Phase II Investigation and Part 360 Hydrogeologic Investigation Work Plan

Brookhaven Landfill

Town of Brookhaven
Suffolk County, New York

DRAFT

Dvirka and Bartilucci
Consulting Engineers

MARCH 1990

Town of
Brookhaven
New York

DEPARTMENT OF WASTE MANAGEMENT
JAMES HEIL, Commissioner
ROBERT REICHERT, Deputy Commissioner
ELAINE McKIBBIN, Supervisor

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DVIRKA & BARTILUCCI

April 23, 1990

Mr. Daniel Morganelli
Divsion of Solid Waste
New York State Department of
Environmental Conservation
Bldg. #40 - State Campus
Stony Brook, New York 11794

Re: Brookhaven Landfill

Dear Mr. Morganelli:

As discussed, in order to expedite review of the Hydrogeologic Investigation Work Plan for expansion of the above referenced landfill, we request that the Part 360 aspects regarding landfill expansion be separated from those aspects relating to closure of the existing landfill and the Phase II Investigation. Specifically, without modifying the existing work plan, this involves simply designating the monitoring wells shown in Figure No. 3-1 of the work plan (also attached), either as part of the expansion application or for closure/Phase II Investigation.

Those wells identified as part of the application for expansion of the Brookhaven landfill are the following: MW-1, 2, 3, 9, 10, 11, 12, and 13; and those identified as part of the landfill closure plan and Phase II Investigation are: MW-4, 5, 6, 7 and 8 (also designated on the attached figure).

If you have any questions with regard to this request or letter, or require additional information, please call me. Thank you for your assistance in this matter.

Very truly yours,

James H. Heil

James H. Heil
Commissioner

JHH:ew
att.
cc: Michael Groben, Assistant Town Attorney
Anthony Candella, NYSDEC
Thomas Maher, Dvirka & Bartilucci ✓

3233 ROUTE 112, MEDFORD, NY 11763 (516) 451-6222

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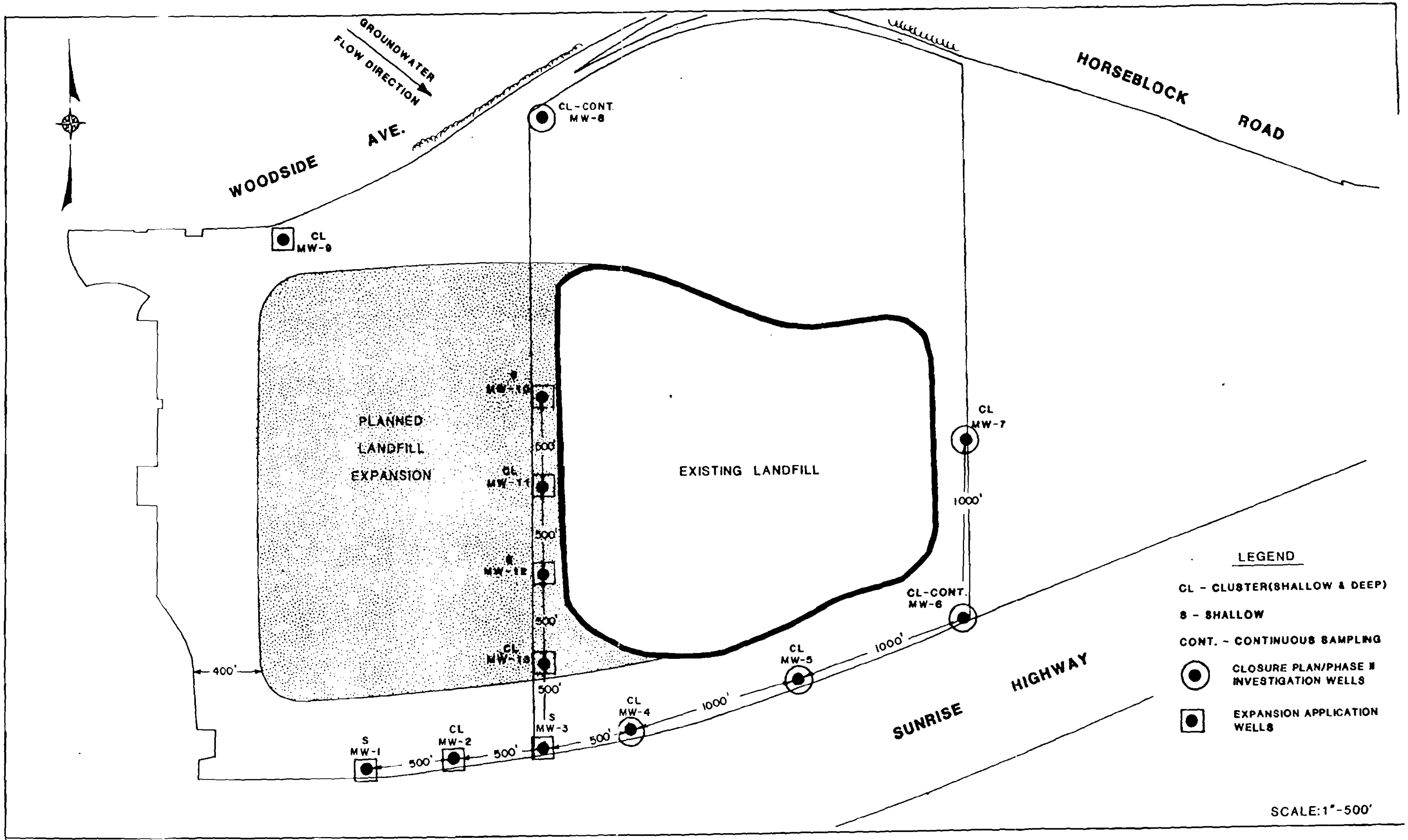

