampling Date: 09/18/96
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: GP
Sample Analyzed By: BC/GP

LAB NUMBER	SAMPLE ID	REACTIVITY Sulfide (ppm)	REACTIVITY Cyanide (ppm)	CORROSIVITY (pH)	IGNITABILITY (°F)
ANALYSIS DATE:		9/20/96	9/20/96	9/19/96	9/19/96
H2652-1	MONUMENT LEAK	<100	<100	6.80	Nonflammable
Quality Control		NR	NR	7.00	NR
True Value QC		NR	NR	7.00	NR
% Accuracy		NR	NR	100	NR
Relative Percent Difference		NR	NR	0	NR

METHOD: EPA SW 846-7.3, 7.2, 1010
40 CFR 261

Chemist

09/24/96
Date

H2652.XLS

CARDINAL LABORATORIES

PHONE (915) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240
PHONE (505) 326-4669 • 118 S. COMMERCIAL AVE. • FARMINGTON, NM 87...

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Telefax No: (505)393-2476

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Company: Cardinal Laboratories Hobbs

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Comments:

Jo Diane Potter

Appendix B

New Mexico Crude Oil Leak Site Closure Work Sheet

NEW MEXICO CRUDE OIL LEAK SITE CLOSURE WORK SHEET

SITE/LOCATION Monument spill site **LEAK/SPILL DATE** 9/8/96

DEPTH TO GROUND WATER 27 FEET 20 SCORE
(Score: < 50' = 20 pts ~ 50' to 99' = 10 pts ~ >100' = 0 pts)

HORIZONTAL DISTANCE TO PRIVATE WATER WELL >200 FEET 0 SCORE
(Score: < 200' = 20 pts. ~ > 200' = 0 pts.)

DISTANCE TO SURFACE WATER >1000 FEET 0 SCORE
(Score: < 200' = 20 pts. ~ 200' to 1000' = 10 pts ~ > 1000' = 0 pts.)

TOTAL SCORE = 20

SITE FINAL CLEANUP LEVELS

If Score=	Less than 19	10 to 19	0 to 9
Benzene	10	10	10
BTEX	50	50	50
TPH	100	1000	5000

These are the maximum levels allowed after site has been remediated

DEFINE LATERAL AND VERTICAL CONTAMINATION 12' LENGTH 12' WIDTH 4' DEPTH _____ SCORE

SPILL SITE MANAGEMENT OPTIONS:

(1) Risk Assesment
(2) OCD Approved Spill Containment Plan.

Soil Remediation Options:

(1) Excavation and removal (Sample to determine if all removed)
(2) Excavation to maximum practical depth (Sample to determine level of non removable soil)
(3) Treat on place (Sample while treating until required level reached)
(4) Manage with an alternate method (requires OCD notification and approval)

Soil Management Options:

(1) Disposal at an OCD permitted or approved facility.
(2) Land Farming
(3) InSitu Treatment (Venting, Bioremediation, other approved system)
(4) Active Soil aeriation, Composting, Bioremediation, Solidification, thermal treatment, etc.

Ground Water Remediation Options: N/A

All Water treatment plans must be approved by OCD prior to starting treatment.

(1) Skimmer or total fluid pumping
(2) Removal and Disposal
(3) Treating in place
(4) Air Sparging, bio remediation

Appendix C

Guidance for Bioremediation of Small Quantities of Hydrocarbon Contaminated Soils

ARCO Pipe Line Company

Houston, Texas

Guidance for the Bioremediation of Small Quantities of Petroleum Hydrocarbon Contaminated Soils

ENSR Consulting and Engineering

September 1996

Document Number 0480-E89

CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

Small amounts of hydrocarbon contaminated soils can be routinely treated biologically using the microbes native to the contaminated soils. Most soils, and particularly those in facilities handling hydrocarbons, have substantial numbers of hydrocarbon-degrading microbes in the soils. The growth of these microbes, with the hydrocarbon contaminants as "food", is usually limited by the lack of one or more of the following:

- air
- mixing
- nutrients (fertilizer)
- water (soil moisture)
- proper soil pH

To stimulate the native microbes to degrade the hydrocarbons faster, the treatment process needs to supply most or all of these factors.

To meet the requirements of regulatory agencies and to avoid practical liability issues, the treatment needs to take place under conditions which meet the regulators requirements and minimize the opportunity to further contaminate the environment.

This guidance is designed to provide the basic approach to remediation of small amount of soils contaminated with hydrocarbons from routine production type of operations.

The basic process is not significantly different from farming or gardening. The soils are spread within a small bermed area in a layer ("lift") on a HDPE or other suitable liner. The soils are amended with fertilizer, pH control agents and water as needed, and cultivated/tilled to mix and aerate. The additions of amendments promote the accelerated degradation of the hydrocarbons by the microbes. The berms and liner prevent spread of the soils or contamination.

2.0 TREATMENT AREA

2.1 Treatment Area and Berm

An area on nearly level ground of the required size, large enough to allow the placement of the contaminated soil in a layer (lift) about one foot deep, needs to be cleared of any large stones or stubble which could puncture the liner and needs to be surrounded by a low soil berm. Ideally, square areas are the best because they require the least berm length to construct, but rectangular areas can be used for ease of cultivation. If possible, the area inside the berms should slope to one end or corner so that end can collect rain or excess water. With small treatment areas for a few cubic yards this slope is usually not critical as long as the area is level. Clean sand or soil must be layered in the treatment area to about six inches deep on top of the liner as a protective layer for the liner. Ideally the small treatment area should be covered with plastic (rain cover), weighted by sandbags, when precipitation threatens, so that any water flows off of or can be dumped off outside the berms and not get under the rain cover (see discussion below under Section 3.2 Moisture). However, the berm needs to be high enough so that, with soils in the treatment system, a 25 year/24 hour rain can be held inside the treatment area. Local rain data can be readily acquired from several local sources including the local Soil Conservation Service or Agricultural Extensions Service agents (both USDA) or Department of Commerce Technical Publication No. 40. In general, the highest 25 year/24 hour rainfalls anywhere in the U.S.A. are 12-13 inches so a berm high enough to contain that rainfall plus the soils in treatment will be adequate almost anywhere. Lower berms can be used depending on the specific rainfall in that location.

2.2 Liner

The treatment area and berms need to be lined with HDPE or other suitable synthetic liner material. The liner must extend over the berms and be anchored along its edges in the soil or by sand bags. The liner should be at least 30 mil, if HDPE, or equivalent with other liners, to resist tears and punctures.

3.0 AMENDMENTS

3.1 Nutrients

Usually, the only nutrients that need to be added to the soil are chemically "fixed" nitrogen and phosphorus, such as fertilizers used on lawns or gardens. The soils and/or oil will almost always contain any other trace nutrients in adequate amounts. The estimates assume that a cubic yard of soil will weigh about 2200 lb or 1000 Kg. No adjustments should be made for soil density since, in the field, this will depend on variables such as water content. This guidance document assumes that the soils at most sites will have equivalent densities.

If the percent of hydrocarbon in the soil is not known, add 0.22 to 0.55 lb of nutrient nitrogen (as N) and 0.11 to 0.22 lb of nutrient phosphorus (as P) per cubic yard of soil (see below for how to determine the N and P content of the fertilizers). Use the lower or higher amounts based on a visual and odor estimate of the level of contamination. In practice, it is difficult to over fertilize with N or P if you do not exceed about 250 ppm (about 0.55-0.6 lb/cubic yard) each of N and P. Additional N and P can easily be added by hand or garden spreader later if field test kit results show that N or P is low in the soils.

If the concentration of hydrocarbons in the soils is known or can be reasonably estimated, add enough nitrogen and phosphorus (as fertilizer), by hand or lawn spreader, to produce a ratio of 100:5:1 of C:N:P. For this purpose assume that hydrocarbons are 90% carbon by weight. Calculate weight of the added N and P from their weight % proportions in the fertilizer. For example, if the soils are assumed to be one metric ton (2200 lb or 1000 Kg) per cubic yard and the fertilizer is 25% N by weight, and you want to add approximately 200 ppm (0.44 lb/yd^3) of N, the actual amount of fertilizer added would be 800 ppm (1.76 lb/yd^3) or 4 X the weight of the N needed. This same calculation is done for P. Prepared fertilizers are marked with their percent content of N-P-K (K=potassium) by numbers such as 25-3-3 which translate as 25%N-3%P-3%K. (K is often as %KCl and can be ignored). If bulk fertilizers such as urea or superphosphate are used, the supplier can provide the % of N or P for this calculation and this value needs to be recorded.

3.2 Moisture

Moisture is needed by the microbes to get access to the nutrients and hydrocarbons. The moisture in the soil must be enough for the microbes but not enough to fill all the pore spaces in the soil and prevent aeration.

Two options for moisture control are visual estimation and field soil moisture measurement.

For visual estimation, the soils should be watered and tilled until the soils look damp but not wet or saturated. The soils need to be visually examined every week and watered as needed, just before tilling, to produce a "damp but not saturated" appearance of the soils. Over-watering may slow the treatment process until the excess water evaporates. The operator will develops an ability to visually estimate the proper amount of moisture content in the soils.

Alternatively, a number of inexpensive soil moisture measuring devices are available which measure soil moisture based on conductivity, resistivity, soil suction (affinity for water), etc. These are usually called irrigation meters, tensiometers, etc. and can be found in many farm supply stores. One brand, Irrometers®, made in Riverside, California, costs less than $100 and many others are available. Attached are copies of literature on several brands and types. These all must be calibrated to some measurement unit to accurately measure soil moisture. The most commonly used measurement is % field capacity. Field capacity is the total weight of water that a given weight of the unconfined (free draining) soil can hold. For treatment purposes, the moisture is kept within a specific range of of the field capacity, typically 40% to 60%. The irrigation meter should be calibrated to measure a range of % field capacity such as 20-80 % per the manufacturers directions.

If rainfall is threatening, the treatment area should be covered by Visqueen, anchored by sand bags. This cover should be removed when not raining. The unit could be allowed to accumulate water and stand idle until the water evaporates but it is best to cover the unit since several days of accumulated rain can exceed the designed holdng capacity of the containment berms.

3.3 pH

Degradation of hydrocarbons generally produces acidic end products, which can lower (acidify) the pH of the soils and inhibit further treatment. Most soils have good natural resistance to pH change. The pH range of the soils to be treated, if unknown, can be readily measured as described below or may be available from either the local Agricultural Extension Agent or Soil Conservation Service. If the soils are from an area where industrial or other activities have raised or lowered the soil pH they will need to be adjusted by amendment with sulfur or lime. Sulfer

will acidify the soils, and lime will adjust the pH upward. Ideally, soil pH should be around pH 7.0. The indigenous microbes in the soil will be acclimated to a pH range of about 5.5 to 8.0 units.

The pH of the soils can be measured using a field/lab procedure. Mix soil and distilled/deionized water in a 1:1 ratio of weight to volume, respectively. Stir, settle and test the pH of water. This will yield a measurement that will approximate the soil pH. The soil-water pH can be tested with a battery powered pH meter or with litmus paper dip-type pH strips.

If the pH drops several units or below pH 5.5, a light application of powdered garden lime prior to the next tilling should be used to raise the pH. If this is done, the pH of the soil should be retested and further adjusted about a week later, if needed.