Dvirka and Bartilucci

TOWN OF BROOKHAVEN

NEW WELL LOCATIONS

FIGURE NO. 3-1

DRAFT

PHASE II INVESTIGATION
AND
PART 360 HYDROGEOLOGIC INVESTIGATION
WORK PLAN

BROOKHAVEN LANDFILL

TOWN OF BROOKHAVEN
SUFFOLK COUNTY, NEW YORK

MARCH 1990

WORK PLAN APPROVAL FORM

PHASE II INVESTIGATION
AND
PART 360 HYDROGEOLOGIC INVESTIGATION

BROOKHAVEN LANDFILL

TOWN OF BROOKHAVEN
SUFFOLK COUNTY, NEW YORK

Approved by:

Project Manager ______________________________ Date __________
Dvirka and Bartilucci Consulting Engineers

Project Director ______________________________ Date __________
Dvirka and Bartilucci Consulting Engineers

Project Manager ______________________________ Date __________
New York State Department of Environmental Conservation

2036E

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Section 1

1.0 INTRODUCTION AND PURPOSE

In 1987, the New York State Department of Environmental Conservation (NYSDEC) issued a Phase I Investigation Report for the Brookhaven landfill (Site No. 152041), which confirmed the release of contaminants from the site to ground water. The report established a Hazard Ranking Score (Migration Score [Sm]) of 37.93, which is above the score of 28.50 that NYSDEC uses to classify a site as a significant threat to health, and recommended that additional investigation be undertaken to evaluate the horizontal and vertical extent of ground water contamination.

Under the New York State Superfund Program, a Phase II Investigation at an inactive hazardous waste site may be required by NYSDEC based on the findings of a Phase I study, or from other information or determinations arising from within the Department, or from requests from other agencies or governmental entities, such as the Town of Brookhaven, subject to the Department's evaluation.

The purpose of this Phase II Investigation to be conducted at the Brookhaven landfill, as requested by the Town of Brookhaven, is to obtain additional information in the vicinity of the site to better document the nature and extent of contamination caused by releases from the landfill. The investigation is to determine the presence of chemical compounds specified on the New York State Target Compound List in samples obtained from soil, ground water, leachate, surface water and surface water sediments in the area of the landfill, as well as landfill leachate indicator parameters in ground water, leachate and surface water. The results of the investigation will be provided to NYSDEC in order to reclassify the landfill from its present classification of 2a, which is a potential hazardous waste site.

In addition to the need and request for a Phase II Investigation, since the Town of Brookhaven plans to close the existing, active portion of the landfill and expand the landfill into a new area in the future, NYSDEC requires the conduct of a Hydrogeologic Investigation as part of the Part 360 landfill permit application for both closure and expansion. The purpose of this Part 360 Hydrogeologic Investigation as defined in the regulations, is to define the site geology and hydrogeology, and ground water and surface water flow at the site, and to establish an environmental monitoring system capable of detecting a contaminant release from the landfill which will form the basis for facility design and a remedial contingency plan.

Since the objectives of both the Phase II Investigation and Part 360 Hydrogeologic Investigation are similar, the purpose of this document is to provide a work plan that will jointly address the regulatory requirements of both the New York State Superfund and Solid Waste Management Facility/landfill programs.

Section 2

2.0 BACKGROUND AND HISTORY

2.1 Site Location and Background

The Town of Brookhaven operates a municipal solid waste landfill for the disposal of approximately 1,600 tons per day of municipal solid waste. The 90 acre landfill is located between Horseblock Road and Sunrise Highway in Yaphank, New York (see Figure No. 2-1). Operation of the landfill began in 1974, and refuse has been deposited in three lined excavated areas (cells), each with its own leachate collection system (see Figure No. 2-2). A fourth lined cell exists but has not been used as of the date of this report.

Cell No. 1 comprises 45 acres, Cell No. 2, 36.5 acres, Cell No. 3, 4.0 acres and Cell No. 4, 4.5 acres.

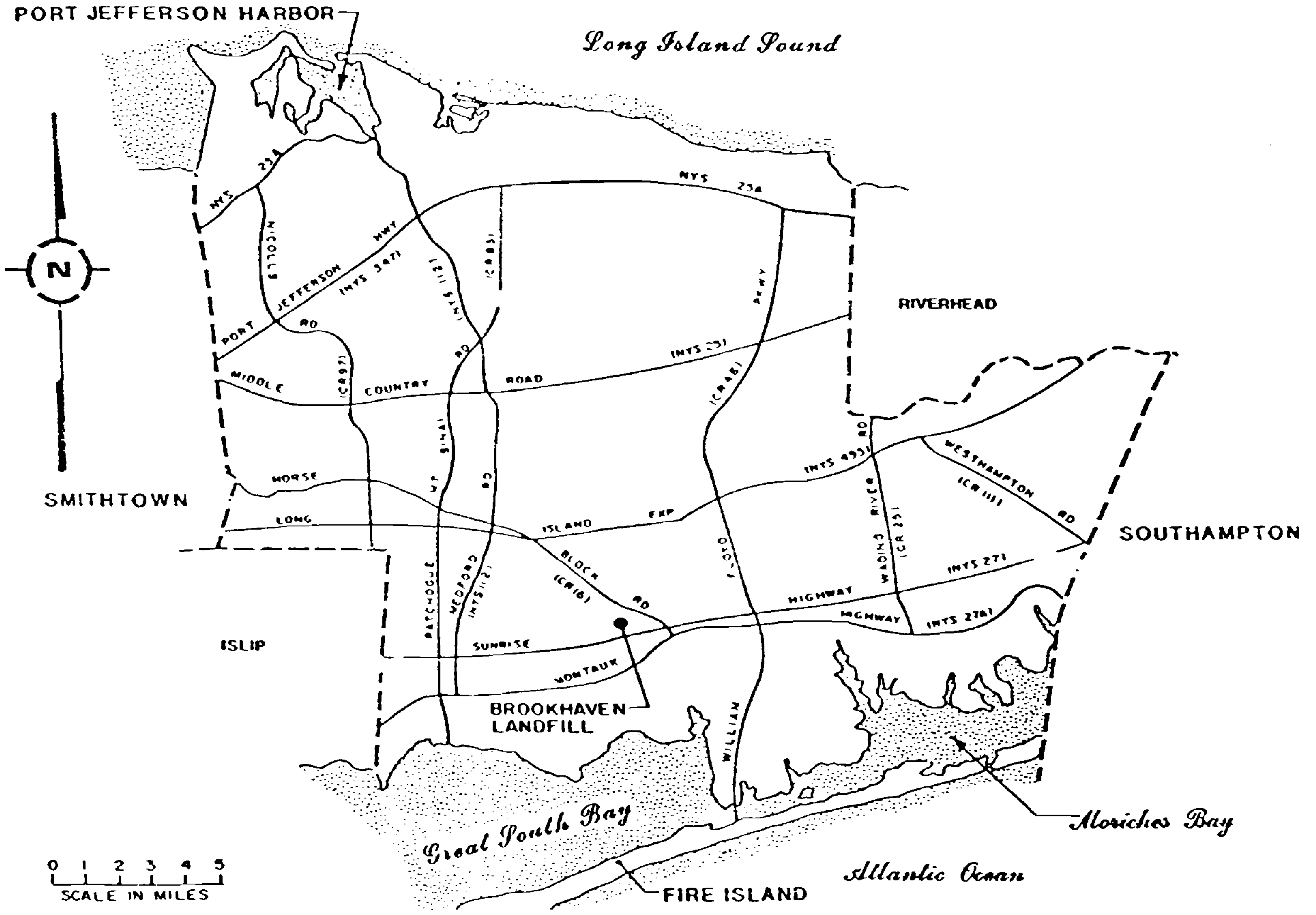
The landfill was excavated in glacial outwash deposits to within approximately 5 to 10 feet of ground water. The excavated areas have a depth below grade ranging from about 10 feet on the east to 30 feet on the west. The bottom of each cell has an underliner and has been graded to allow leachate to move towards a leachate collection/recovery system.