TABLE 3-1

Nutrient Applications for Remediation

Cubic Yards of Soil	If the soil is heavily contaminated, add:		Cubic Yards of Soil	If the soil is lightly contaminated, add:	
	Pounds of Urea	Pounds of Superphosphate		Pounds of Urea	Pounds of Superphosphate
1	2	1	1	2	1
5	6	2	5	2	1
10	12	4	10	3	1
25	30	10	25	10	2
50	60	20	50	20	6
100	120	40	100	40	15
250	300	100	250	100	30

- For other volumes add or multiply the above for the appropriate pounds of Urea or Superphosphate; other fertilizers can be used if they provide about the same amount of nitrogen and phophorus as these.
- Heavily contaminated soil has a strong odor, free oil, black stained color, spongy consistency.
- Lightly contaminated soil has slight odor, brown staining, firm grainy consistency.

4.0 OPERATIONS

4.1 Soil Preparation

The soils should be spread into a lift nine to twelve inches deep. The soils should be amended with water, nutrients, and pH control agents as discussed in Section 3.0, and thoroughly tilled in place in the treatment area.

4.2 Tilling/Mixing

The soils need to be routinely tilled to trap air in the soils and to evenly distribute the microbes, nutrients, water and hydrocarbons to increase treatment rates. Tilling should be performed every two to three weeks at a minimum. It is often beneficial to till every week during the first few weeks of the start of treatment to thoroughly distribute the moisture and nutrients.

If treating a small volumes of soils, tilling is best done using a garden tiller/cultivator or manually. Care must be taken to not allow the tiller to dig in deep enough to tear the liner. Tilling should not penetrate into the clean sand or soil layer underneath. If the tiller is turning up the clean sand or soil layer, the method of operation and/or the tiller head needs to be changed to produce a shallower treatment.

4.3 Monitoring

Monitoring needs to be done for operating (controlling) the treatment process and for verification of clean-up. Operations monitoring needs to be done for the various amendments; moisture, nutrients, and pH as discussed in Section 3.0.

- Moisture needs be maintained between 20-80 % of field capacity. Water needs to be added to adjust moisture to a range of 40-60 % of field capacity prior to each tilling.
- The pH of the soils needs to be kept within ± 1 pH unit of the natural pH or within the range of pH 6.0-8.0. Any change of several pH units needs to be adjusted back to the range above by the addition of either lime or sulfur to adjust the pH up or down respectively.
- Nutrient N needs to be adjusted if the total inorganic fixed N ($NH_4 + NO_3 + NO_2$) is 5 ppm or less.
- Nutrient P needs to be adjusted if the total inorganic fixed P is 5 ppm or less.
- Adjustments of N and P should be done as described in Section 3.1.

5.0 SAMPLING AND ANALYSIS

5.1 Routine

For routine monitoring of the various treatment condition, field procedures and field test kits such as those supplied by vendors such as Hach and LaMotte for soil analyses are adequate.

- Moisture - Use procedure described above for moisture to measure moisture content in the soils being treated. Calculate the amount of water needed to raise the moisture from its current level to the desired level based on the volume of soils being treated. For example: if the soils are assumed to weigh 2200 lb per cubic yard and soil's field capacity is 880 lb of water per cubic yard of soil (or 400 g/Kg = FC), to increase the moisture from a measured 20% of field capacity to 50 % field capacity, add 264 lb (approximately 33 gal) of water and till into soil.

  CALCULATION:

  if 880/2200 = field capacity
  880 lb = 100% of field capacity
  20 % FC (current moisture) = 176 lb
  50 % FC (desired moisture) = 440 lb
  440 - 176 = 264 lb of water need to be added
  at approx. 8 lb/gal of water (264/8 = 33), 33 gal of water need to be added

  The rate of watering can be field estimated. These measurements must use the same hose, nozzle, etc that is used for watering. In the example above, if the watering system delivers 5 gal/min, then 33/5 = 6.6 minutes of watering.

- Nutrients - Measure nutrients with Hach or Lamotte type kits per their instructions. Table 5-1 provides the numbers of various kits from Hach for these measurements (other vendors have comparable kits), frequency of measurements and the ranges for operation. Measure ammonia, nitrate/nitrite for the total of available nutrient-N. Measure phosphorus for the total readily available nutrient-P. Measure pH using the method described above.

TABLE 5-1

Summary of Treatment Guidance

OPERATION/ PARAMETER	FIELD ANALYSIS	LAB ANALYSIS	METHOD/ APPLICATION	MATERIAL	COMMENTS
TILLING	—	—	Hand or Garden Tiller	—	Avoid tearing liner. Mixing of gravel into contaminated soils indicates tilling too deep.
NITROGEN	Field Colorimetric Test (Hach Soil Fertility Kit - NPK-1 or equivalent) for Nitrate and LaMotte 3335/SL-AN for ammonia	—	Hand or Garden Rotary/Drop Spreader	Commercial Garden Fertilizers	Available as part of standard lawn or garden fertilizer mixes with weight % content specified as N-P-K in numbers such as 26-3-3. N also available as urea and other nitrogenous fertilizers. Supplier will know weight % of N in these fertilizers. Add total ppm of ammonia and nitrate to determine N content of soils. For LaMotte ammonia kit, read out is lb/acre. For conversion, lb/acre ÷ 2 = approx. ppm
PHOSPHORUS	Field Colorimetric Test (Hach Soil Fertility Kit - NPK-1 or equivalent)	—	Hand or Garden Rotary/Drop Spreader	Commercial Garden Fertilizers	Available as part of standard lawn or garden fertilizer mixes with weight % content specified as N-P-K in numbers such as 26-3-3. P also available as superphosphate and other phosphorous fertilizers. Supplier will know weight % of P in these fertilizers.
MOISTURE	Field Moisture Meter/Gauge	One time test of soils for approx. field capacity if not known	Garden Sprinkler and Hose	—	With practice the right water content can be estimated visually. Kick test -- kick the soil if you see dust it's too dry - if the soil sticks to your boot it's too wet.
pH	Field pH Test (Hach Soil Fertility Kit - NPK-1 or equivalent)	—	Hand or Garden Rotary/drop Spreader	Crushed Limestone or Nutrient Acids	If indicated, apply lightly, till and check pH after 2-4 days.
TPH	Sheen Test	8015 GC (TPH) 8020 GC (BTEX)	—	—	EPA Method 418.1 is specifically prohibited for use in verification, etc.

— = not applicable

- Total Petroleum Hydrocarbons - TPH should be measured using either EPA 418.1 of EPA Method 8015 (modified).

5.2 Verification

Laboratory analyses should be used to verify the TPH content of the treated soils. For verification samples with these type of hydrocarbon wastes, two categories of analyses are usually done:

- BTEX (8020)
- TPH by GC (8015/8015M)

Potential standards for cleanup can be estimated based on the State of New Mexico Oil Conservation Division (NMOCD) "Guidelines for Remediation of Leaks, Spills, and Releases" dated August 13, 1993.

APPENDIX A

Moisture Meter Information

ORDERS UNDER $50.00 ADD $7.50 HANDLING

Prices effective January 1, 1991 — Supersedes all previous price lists

Member

PRICE LIST — IRROMETER Soil Moisture Indicators

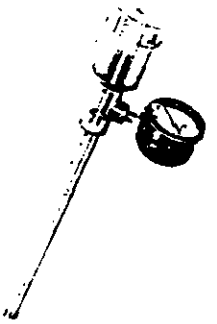
Please order by Catalog Number **All Products Made in U.S.A.**

SERVICE UNIT SHOULD BE PURCHASED WITH INITIAL ORDER (ONE PER USER)

MODEL "R" (Agriculture)

Cat. No.	Length	Price each
106	6"	$40.00
112	12"	41.50
118	18"	43.00
124	24"	44.50
136	36"	47.50
148	48"	50.50

For longer lengths — Add $3.00 per foot



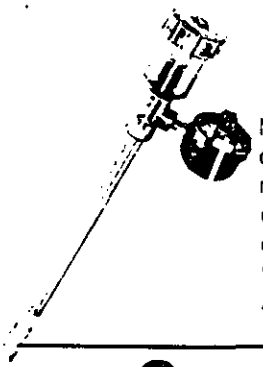
Standard **IRROMETER** for general use with row, tree and field crops. Shorter lengths for greenhouse and pots.

Includes reservoir, air free gauge chamber and hermetically sealed **IRROMETER** vacuum gauge.

MODEL "RA" (Automatic)

Cat. No.	Length	Price each
606	6"	$64.50
612	12"	66.00
618	18"	67.50
624	24"	69.00
636	36"	72.00

For longer lengths — Add $3.00 per foot



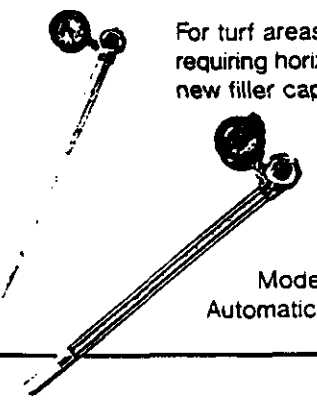
Model "RA" **IRROMETER** is the Model "R" with direct switching capabilities. Adjustable moisture level selector switch may be set at any desired moisture level. The switch will be closed past the setting to actuate solenoid, time clock, or warning light. Switch available for AC or DC power.

MODEL "TG" (Turf)

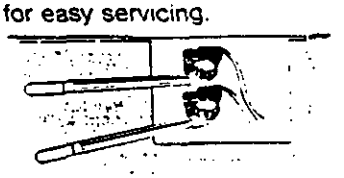
Cat. No.	Length	Price each
312	12"	$43.75
318	18"	45.25

MODEL "TGA" (Turf Automatic)

Cat. No.	Length	Price each
812	12"	$68.25
818	18"	69.75



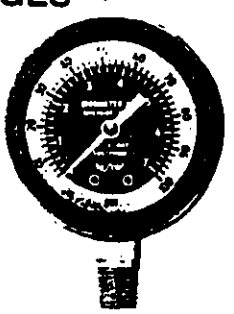
For turf areas where underground installation requiring horizontal placement is desirable. Has new filler cap for easy servicing.



Model TGA pictured above has Automatic Switching Capabilities for Turf

IRROMETER PRESSURE GAUGES

Cat. No.	Length	Price each
7-15	15 P.S.I.	$12.90
7-30	30 P.S.I.	12.90
7-60	60 P.S.I.	12.90
7-100	100 P.S.I.	12.90
7-200	200 P.S.I.	12.90
7-400	400 P.S.I.	12.90
7S	Snubber	1.50/Gauge (add to gauge price)



Hermetically sealed pressure gauges — water tight, dust proof — shatterproof face — shock resistant — 2" bottom connected gauge with ¼" brass standard pipe thread stem. PSI outer scale — Kg/CM² inner scale. **Factory installed snubber improves gauge life by absorbing surges. Add "S" to pressure gauge size.**

IRROMETER PRESSURE GAUGES

*LIQUID FILLED

Cat. No.		Price each
7-60LF	60 P.S.I.	$19.90
7-100LF	100 P.S.I.	19.90
7-200LF	200 P.S.I.	19.90
7-400LF	400 P.S.I.	19.90

Glycerin filled pressure gauges — stainless steel case with durable polycarbonate face — 2½" (63MM) bottom connected gauge with ¼" NPT. P.S.I. outer scale — kPa/bars inner scale. **For severe service conditions of surges, pulsation and vibration.**

— Important Accessories On Other Side —

WATERMARK Soil Moisture Sensor

MODEL 200 (Basic Sensor)

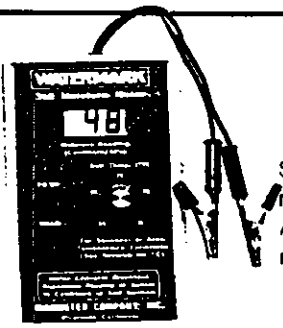
Cat. No.	Wire Lead Length	Price each
200-5	5 Feet	$16.80
200-10	10 Feet	18.80
200-X	No Wire Lead	14.80

Basic **WATERMARK** Soil Moisture Sensor. For use with all crops. To be used with **WATERMARK** meter. Reads electrical resistance in 10-200 centibar range.

WATERMARK Meter

Cat. No.		Price each
30-KTCD	Digital Readout	170.00

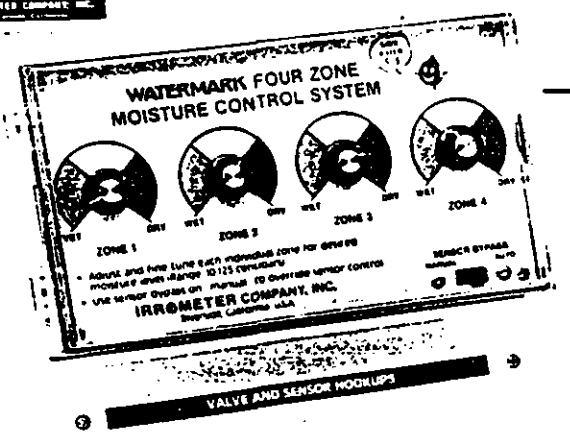
(One meter required to read all WATERMARK Sensors)



Solid state alternating current resistance bridge meter for reading **WATERMARK** sensors. Adjustable for soil temperature variations. One meter required to read all sensors.

WATERMARK FOUR ZONE MOISTURE CONTROL PANEL

Cat. No.		Price each
WFZ-12	12 Station	$495.00
WFZ-24	24 Station	520.00
WFZ-JC	Jumper cable	2.25



Panel comes complete with 8 WATERMARK SENSORS (2 per sensor location) and 12 or 24 jumper cables (as specified) to connect panel to controller/time clock valve terminal strip. For controllers with more than 24 valves, extra jumper cables will be required (one per valve). Installation and operating manual will be included.

Designed to interface WATERMARK sensors with 24 VAC Controller/time clock. Provides up to four independent moisture sensing locations used to control the valves by "group", based on common irrigation need. Each moisture sensing location can be independently adjusted for desired moisture level. Sensor Bypass Switch provides for override of sensors at the panel.

WATERMARK ELECTRONIC MODULE

Cat. No.	
WEM	$95.00

Watermark Electronic Module comes complete with 2 Watermark Sensors and Installation/ Operating manual.

Designed to interface WATERMARK sensors with individual 24 VAC solenoid valves. For those who desire each valve to be controlled individually by moisture sensors located in the valve area or "zone". User can select Wet, Medium or Dry moisture level control. Fully potted electronics are impervious to moisture.

IRROMETER Soil Solution Access Tubes

MODEL SSAT

Cat. No.	Length	Price each
A24	Up to 24"	$7.50
A36	36"	8.00
A48	48"	8.50
A60	60"	9.00
A72	72"	9.50

For longer lengths — Add $.50 per foot.

For easy extraction of soil solution samples for testing as to salinity or plant nutrients in soil water. See below for suction line, stopper and finger clamp assembly.

MODEL SSAT Suction Line (Complete)

Cat. No.	Length	Price each
SLC	Matched to SSAT	$7.00

(Includes suction line, stopper and finger clamp — Add to cost of SSAT)

MODEL SSAT can be ordered "complete" by adding the suction line, stopper and finger clamp assembly. For use with disposable syringe for easy in-field extraction of soil solution samples.

MODEL SSAT Disposable Syringe

Cat. No.	Price each
DS-50 cc	$2.75

Disposable 50cc syringe for pulling vacuum on Model SSAT "Complete" tubes and for extracting soil solution samples. Use with Field Test Kits (Hach Company, Loveland, CO.)

IRROMETER REMOTE SENSING TENSIOMETER

Cat. No.		Price each
RSR	Ag Type	$200.00
RST	Turf Type	200.00

Ag Type is used for vertical placement (see Model R). Turf type is used for horizontal placement (see Model TG). User must specify length desired. Standard lengths for Ag type are the same as Model R. For Turf type, standard lengths are 12" and 18". Specification data available on request.

Standard Irrometer Soil Moisture Indicator equipped with pressure transducer, fluid level sensor and electronic package mounted on the instrument. Converts soil suction reading to an analog signal (1-5 VDC) which can be transmitted from the field to a central computer via cable, telephone modem or other telemetry. Also can be interfaced with electronic data loggers.

All prices F.O.B. Riverside, California
Terms — Cash with order or C.O.D. Net 30 days with credit previously established.
Prices and specifications subject to change without notice. Show catalog number on purchase order.

IRROMETER COMPANY, INC.

P. O. Box 2424 • Riverside, California 92516-2424 • (714) 689-1701 • FAX (714) 689-3706
SHIPPING ADDRESS: 8835 Philbin • Riverside, California 92503

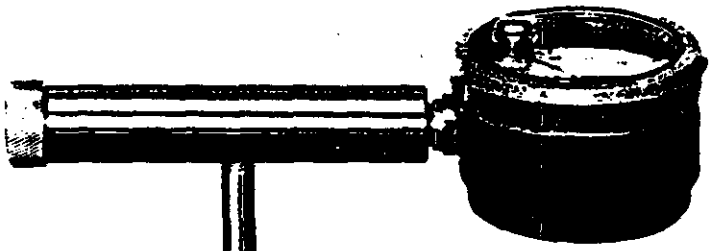
Foreign Department — Pacific Exports — Telex: 469462 — Telefax: (714) 599-8309

LITHO IN U.S.A.

MODEL

2900FI Quick Draw SOILMOISTURE PROBE

Portable, Accurate and . . . Fast!



AGRICULTURAL RESEARCH

- Characterize soil moisture
- Profile soil moisture content

IRRIGATION SCHEDULING

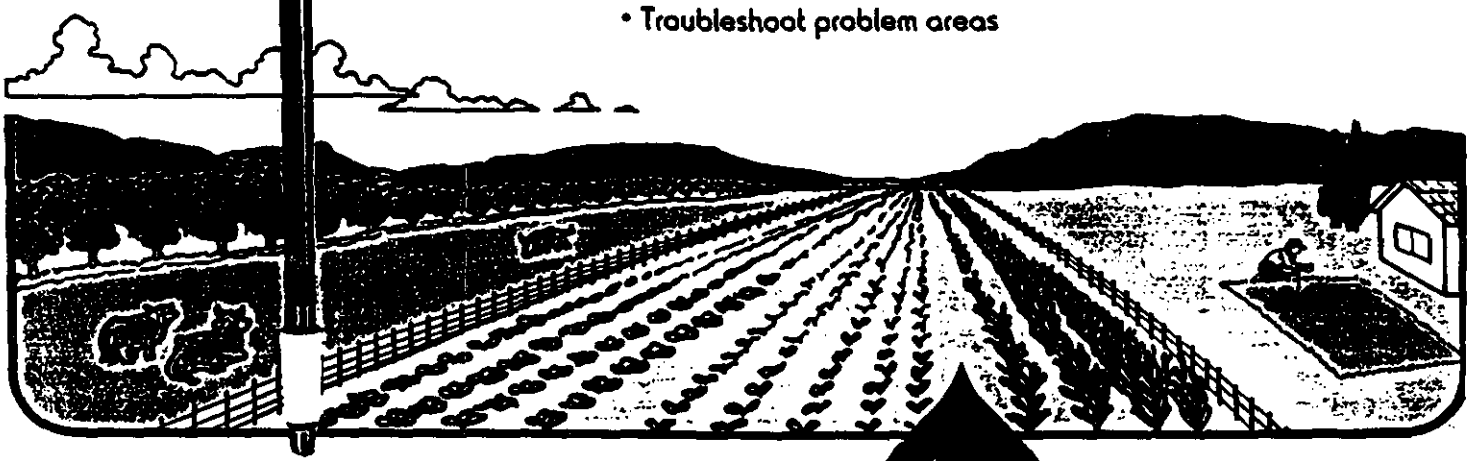
- Forecast irrigation needs
- Quickly assess availability of soil moisture for plant growth
- Check depth of water penetration

ENVIRONMENTAL MONITORING

- Profile vadose zone soil moisture
- Determine suitability for pore liquid extraction
- Manage wastewater irrigation projects

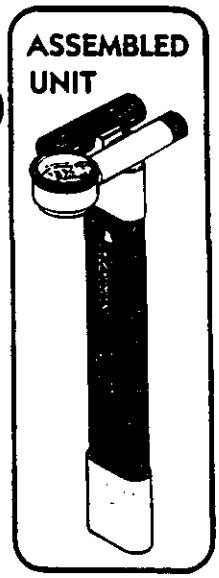
LANDSCAPE AND TURF MANAGEMENT

- Maintain optimum moisture for plant growth
- Manage seed-bed moisture
- Troubleshoot problem areas



SOILMOISTURE EQUIPMENT CORP.

UNIQUE, PATENTED CONSTRUCTION*



VENT SCREW
Permits adjustments for variations in altitude. Also provides access to recalibration screw for adjustments of "zero point" setting.

HARDWOOD HANDLE
Durable, waterproof laminated hardwood construction allows for removal of soil core profiles through the hole in the top.

NULL KNOB
Provides a fast and accurate method of "bracketing" moisture readings using artifically created vacuum settings. Also provides "self-servicing" evacuation in the field, eliminating the need for a service kit.

RECALIBRATOR VACUUM GAUGE
Hermetically sealed and has large 2-inch, easy-to-read dial face. Graduated from 1 to 100 centibars (Kpa) of soil suction.

SNAP-FIT END PIECES
Molded & resilient to improve shock resistance, compactness and ease of use in the field.

UNIQUE 30 PSI PRESSURE RELIEF PORT
Prevents damage to the vacuum gauge from overpressurization

PATENTED THERMAL ISOLATION
Utilizes capillary tube connections and assures fast, temperature independent response.

TAPERED CORING TOOL
Constructed of chrome molybdenum steel. Tapered design provides easy insertion into the soil and matches taper of ceramic tip for good soil contact.

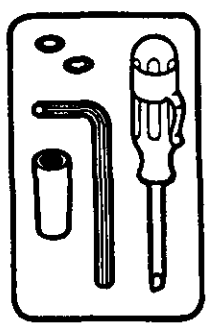
CARRYING CASE
Made of sturdy, lightweight extruded PVC and accomodates all the required parts for portable field soil moisture measurements.

BEVELED CUTTING EDGE
On coring tool maintains cutting ability in most soil types.

"HI-FLOW" POROUS CERAMIC
Sensing tip assures maximum sensitivity in all types of soil.

REMOVABLE PROBE CAP
Permits easy field replacement of ceramic sensing tip.