The single liner for Cell No. 1 is composed of 20 mil polyvinyl chloride (PVC), and the double liner for Cell No. 2 consists of 20 mil PVC overlain with 20 mil chlorinated polyethylene (CPE). Cell Nos. 3 and 4 comprise double liners consisting of 80 mil high density polyethylene (HDPE) overlain with 60 mil PVC.

Cell No. 1 was completed in 1983, and is capped in part (15 acres) with a 10 mil PVC liner (see Figure No. 2-2) and 2 feet of soil. The cap was completed in 1985. Cell No. 2 began operation in 1983, and is currently being used. Cell No. 3 commenced operation in 1989 and is also presently being used. As mentioned above, Cell No. 4 is not currently being utilized.

A methane collection system has been installed at the landfill. Methane gas is used as fuel in modified diesel engines to generate electricity.

The ground water monitoring program for the landfill was initiated by the New York Environmental Facilities Corporation (EFC) in 1972 with 22 wells installed in clusters around the landfill which were monitored quarterly.

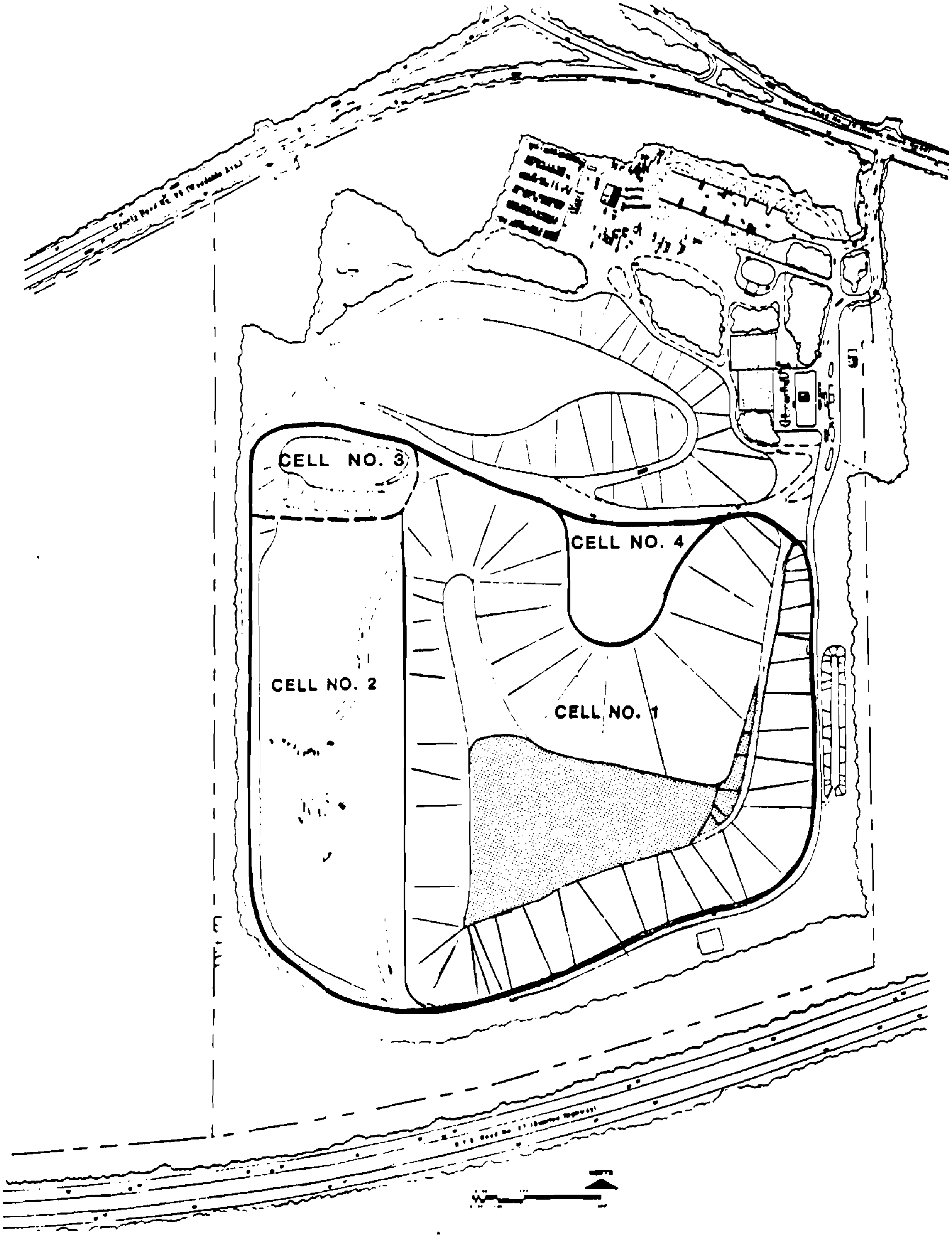


TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

LOCATION OF BROOKHAVEN LANDFILL

Dvirka and Bartilucci
CONSULTING ENGINEERS

FIGURE NO. 2-1



SOURCE: LOUIS K. McLEAN ASSOC.,P.C.

TOWN OF BROOKHAVEN MUNICIPAL LANDFILL

SITE PLAN

FIGURE NO. 2-2