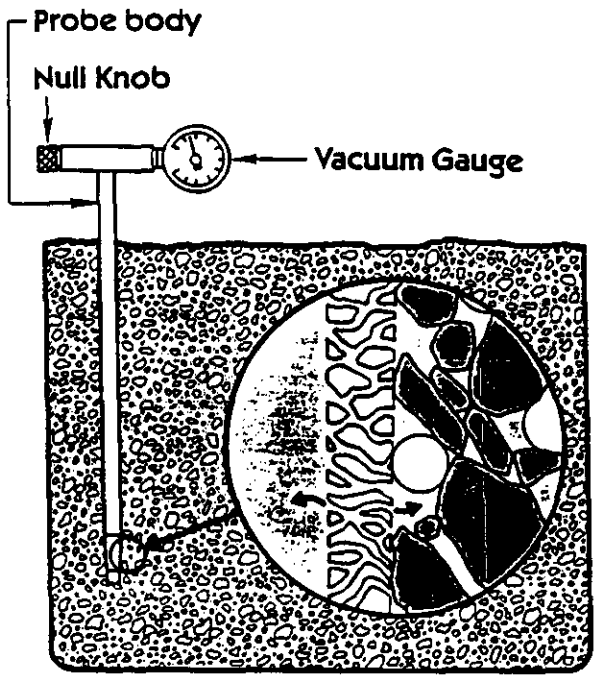
ACCESSORY KIT
Is included with the Model 2900F1 and includes a replacement ceramic sensing tip and "O" rings, a screwdriver for gauge recalibration and a hex wrench for unlocking the gauge.



CLEANING ROD
Is included to assist in removing sticky and hard packed soils from the coring tool, and to remove any remaining soil from the cutting tip.

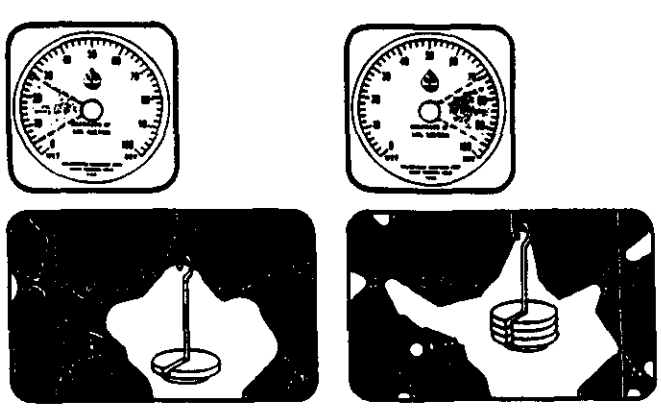
SPONGE CARTRIDGE
Assures a wet tip for optimum response in moisture measurements.

*Patent No. 4068525



Tensiometers are the only instrument that can make a direct measurement of "soil suction" – the force that determines the direction of moisture flow in soil and the force that plants must overcome to get needed water.

The "Quick Draw" Soilmoisture Probe consists of a patented thermally isolated tube with a porous ceramic tip on the bottom, a vacuum gauge at the top and a "Null Knob" sealing cap. When it is filled with water and inserted into the soil, water can move into and out of the Probe through the connecting pores in the tip (as shown in the above illustration). As the soil dries and water moves out of the Probe, it creates a vacuum inside the Probe which is indicated on the gauge. When the vacuum created just equals the soil suction, water stops flowing out of the Probe. The dial gauge reading is then a direct measure of the force required to remove water from the soil. If the soil dries further, additional water moves out

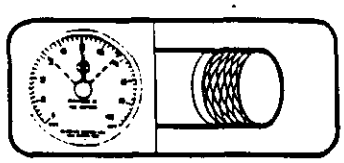


WET SOIL DRY SOIL

until a higher vacuum level is reached. When moisture is added to the soil, the reverse process takes place. Moisture from the soil moves back into the Probe through the porous tip until the vacuum level is reduced to equal the lower soil suction value, then water movement stops. If enough water is added to the soil so that it is completely saturated, the gauge reading will drop to zero. Because water can move back and forth through the pores in the porus ceramic tip, the gauge reading is always in equilibrium with the soil suction.

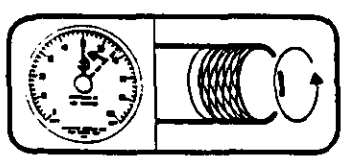
The body design of the Model 2900F1 "Quick Draw" Soilmoisture Probe utilizes a capillary tube and thermal isolation to allow rapid attainment of equilibrium. The result is a fast, easy and portable tensiometer that provides the means for obtaining accurate, temperature-independent soil suction measurements.

Null Knob speeds measurements – The unique Null Knob can be used to rapidly increase the vacuum inside the Probe to approximate that caused by the soil suction surrounding the Probe tip. This allows you to "bracket" the soil suction values and to very quickly adjust the Probe to the true suction value.



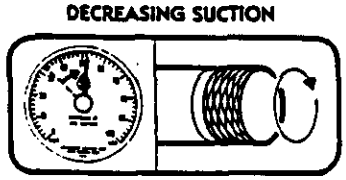
Consider, for example, an application which requires a soil suction measurement in a "dry" soil that has an approximate soil suction of 50 centibars.

INCREASING SUCTION



By turning the Null Knob on the "Quick Draw" counterclockwise, a vacuum can be created which will be close to the soil suction value. In the figure above, a vacuum has been created at 60 centibars. Because the soil suction is less than the vacuum created using the Null Knob, water will move from the soil, through the porous ceramic, and relieve the excess vacuum until the indicator needle rests on the true value, in this case, of 52 centibars.

DECREASING SUCTION

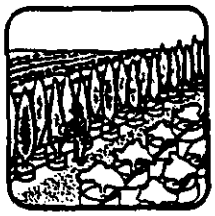


Without disturbing the placement of the "Quick Draw" Probe Tip in the soil, the Null Knob is then gently turned clockwise until the indicator on the vacuum dial gauge points to 40 centibars. Now because the soil suction is greater than the vacuum created with the Null Knob, water will flow out of the probe and through the porous ceramic until equilibrium is reached with the suction of the surrounding soil. The indicator needle confirms a true soil suction value of 52 centibars.

So, by using the Null Knob, one can very simply and quickly "bracket" the true reading.

tiful, lush, green natural growth and colorful abundant flowers.

Landscape Irrigation – Irrigation of landscaped areas is much easier and more efficient with the "Quick Draw." Give areas of special growth the special attention they need. The "Quick Draw" is a proven, scientific tool for determining the moisture requirements of a wide variety of plants. The "Quick Draw" can be used to set irrigation timing devices or adjust timing intervals to account for seasonal changes in watering requirements.

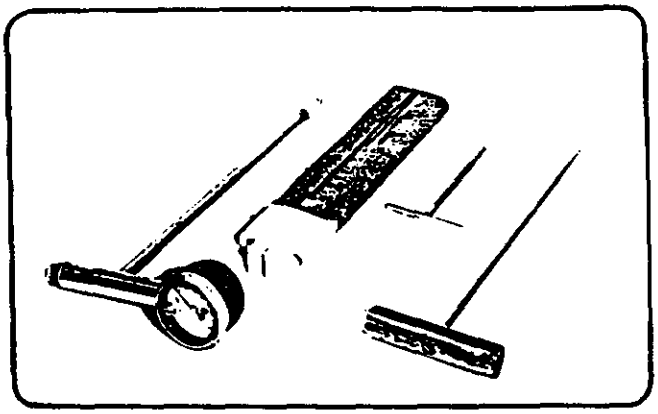


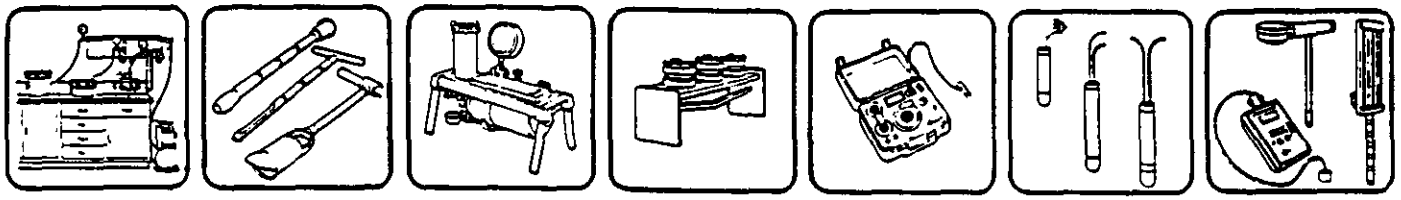
Commercial Container Growers – The portability and quick response of the "Quick Draw" specifically adapt it to use in identifying the unique watering requirements of containerized plant growth. Maintenance of optimum soil moisture using the "Quick Draw" reduces root rot, promotes vigorous growth, reduces water waste and aids in bringing container-grown plants to market sooner.

Model 2900F1L12
"Quick Draw" Soilmoisture Probe, 12" size.
Used at depths ranging to 12".

Model 2900F1L18
"Quick Draw" Soilmoisture Probe, 18" size.
Used at depths ranging to 18".

Model 2900F1L24
"Quick Draw" Soilmoisture Probe, 24" size.
Used at depths ranging to 24".





WITH DEALERS THROUGHOUT THE WORLD, YOU HAVE CONVENIENCE OF PURCHASE AND ASSURANCE OF AFTER-SALES SERVICE.

FOR FURTHER INFORMATION AND TO PLACE ORDERS

SOILMOISTURE EQUIPMENT CORP.
P.O. Box 30025
Santa Barbara, CA 93105 U.S.A.

Telephone:
Area Code 805 964-3525

Cable Address:
Soilcorp

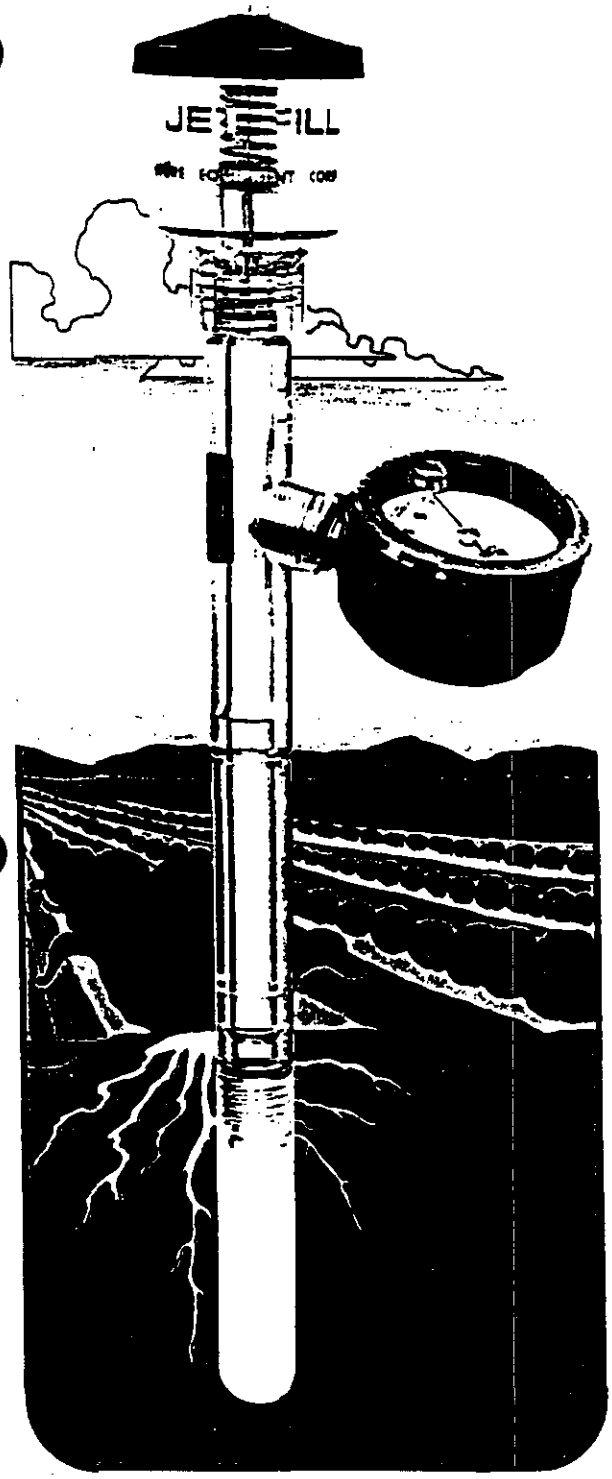
Telex:
Telex No. 65-8424

FAX:
805-683-2189

Plant and Office Location:
801 South Kellogg Ave.
Goleta, CA 93117 U.S.A.