EFC was the original owner of the Brookhaven landfill and operated the facility until 1976 when ownership and operation was assumed by the Town of Brookhaven. This is discussed in more detail in Section 2.3.

Since 1976, the Town of Brookhaven has conducted a routine ground water monitoring program for landfill leachate parameters. Samples were collected from select wells around the perimeter of the landfill quarterly until 1981, and semi-annually thereafter.

From 1981 to 1983, and again in 1989, the United States Geological Survey (USGS), in separate studies and in cooperation with the Town of Brookhaven, collected data on the hydrogeology and ground water near the Brookhaven landfill site in order to assess the potential effects of leachate contamination on ground water quality in this area. Reports prepared as a result of these studies, as well as other reports pertaining to the Brookhaven landfill, such as the Phase I Investigation, are provided in Section 8.0 (References).

The results of these Town and USGS investigations indicated elevated concentrations of several inorganic chemicals in a number of on-site and downgradient wells. In addition, organic compounds were detected in several wells adjacent to the landfill.

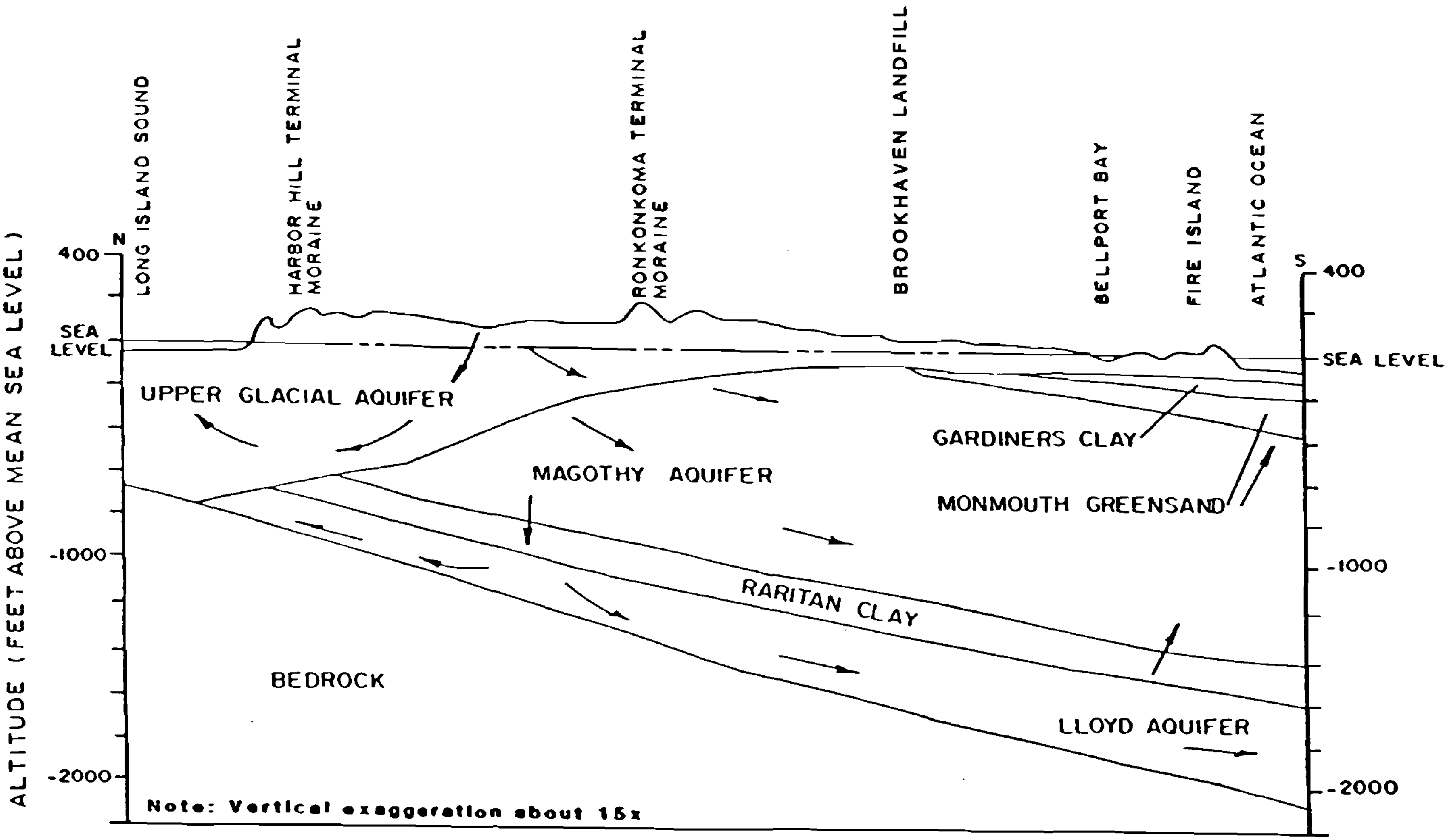
2.2 Hydrogeologic Setting

A generalized hydrogeologic cross section in the vicinity of the Brookhaven landfill is shown in Figure No. 2-3. Surficial deposits consist of sand and gravel deposited as outwash during the Pleistocene glaciation.

The landfill is in an area where the Gardiners clay appears to be present under the glacial deposits; however, it is not known if the Gardiners clay extends beneath the landfill. Information on the presence of the Monmouth greensand is lacking.

Underlying the Pleistocene deposits is the Magothy-Mattawan group (Undifferentiated), which is a continental deltaic deposit of the Cretaceous age. The thickness of this group in the area of Brookhaven is greater than 900 feet.

The Raritan formation underlies the Magothy-Mattawan group. This formation is composed of two components: the Raritan clay and the Raritan formation. In the Brookhaven area this formation is approximately 600 feet thick (200 feet clay and 400 feet sand).



SOURCE: USGS WRI REPORT 85-4218, 1986

TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

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CONSULTING ENGINEERS

NORTH-SOUTH HYDROGEOLOGIC CROSS SECTION

FIGURE NO. 2-3

Metamorphosed crystalline bedrock underlies the Raritan formation. The bedrock is relatively impermeable and is not considered to be a source of water.

Regional ground water flow near the Brookhaven landfill is shown in Figure No. 2-4. As this map indicates, regional horizontal flow is towards the southeast.

For the vertical component of ground water flow, the 1978 Long Island Comprehensive Waste Management (208) Plan placed the area of the landfill in the discharge area of the aquifer system, just south of the deep recharge zone.

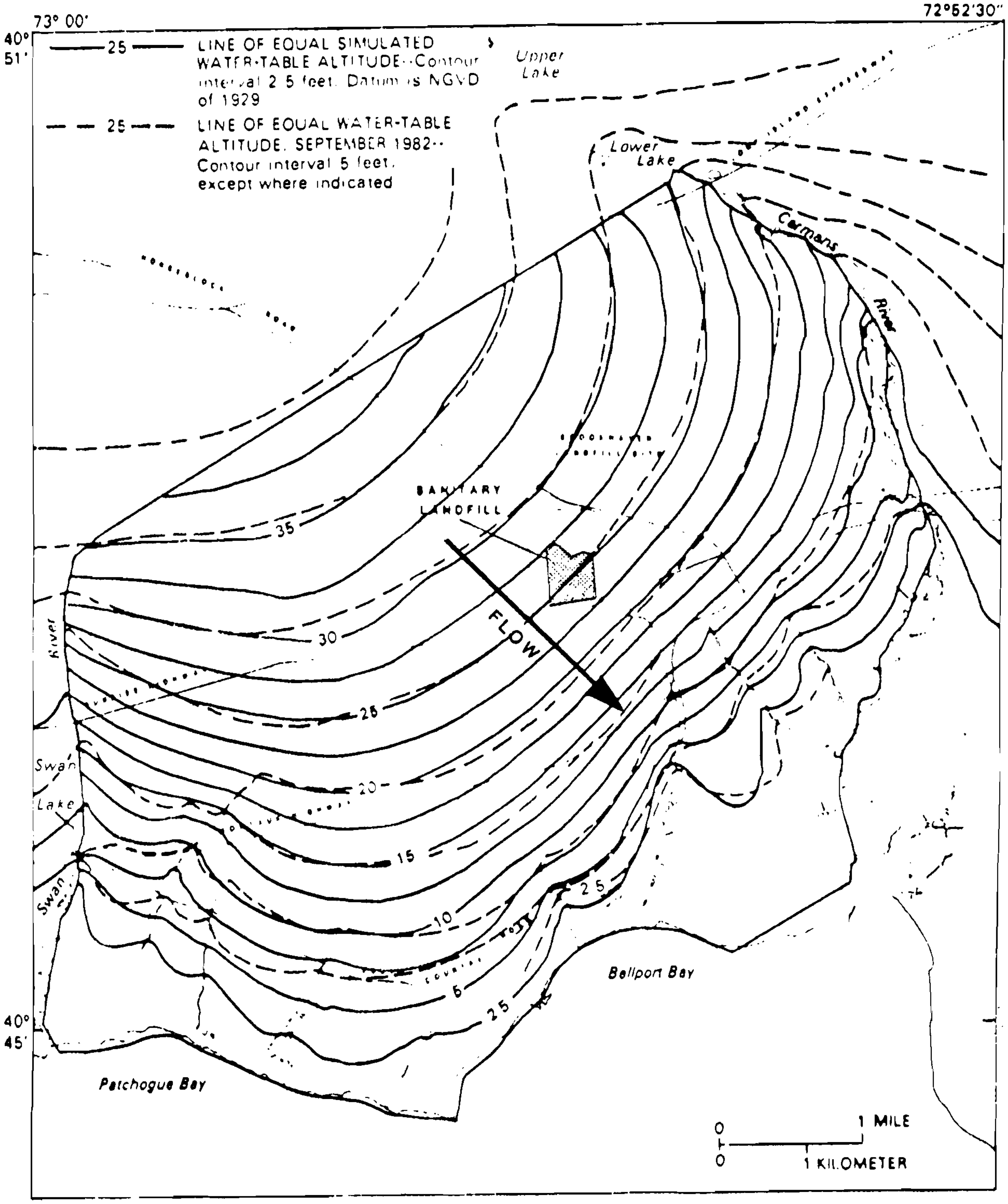
Based on the March 1988 ground water table contour map prepared by the Suffolk County Department of Health Services, the depth to ground water is estimated to be approximately 10 to 50 feet below ground surface in the vicinity of the landfill.

Within 3 miles of the site, the upper glacial and Magothy aquifer has been developed by two Suffolk County Water Authority well fields and some private wells. Locations of the supply wells and the areas served by public water are illustrated in Figure No. 2-5. Figure No. 2-6 shows, in greater detail, the location of public water supply downgradient of the landfill.