Your Nearest Representative

SOILMOISTURE EQUIPMENT CORP.



2725 SERIES

JET FILL TENSIOMETERS

THE MOST ADVANCED, MOST SENSITIVE INSTRUMENTS AVAILABLE FOR THE FIELD MEASUREMENT OF SOIL MOISTURE.

USE THEM IN:

AGRICULTURE

● to tell you when to start irrigating ● to tell you when to stop irrigating ● to save expensive water, fertilizer, power, and labor costs ● to improve crop yields ● to make profits for you!

AGRONOMY RESEARCH

● to maintain accurate control of soil moisture during plant growth experiments in the development of superior varieties ● to correlate physiological plant changes with surrounding soil moisture values ● to develop effective irrigation practices for crop production

HYDROLOGY

● to measure soil moisture potential to determine subsurface moisture flow ● to verify proper moisture conditions for vadose zone soil water sampling—vital in pollution control ● to provide essential data to relate computer modeling to actual field conditions

Engineered and produced by the foremost manufacturer of soil moisture measuring equipment for over 30 years.

SOILMOISTURE EQUIPMENT CORP. ®

THE MODEL 2725 JET FILL

IS THE BEST TENSIOMETER IN THE WORLD

The flexible reservoir cover allows for convenient filling and sealing of stored water.

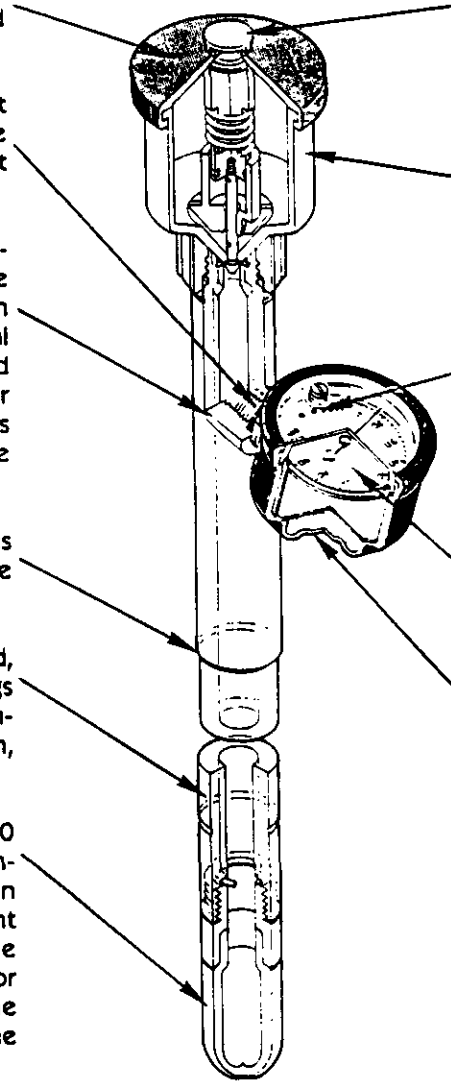
Time proven "O" ring seals throughout assure leak proof vacuum joints while allowing easy removal or replacement of critical components.

Angle molded port in the sidewall provides a strong connection, keeping the dial gauge continuously filled with water and easy to view. The Vacuum Dial Gauge is readily replaceable in the field and can be oriented in any position for reading convenience. Port also accepts Electrical Switching Gauge and Pressure Transducers.

Convenient molded shoulder indicates soil surface position for easy, accurate depth placement.

Heavy walled tube constructed of rigid, clear plastic assures accurate readings at high soil suction values, and is completely immune to damage by sun, water, or soil conditions.

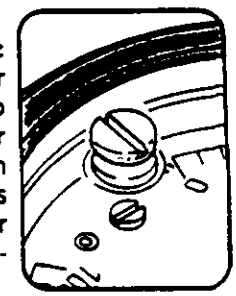
Unique superporous ceramic tip has 10 times the water conductivity of comparable units, providing the ultimate in sensitivity and long life. Convenient thread adaptor design allows the ceramic tip to be readily removed or replaced, as well as permitting the addition of extension tubes to vary the placement depth of the tensiometer.



At a push of the button, patented Jet Fill action instantly injects water into the body of the tensiometer and removes accumulated air with no disturbance to the soil. Recovery is in minutes—not hours!

Large volume, detachable reservoir holds sufficient water for months of servicing. All materials are completely weatherproof for years of use.

Optional recalibrator style gauge allows for adjustment of zero point setting for careful research work. Also permits compensation for water table reference point.



The large 2 inch diameter easy-to-read dial face has a fixed pointer and is graduated from 0 to 100 centibars (Kpa) of soil suction.

A flexible temperature adjusting outer jacket interlocks with the unbreakable, clear plastic coverplate to hermetically seal the gauge, protecting against weather and shock. Complete with vent screw to compensate for altitude variations.

Superior Features Protected by Patent No. 3898872

JET FILL TENSIOMETERS

Are more precise than any other method of measuring soil moisture conditions in the field.

Do not require calibration.

Do not require transporting bulky measuring equipment into the field.

Do not require attaching electrical leads to make a measurement—simply look at the dial gauge.

Do not require any power source.

Can be read instantly—simply look at the dial gauge.

Available in nine stock lengths from 6" (15 cm) to 60" (150 cm) to meet varying installation requirements.

Extra long lengths, extension tubes and special modification supplied on short notice.

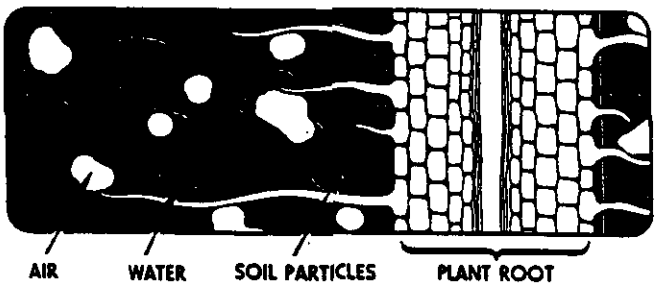
Simple "field replaceable" parts assure years of service.

The single most inexpensive instrument to give precise, direct, continuous measurement of soil moisture conditions.

Available throughout the world.

HOW IT WORKS

Beneath the soil surface, soil particles, water, air, and plant roots share the same space. In this environment water does not move freely as it does above the surface, but is held in the grasp of the soil which determines how it will move and how plant roots can withdraw it.

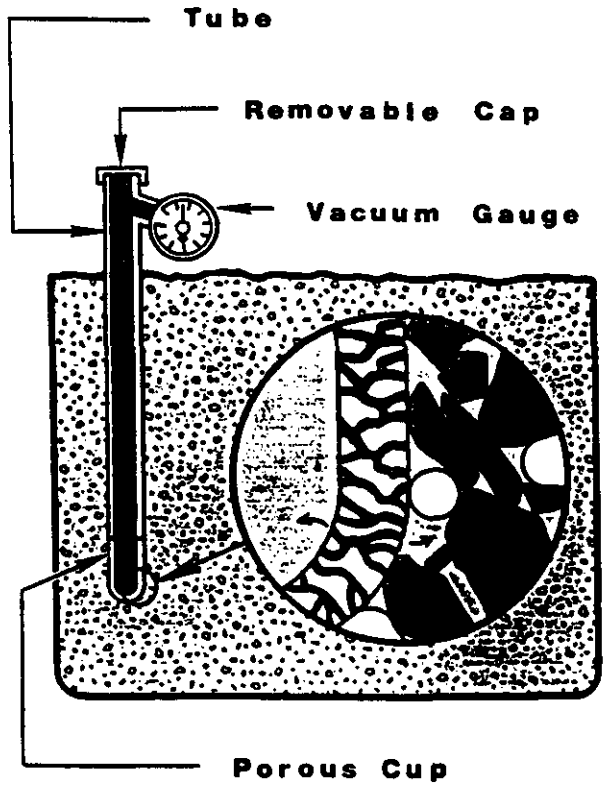


The illustration above shows how the soil particles, water, air, and roots intermingle. The water is naturally attracted to the soil particles and it sticks on the surface of each particle and in the various sized "capillary" spaces or "pores" between the soil particles. When the soil is very wet, most all the large pores are filled with water, and the water can move quite freely and can be easily removed by the plant root. As the soil dries out, the water remaining is held more tightly in the smaller sized capillary spaces.

The picture below illustrates the increasing force required to remove the water from the small sized pores compared to the large pores, as the soil dries out. Because of this, plants find it increasingly difficult to get adequate water as the soil

dries. When remaining water is held only in extremely small pore spaces, the plants cannot exert enough force to withdraw it, and the plants wilt and die. Even though there may be a considerable volume of water in the soil, the plants can't pull it out.

Tensiometers are the only instruments that can make a direct measurement of "Soil Suction"—the force that plants have to overcome to get needed water, and the force that determines which way moisture will move in the soil. A tensiometer consists of a tube with a porous ceramic tip on the bottom, a vacuum gauge near the top, and a sealing cap. When it is filled with water and inserted into the soil, water can move into and out of the tensiometer through the connecting pores in the tip, as shown in the illustration. As the soil dries and water moves out of the tensiometer, it creates a vacuum inside the tensiometer which is indicated on the gauge. When the vacuum created just equals the "Soil Suction", water stops flowing out of the tensiometer. The dial gauge reading is then a direct measure of the force required to remove water from the soil. If the soil dries further, addi-

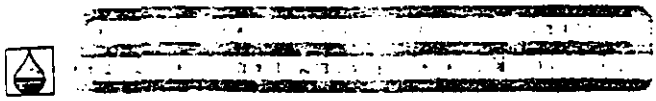


tional water moves out until a higher vacuum level is reached. When moisture is added to the soil, the reverse process takes place. Moisture from the soil moves back into the tensiometer through the porous tip until the vacuum level is reduced to equal the lower Soil Suction value, then water movement stops. If enough water is added to the soil so that it is completely saturated, the gauge reading on the tensiometer will drop to zero. Because water can move back and forth through the pores in the porous ceramic tip, the gauge reading is always in "balance" with the Soil Suction.

The Optimum Plant Growth Range is within the operating range of tensiometers. Plants will live until the soil is so dry that the soil suction value reaches 15 Bars—referred to as the "Wilting Point." It is within the 0-.85 Bar soil suction operating range of tensiometers, however, where most all movement of moisture takes place and where the important moisture is stored for plant growth.

A "bar" is the unit of pressure that has been adopted for the expression of soil suction. The bar is an international unit of pressure, either positive or negative, in the metric system. A bar is equivalent to 14.5 lb/in^2 or .897 atmospheres. It is also equivalent to the pressure exerted by a height of 750 millimeters of mercury or the height of 1,020 cm of water or the height of 33.5 ft. of water. Scientifically it is defined as 10^6 dynes/cm^2.

Tensiometer measurements are always less than 1 bar and for convenience the tensiometer scale has been divided into 100 divisions so that each division is 1/100 of a bar or "1 centibar." This is usually abbreviated as 1 cb. 1 centibar is also equal to 1 Kpa (kilopascal). The full dial gauge reading on our Jet Fill Tensiometer is 100 centibars of negative pressure or vacuum



MODEL 2710AR SERIES

An inexpensive, versatile tensiometer supplied with solid sealing cap and recalibrator type vacuum gauge. Ideal for general irrigation control purposes.

Stock sizes available:

2710ARL06	SOILMOISTURE TENSIOMETER	6" size
2710ARL12	SOILMOISTURE TENSIOMETER	12" size
2710ARL18	SOILMOISTURE TENSIOMETER	18" size
2710ARL24	SOILMOISTURE TENSIOMETER	24" size
2710ARL36	SOILMOISTURE TENSIOMETER	36" size
2710ARL48	SOILMOISTURE TENSIOMETER	48" size
2710ARL60	SOILMOISTURE TENSIOMETER	60" size

MODEL 2725AR SERIES

Ideal for research purposes and irrigation control. Provided with Jet Fill Reservoir Cap and recalibrator type gauge.

Stock sizes available:

2725ARL06	JET FILL TENSIOMETER	6" size
2725ARL12	JET FILL TENSIOMETER	12" size
2725ARL18	JET FILL TENSIOMETER	18" size
2725ARL24	JET FILL TENSIOMETER	24" size
2725ARL36	JET FILL TENSIOMETER	36" size
2725ARL48	JET FILL TENSIOMETER	48" size
2725ARL60	JET FILL TENSIOMETER	60" size

SELECT A SOILMOISTURE TENSIOMETER TO FIT YOUR APPLICATION

The unique, modular construction of Soilmoisture Tensiometers allows you to configure a tensiometer exactly suited to your research, management or monitoring application. Start by selecting the appropriate TENSIOMETER BODY AND CUP. For each tensiometer station you can then select an appropriate TOP SEAL OPTION and MEASUREMENT OPTION from the list below. Further flexibility in application is provided by the TENSIOMETER EXTENSION TUBE OPTION. The length of a tensiometer can be extended, or an angled extension can be used for pinpoint placement of the ceramic cup.

Stock sizes available:

2630AL06K	TENSIOMETER BODY & CUP	6" size
2630AL12K	TENSIOMETER BODY & CUP	12" size
2630AL18K	TENSIOMETER BODY & CUP	18" size
2630AL24K	TENSIOMETER BODY & CUP	24" size
2630AL36K	TENSIOMETER BODY & CUP	36" size
2630AL48K	TENSIOMETER BODY & CUP	48" size
2630AL60K	TENSIOMETER BODY & CUP	60" size

TOP SEAL OPTIONS

2026 SCREW CAP
Provides vacuum tight seal

2075 JET FILL RESERVOIR CAP, COMPLETE
Patented reservoir provides vacuum tight seal, push button servicing convenience, and no soil disturbance when replenishing water to tensiometers.

TENSIOMETER MEASUREMENT OPTIONS

(All with ¼ NPT stem fittings for use with Soilmoisture Tensiometers)

2060G4 VACUUM DIAL GAUGE
2" dial, 0-100 centibar scale, recalibrator type

2601 MERCURY MANOMETER ASSEMBLY
Rugged 1" wide aluminum channel, scaled 0-850 mb. Complete with sightglass, reservoir, and filler bottle. Used with Model 2026 Screw Cap.

5301 CURRENT TRANSDUCER
4-20 ma output, fully temperature compensated and hermetically sealed for rugged field use.

TENSIOMETER EXTENSION TUBE OPTIONS

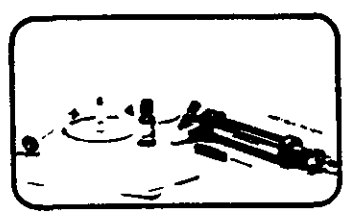
Stock sizes available:

2720L06	EXTENSION TUBE	6" size
2720L12	EXTENSION TUBE	12" size
2720L24	EXTENSION TUBE	24" size
2720L60	EXTENSION TUBE	60" size
2721A135	EXTENSION TUBE with 135 degree angle	12" size

ACCESSORY ITEMS

2710K1 SERVICE KIT

Kit should be ordered with each initial order of tensiometers.



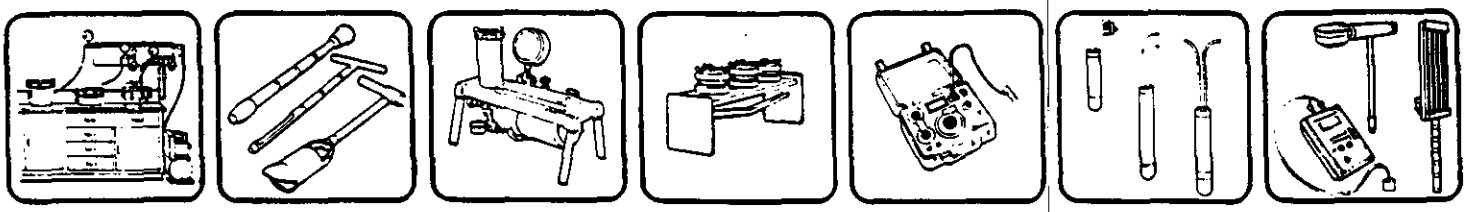
240L INSERTION TOOL

Cuts ⅞" diameter hole in rock-free soils for rapid installation of 2725 and 2710 Series Tensiometers.

230D2 SOIL AUGER, 2" Diameter

5' overall length for installation of tensiometers in rocky soils.

2010	MONTHLY CHART FORMS	pad of 100
2041	TENSIOMETER CHART	12 months



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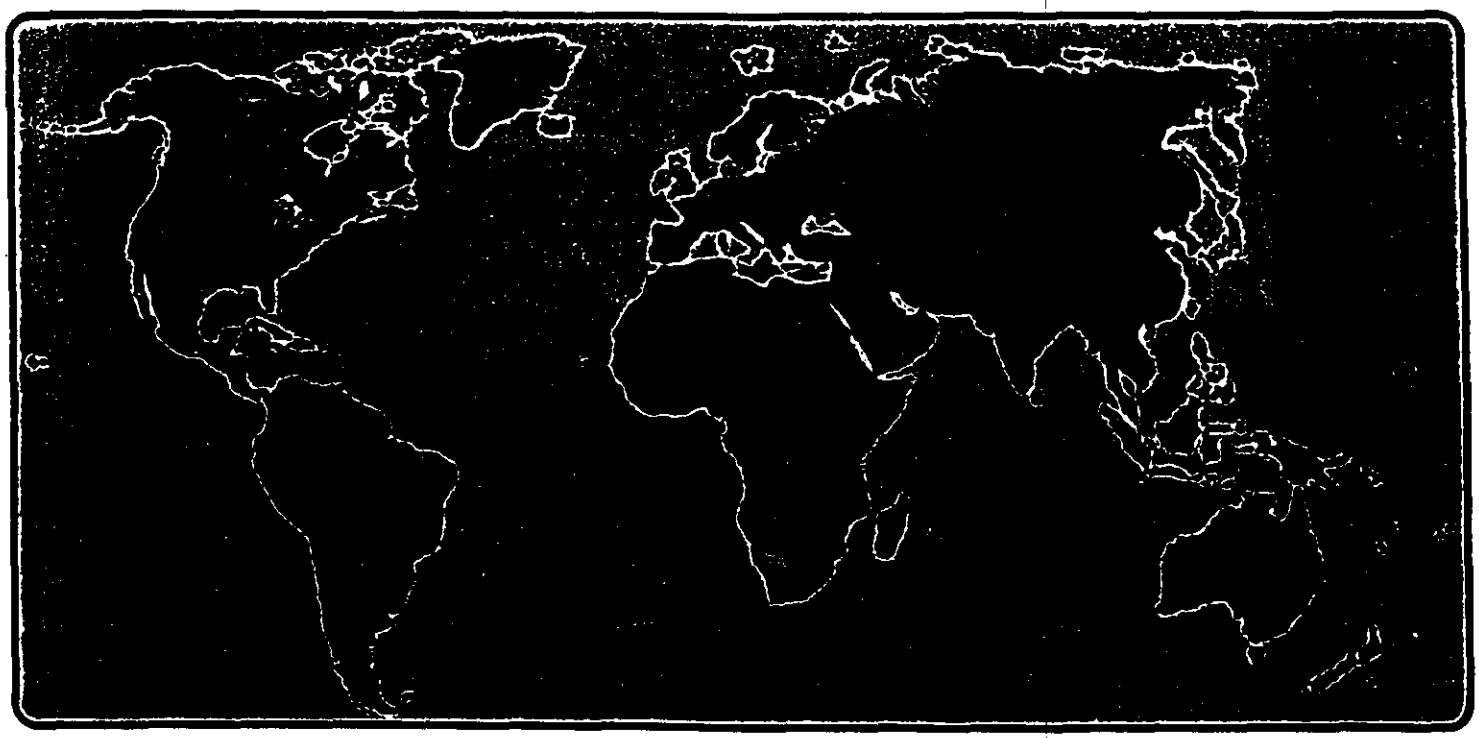


FOR FURTHER INFORMATION AND TO PLACE ORDERS

Your Nearest Representative

SOILMOISTURE EQUIPMENT CORP.
P.O. Box 30025
Santa Barbara, CA 93105 U.S.A.