2.3 Site History

The Brookhaven landfill is an active municipal solid waste landfill. The New York State Environmental Facility Corporation (EFC) opened the original landfill on a 116 acre parcel of vacant land in March 1974. The Town of Brookhaven assumed ownership and responsibility for the landfill in 1976. Today the property owned by the Town comprises approximately 200 acres and the landfill covers 90 acres and accepts about 585,000 tons of municipal solid waste per year, including approximately 25,000 tons of treated sewage sludge and sludge incineration ash from the Southwest Sewer District Treatment Plant. The landfill does not accept liquid wastes, and did not knowingly accept hazardous waste for disposal since its opening in 1974.

Fifteen acres of the original landfill (at the highest elevation) have a synthetic cap and the entire landfill has synthetic underliners. A collection system under the landfill collects approximately 35,000 gallons of leachate per day, which is transported by truck to the Southwest Sewer District for treatment. Over the years, EFC, the Town and the USGS have installed a monitoring network of 140 wells at the site. Table No. 2-1 contains the most recent inventory of monitoring wells around the Brookhaven landfill compiled by the USGS.



SOURCE: USGS WRI REPORT 86-4106,1988

TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

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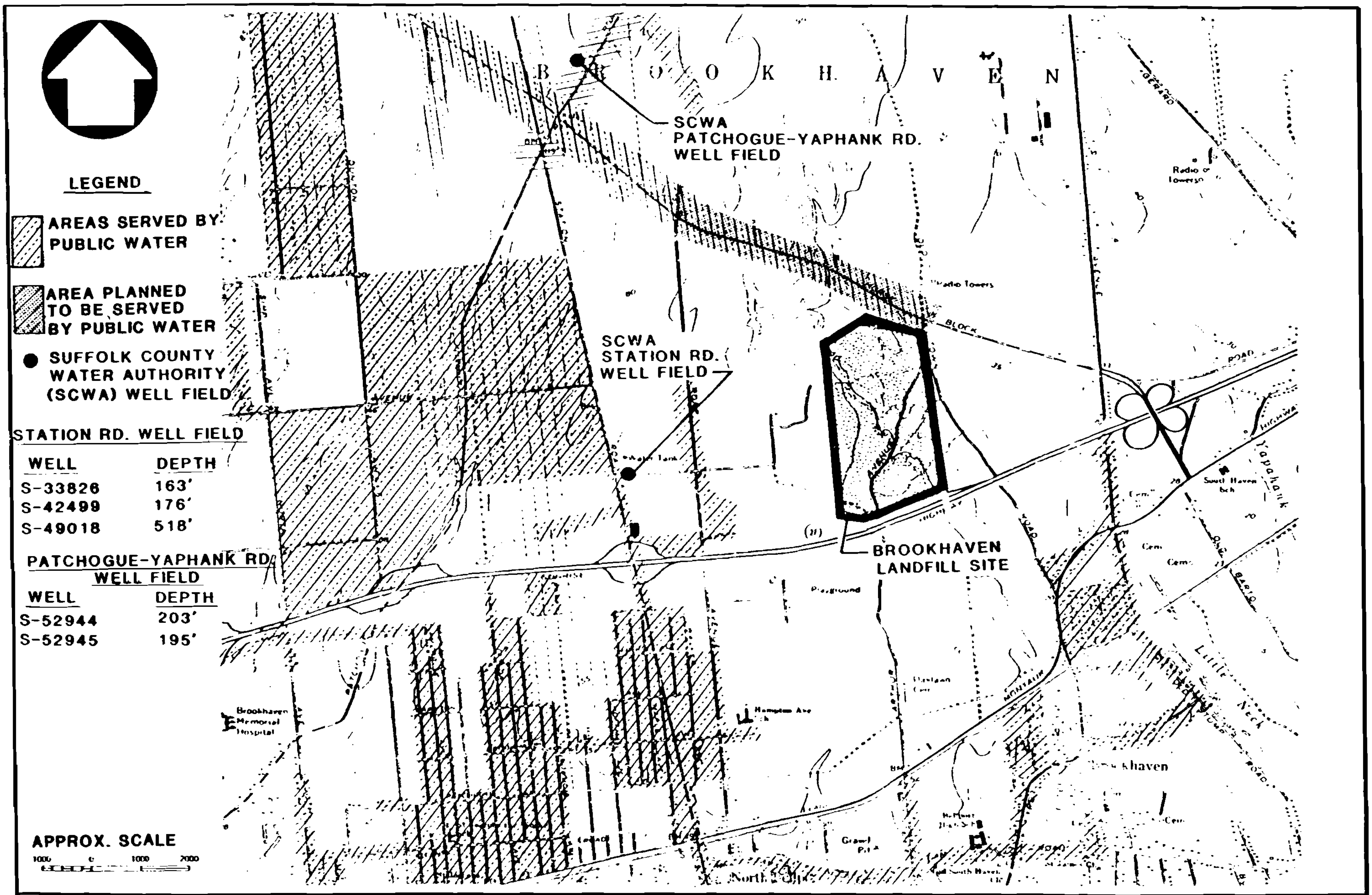
CONTOUR MAP OF WATER TABLE

FIGURE NO. 2-4



LEGEND

▨ AREAS SERVED BY PUBLIC WATER

▨ AREA PLANNED TO BE SERVED BY PUBLIC WATER

● SUFFOLK COUNTY WATER AUTHORITY (SCWA) WELL FIELD

STATION RD. WELL FIELD

WELL	DEPTH
S-33826	163'
S-42499	176'
S-49018	518'

PATCHOGUE-YAPHANK RD. WELL FIELD

WELL	DEPTH
S-52944	203'
S-52945	195'

TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

PUBLIC WATER SUPPLY WELLS AND AREAS SERVED BY PUBLIC WATER IN THE VICINITY OF THE SITE

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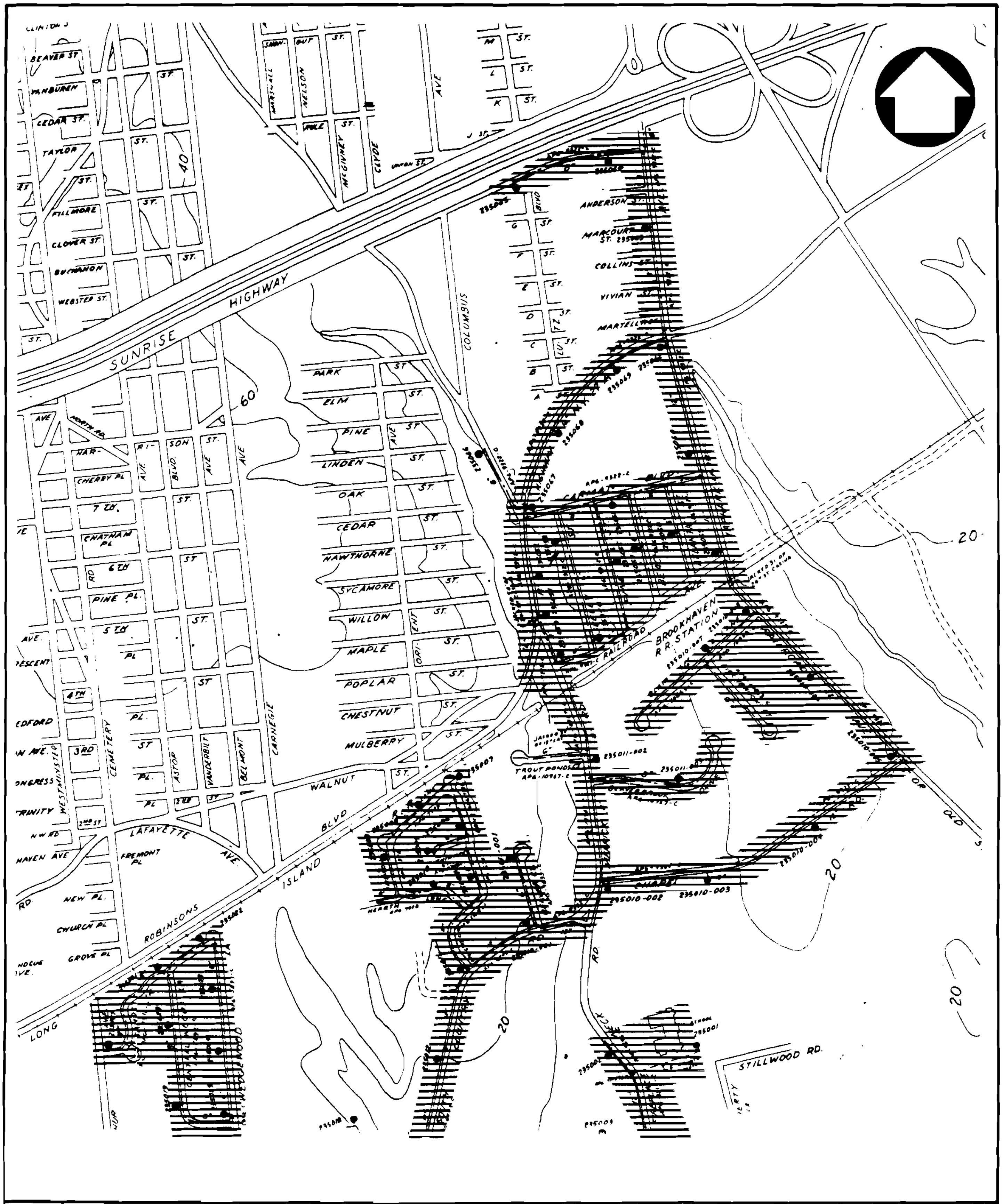
FIGURE NO. 2-5



TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

PUBLIC WATER SUPPLY WELLS AND AREAS SERVED BY PUBLIC WATER DOWN GRADIENT OF SITE

FIGURE NO. 2-6

Dvirka and Bartilucci
CONSULTING ENGINEERS

Table No. 2-1

MONITORING WELLS AROUND BROOKHAVEN LANDFILL

	Well	Diameter (inches)	Aquifer	Depth (feet)	Screen Top	Screen Bottom	Casing Material	Status
1	128			931	0	0		Test boring
2	3527			89	0	0		Observation
3	3529		Glacial	34	0	0		Observation
4	3529	2.0	Glacial	45	41	45	PVC	Observation
5	44574	2.0	Glacial	52	50	52	PVC	Observation
6	44575	2.0	Glacial	59	57	59	PVC	Observation
7	44576	2.0	Glacial	72	70	72	PVC	Observation
8	44577	2.0	Glacial	50	48	50	PVC	Observation
9	44578	2.0	Glacial	55	53	55	PVC	Observation
10	44581	2.0	Glacial	22	20	22	PVC	Observation
11	47439		Magothy	707	0	0		Test boring
12	47747	6.0	Glacial	34	22	32	Steel	Observation
13	66943			77	54	75		
14	72117		Glacial	64	60	64		Observation
15	72118	2.0	Glacial	52	48	52	PVC	Observation
16	72119		Glacial	54	50	54		Observation
17	72120		Glacial	52	48	52		Observation
18	72121	2.0	Glacial	66	62	66	PVC	Observation
19	72122		Glacial	72	68	72		Observation
20	72123		Glacial	23	19	23		Observation
21	72124	2.0	Glacial	43	39	43	PVC	Observation
22	72125		Glacial	64	60	64		Observation
23	72126		Glacial	63	59	63		Observation
24	72127	2.0	Glacial	54	50	54	PVC	Observation
25	72129		Glacial	44	40	44		Observation
26	72130		Glacial	23	19	23		Observation
27	72131	2.0	Glacial	55	51	55	PVC	Observation
28	72132		Glacial	62	58	62		Observation
29	72133		Glacial	61	57	61		Not found last time visited
30	72134	2.0	Glacial	34	30	34	PVC	Observation

Table No. 2-1 (continued)