Telephone:
Area Code 805 964-3525

Cable Address:
Soilcorp

Telex:
Telex No. 65-8424

Plant and Office Location:
801 South Kellogg Ave.
Goleta, CA 93117

SOILMOISTURE EQUIPMENT CORP.
®

APPENDIX B

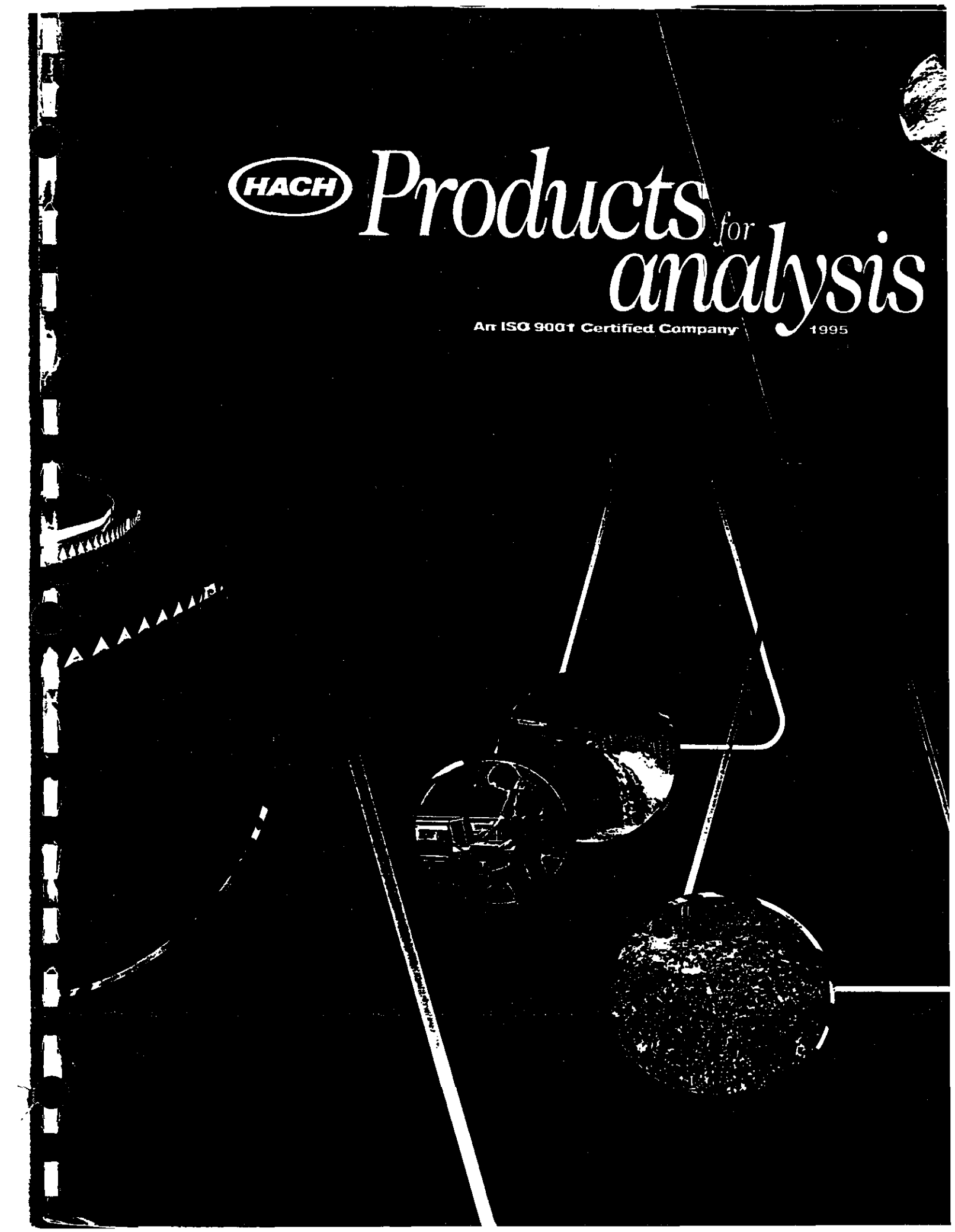
Nutrient Test Kit Information

HACH

Products for analysis

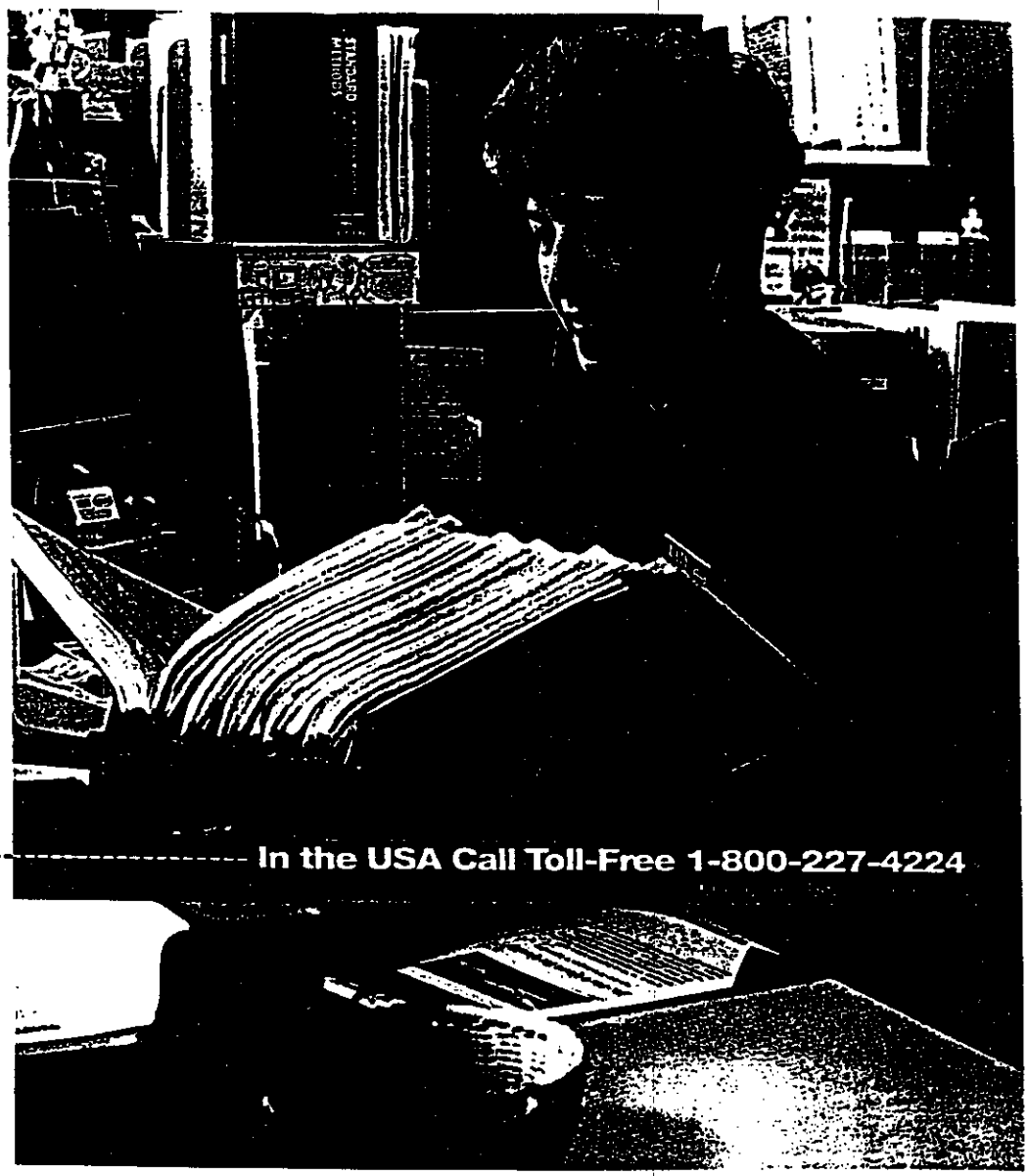
An ISO 9001 Certified Company

1995



Quick Guide to Calling Hach

It's easy to reach us.



Before you call...

You can save time by having this information nearby when you make a call to us.

1. **Your Hach account number or your billing ZIP code**
2. **Billing address**
3. **Shipping address and final shipping destination**
4. **Catalog number**
5. **Quantity**
6. **Purchase order number**
7. **Product description or model number**
8. **Preferred shipping method**

Charge it!

Now you can use your VISA® or MasterCard* when ordering by telephone, mail or fax. When you place your order, please provide this information:

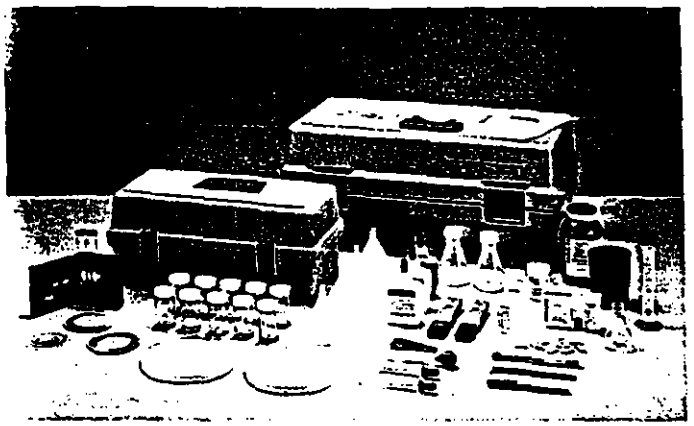
1. **Cardholder's name**
2. **Company's name**
3. **Credit card account number**
4. **Card expiration date**
5. **Billing address**

*issued by approved U.S. banks

You may be an international customer

If the product you're ordering will be transported or used outside the United States, you qualify for many free export services. Whether you represent a USA-based trading company, a multi-national corporation with shipping points worldwide, or an individual wishing to send your Hach purchase overseas, we can help you with export documentation, packaging and shipping. See page 362 for details.

Recycled and Recyclable
In an effort to conserve natural resources, this catalog is printed on recycled paper. Please recycle this book once you are finished with it.



Soil and Irrigation Water Kit, Model SIW-1, Cat. No. 24960-00

Soil Fertility Kit, Model NPK-1, Cat. No. 24959-00

Soil and Irrigation Water Testing, Model SIW-1

A test kit for professional scientists and non-scientists alike, the SIW-1 is ideal for fertility analysis, site characterization, and irrigation water quality assessment under a wide variety of conditions. Farmers, researchers, extension agents and educators can use the versatile kit at remote sites, in the classroom or even in areas lacking electricity.

Soil Fertility Kit, Model NPK-1

Designed for economical on-site evaluations of soil fertility, the NPK-1 provides a simple effective way for analysts to determine nitrogen, phosphorus and potassium content of the soil. The kit also includes a Pocket Pal Tester for quick checks of pH.

Economical Operation

Hach test kits typically include reagents for 100 tests. Other comparably priced kits include reagents for only 50 tests. So test for test, dollar for dollar, you'll not only get more with Hach kits, but you'll save more too.

Agriculture Test Kits

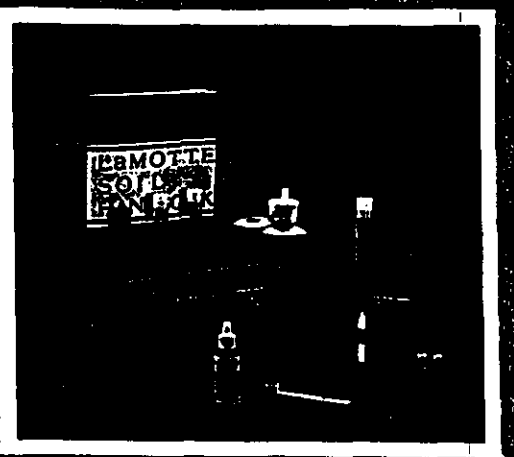
Model	Cat. No.	Test	Range	Case Style (See p. 240)	Ship. Wt. (lb)	Price
NPK-1 dipstick, color disc, Pocket Pal Tester	**24959-00**	**Phosphorus**	0-130 mg/L	Q	18	$386.00
		Potassium				
		Nitrate-Nitrogen				
		pH				
SIW-1 dipstick, drop count, color disc, Pocket Pal Tester	**24960-00**	***Soil Tests***		J, G	22	950.00
		% Base Saturation	0-100% B.S.			
		Cation Exchange Capacity	0-M* meq/100 g			
		Exchangeable Sodium	Calculation			
		Free-Lime Estimation	Visual analysis			
		Gypsum Requirement	0-360 kg/ha (0-15 tons/ac)			
		Exchangeable Calcium & Magnesium	0-M* meq/100 g			
		Lime Requirement	0-360 kg/ha (0-15 tons/ac)			
		Nitrate-Nitrogen	0-60 ppm			
		pH	0-14 pH			
		Phosphorus	0-130 ppm			
		Potassium	0-250 ppm			
		Sodium, exchangeable	Calculation			
		Soil Texture Estimation	Visual analysis			
		Total Exchangeable Acidity	0-M* meq/100 g			
		Irrigation Water Tests				
		Conductivity				
		Calcium & Magnesium				
		Nitrate-Nitrogen	0-50 mg/L			
		pH	0-14 pH units			
		Potassium	0-5 mg/L			
		Sodium Estimation	Calculation			
		Sodium Adsorption Ratio	Calculation			

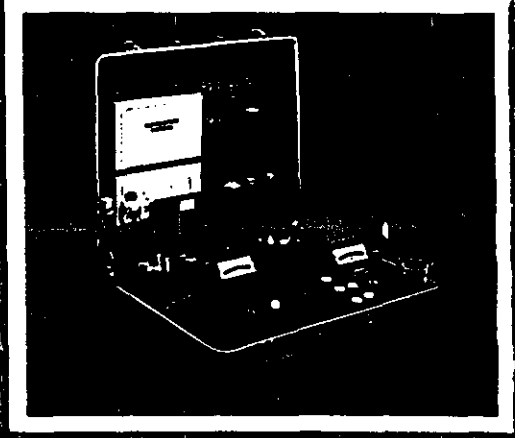
*No upper limit

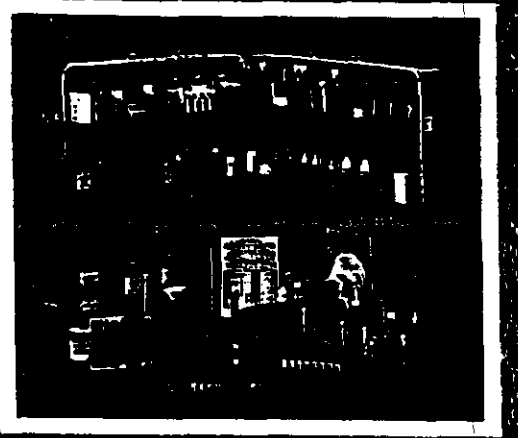
LaMotte Chemical

Test Equipment for the Grower

Soil
Hydroponics
Aquaculture
Dairy



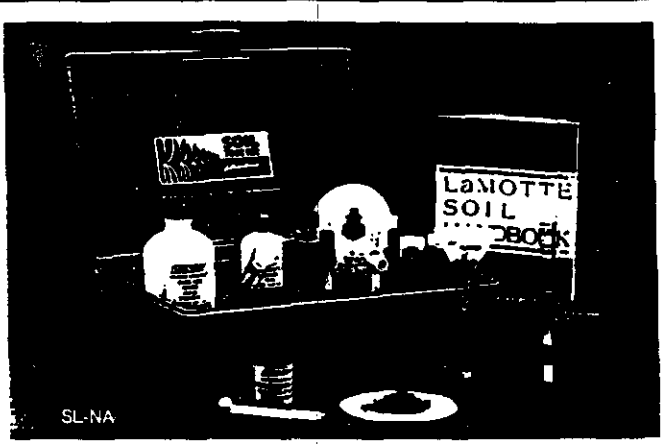




Individual Soil Kits
Macronutrients — Nitrogen and Phosphorus

Nitrogen

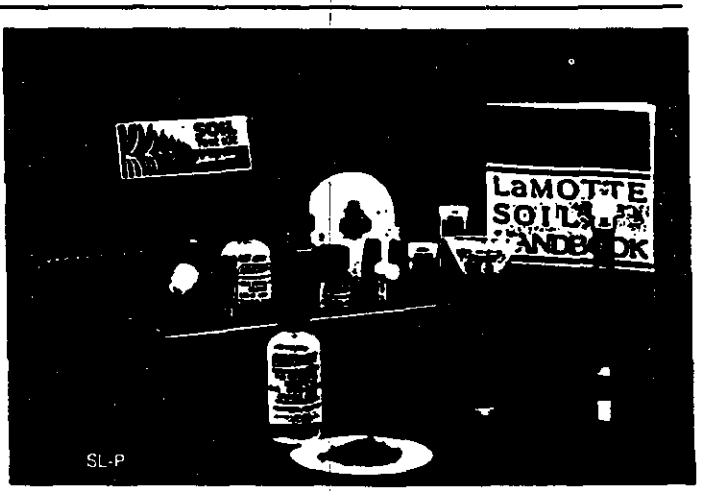
Nitrogen is an essential plant nutrient that promotes above-ground growth and produces the rich green color in leaves resulting from the production of chlorophyll. Deficiencies are characterized by chlorosis and can lead to insufficient growth of seed and vegetation. While crop yields can be greatly increased by nitrogen applications, they must also be protected from excessively high nitrogen levels. Extremely high levels can delay plant maturity and produce greater vegetative growth at the expense of fruit and seed production. Nitrogen is easily leached out of soil and must be measured accurately. Each of the kits below includes a copy of the LaMotte Soil Handbook.



CODE/MODEL	TEST METHOD	RANGE AND SENSITIVITY	REAGENT SYSTEM	NUMBER OF TESTS	PRICE
3338/SL-NA (Nitrate)	Octa-Slide Filtered Extract	2.5, 5.0, 10, 20, 40, 60, 80, 100 lb/A nitrate N	Cadmium Reduction 2 reagents	50	$49.90
5420/ST-N (Nitrate)	Color Chart Filtered Extract	10, 20, 40, 100 lb/A nitrate N	Cadmium Reduction 2 reagents	50	43.80
3335/SL-AN (Ammonia)	Octa-Slide Filtered Extract	10, 20, 30, 40 50, 60, 70, 80 lb/A ammonia N	Nesslerization 3 reagents	50	49.90

Phosphorus

Phosphorus stimulates early root formation, gives a rapid and vigorous start to plants, hastens maturity, stimulates blooming and aids in seed formation. Deficiency symptoms include stunted growth, leaf abnormalities and even dead areas on leaves, fruit and stems. Most soils do not have enough phosphorus and need to be monitored constantly by soil analysis. The presence of available nitrogen and a soil pH level in the range of 6.0 to 7.0 provide optimal conditions for plant uptake of phosphorus. The kits listed below measure phosphorus in pounds per acre, and each is furnished with a copy of the LaMotte Soil Handbook. Note the Model ST-NF is for measuring phosphorus in alkaline soils.



CODE/MODEL	TEST METHOD	RANGE AND SENSITIVITY	REAGENT SYSTEM	NUMBER OF TESTS	PRICE
3340/SL-P	Octa-Slide Filtered Extract	15, 20, 45, 60, 75, 90, 120, 150 lb/A phosphorus	Vanadomolybdo-phosphoric Acid 2 reagents	50	$49.90
5025/ST-P	Color Chart Filtered Extract	10, 25, 50, 75, 100, 150, 200 lb/A phosphorus	Ammonium Molybdate 3 reagents	50	31.30
5071/ST-NF (for alkaline soils)	Octet Comparator Filtered Extract	15, 30, 40, 60, 75, 90, 120, 150 lb/A phosphorus	Vanadomolybdo-phosphoric Acid 2 reagents	50	65.40

Custom Test Kit Service and Ordering Information

Custom Test Kit Service

In addition to a broad selection of standard test kits, LaMotte Chemical offers custom test kits to meet the exact requirements of our customers. If there isn't a standard LaMotte test kit that will satisfy your needs, our custom equipment service can solve your problem by matching a custom test kit to your job. This is accomplished in a number of different ways.

- Selection from our extensive inventory of non-catalog test kits for specialized applications
- Alteration of standard tests to meet your special requirements
- Development of new test methods for new proprietary compounds or for control of specialized treatment programs
- Customized multi-parameter outfits in which you specify the test factors, methods, and packaging to meet your needs.

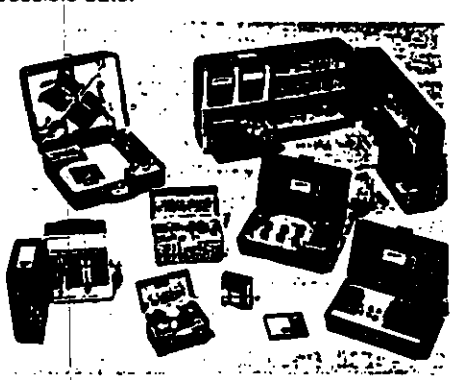
How the custom equipment service works

For a test kit that will meet your special needs, here is all you have to do.

Step 1. Send us a profile of the project under consideration. Indicate the use of the product, the level of accuracy desired, the ranges to be covered, the quantity of production units involved, and any limitations such as size, weight, cost, or the level of skill of the end user. Please indicate if any part of the project is to be kept confidential.

Step 2. Based on the information submitted, we will either suggest one of our non-catalog test kits or furnish you with a proposal that will provide a cost schedule for producing the item and also indicate if there will be any development charges for any original investigative work that may be required. There is no obligation for a quote.

Step 3. Upon receipt of your approval and the order, development work or production will begin immediately. Delivery of the finished products will be made at the earliest possible date.



Ordering Information and Terms of Sale

Address orders to LaMotte Chemical Products Company
P.O. Box 329
Chestertown, Maryland 21620

Or telephone 800-344-3100 (In MD, 301-778-3100).

Or telex (WUI) 6849068
This is a Western Union International telex number. Our answerback is LAMOCHEM.

Please include the Product Code Number and desired quantity for each item on your purchase order. Also be sure to include complete address information for both shipping and billing.

Prices shown in this catalog may be subject to change without notice. Prices are f.o.b. Chestertown. Freight charges are shown separately on our invoices.

Payment is due within thirty days from date of invoice for customers who have established accounts with us. If you are ordering from LaMotte Chemical for the first time, please provide credit references or send a check or money order with your purchase order. If you call us, our order clerks will be happy to take your credit references by phone.

A Small-Order Handling & Delivery Fee of $4.00 is applied to all orders totaling less than $25.00 net. This flat fee includes the cost of delivery via surface transportation. It simplifies order processing and enables us to service small orders without instituting a minimum order requirement. Orders totaling net $25.00 or more are billed at invoice value plus actual freight charges.

Please allow ten working days for processing and shipment of your order. LaMotte test kits are made to order to insure that all reagents are as fresh as possible when you receive them. And every LaMotte test kit undergoes a 100% inspection procedure before leaving our plant.

Shipment will be by the method specified on your purchase order, unless prohibited by size, weight or restrictive chemical nature of the materials ordered. When method of shipment is not specified, our expert Traffic Department will select the best carrier based on economy and service. Please note that air shipment of reagents classified as hazardous materials may entail an additional charge for special packaging and preparation of restricted article documentation.

Insurance will be applied to all shipments at the purchaser's expense, unless the purchase order specifically requests us not to insure.

Claims for shortages or breakage must be filed with us within ten days from date of invoice, if the shipping carton is undamaged. If the shipping carton is received in damaged condition, the claim should be filed immediately with the carrier.

Before returning any material to us, please contact us about the materials to be returned. Returned goods are subject to a re-stocking charge. Appropriate credit or exchange will be issued following our inspection of the returned materials.

Export Sales

Our experienced Export Department handles orders from all countries other than the United States and Canada. Our export sales terms are payment in advance, either by direct payment in U.S. dollars or by irrevocable letter of credit in U.S. dollars. We will gladly provide a no-obligation proforma quotation detailing our f.o.b. Chestertown prices, plus all freight and insurance costs. Export pricing is based on our regular domestic prices, as shown in this catalog. To cover our additional costs for export packaging, documentation and handling, we apply an Export Service Charge to our regular domestic prices. The Export Service Charge is equal to 10% of the net invoice total. The minimum charge is $10.00 (on orders with net total of $100.00 or less); the maximum charge is $200.00 (on orders with net total of $2,000.00 or more).

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