MONITORING WELLS AROUND BROOKHAVEN LANDFILL

	Well	Diameter (inches)	Aquifer	Depth (feet)	Screen Top	Screen Bottom	Casing Material	Status
31	72136	2.0	Glacial	63	59	63	PVC	Observation
32	72138		Glacial	28	24	28		Observation
33	72140	2.0	Glacial	41	37	41	PVC	Observation
34	72141		Glacial	34	30	34		Observation
35	72143	2.0	Glacial	34	30	34	PVC	Observation
36	72144		Glacial	32	28	32		Observation
37	72149	6.0	Glacial	46	30	45	Steel	Fire well
38	72150	6.0	Glacial	47	32	47	Steel	Fire well
39	72151	6.0	Glacial	50	35	50	Steel	Fire well
40	72152	6.0	Glacial	49	34	49	Steel	Observation
41	72153	6.0	Glacial	48	33	48	Steel	Fire well
42	72159	6.0	Glacial	51	36	51		Observation
43	72160	6.0	Glacial	45	30	45	Steel	Fire well
44	72161		Glacial	42	27	42		Observation
45	72169		Glacial	46	31	46		Observation
46	72812	4.0	Magothy	198	189	194	PVC	Observation
47	72813	4.0	Magothy	219	210	215	PVC	Observation
48	72814		Magothy	178	170	175		Plugged
49	72815		Glacial	66	62	66		Observation
50	72816	2.0	Glacial	67	63	67	PVC	Observation
51	72817	2.0	Glacial	22	18	22	PVC	Observation
52	72818	2.0	Glacial	8	4	8	PVC	Observation
53	72819	2.0	Glacial	23	19	23	PVC	Observation
54	72820	2.0	Glacial	43	39	43	PVC	Observation
55	72821	2.0	Glacial	23	19	23	PVC	Observation
56	72822	2.0	Glacial	43	39	43	PVC	Observation
57	72823		Glacial	13	9	13		Observation
58	72824		Glacial	34	30	34		Observation
59	72825		Glacial	24	20	24		Observation
60	72826		Glacial	43	39	43		Observation
61	72827	2.0	Glacial	14	10	14	PVC	Observation

Table No. 2-1 (continued)

MONITORING WELLS AROUND BROOKHAVEN LANDFILL

	Well	Diameter (inches)	Aquifer	Depth (feet)	Screen		Casing Material	Status
					Top	Bottom		
62	72828	2.0	Glacial	33	29	33	PVC	Observation
63	72829		Glacial	33	29	33		Observation
64	72830		Glacial	53	49	53		Observation
65	72831		Glacial	56	52	56		Observation
66	72832		Glacial	72	68	72		Observation
67	72833	2.0	Glacial	72	68	72	PVC	Observation
68	72834	2.0	Glacial	34	30	34	Steel	Observation
69	72835		Glacial	64	60	64		Observation
70	72836	2.0	Glacial	54	50	54	PVC	Observation
71	72837	2.0	Glacial	73	69	73	PVC	Observation
72	72838		Glacial	64	60	64		Observation
73	73750	4.0	Glacial	34	29	34	Steel	Observation
74	73751	4.0	Glacial	55	50	55	Steel	Observation
75	73752	4.0	Glacial	85	80	85	Steel	Observation
76	73753	4.0	Glacial	34	29	34	Steel	Observation
77	73754	4.0	Glacial	54	49	54	Steel	Observation
78	73755	4.0	Glacial	85	80	85	Steel	Observation
79	73756	4.0	Glacial	103	98	103	Steel	Observation
80	73757	4.0	Glacial	73	68	73	Steel	Observation
81	73758	4.0	Glacial	53	48	53	Steel	Observation
82	73759	4.0	Glacial	128	123	128	Steel	Observation
83	73760	4.0	Glacial	65	60	65	Steel	Observation
84	73761	4.0	Glacial	85	80	85	Steel	Observation
85	73762		Glacial	115	110	115		Observation
86	73763	4.0	Glacial	140	135	140	Steel	Observation
87	73764	4.0	Glacial	58	53	58	Steel	Observation
88	73765	4.0	Glacial	78	73	78	Steel	Observation
89	73766	4.0	Glacial	108	103	108	Steel	Observation
90	73767	4.0	Glacial	63	58	63	Steel	Observation
91	73768	4.0	Glacial	79	74	79	Steel	Observation
92	73769		Glacial	82	77	82		Observation

Table No. 2-1 (continued)

MONITORING WELLS AROUND BROOKHAVEN LANDFILL

	Well	Diameter (inches)	Aquifer	Depth (feet)	Screen Top	Screen Bottom	Casing Material	Status
93	73770		Glacial	28	23	28		Observation
94	73943	1.5	Glacial	45	43	45	Steel	Observation
95	73944	1.5	Glacial	65	63	65	Steel	Observation
96	73945	1.5	Glacial	50	48	50	Steel	Observation
97	73946	1.5	Glacial	42	40	42	Steel	Observation
98	73947	1.5	Glacial	60	58	60	Steel	Observation
99	73948		Glacial	37	35	37		Observation
100	73953	2.0	Glacial	44	40	44	PVC	Observation
101	73954	2.0	Glacial	64	60	64	PVC	Observation
102	73955	2.0	Glacial	63	59	63	PVC	Observation
103	74774		Glacial	28	24	28		Observation
104	76380	1.0	Glacial	24	19	24	PVC	Observation
105	76381	1.0	Glacial	44	39	44	PVC	Observation
106	76382	1.0	Glacial	64	59	64	PVC	Observation
107	76383	1.0	Glacial	82	77	82	PVC	Observation
108	76384	1.0	Glacial	102	97	102	PVC	Observation
109	76385	1.0	Glacial	120	115	120	PVC	Observation
110	76386	1.0	Glacial	24	19	24	PVC	Observation
111	76387	1.0	Glacial	44	39	44	PVC	Observation
112	76388	1.0	Glacial	63	58	63	PVC	Observation
113	76389	1.0	Glacial	83	78	83	PVC	Observation
114	76390	1.0	Glacial	103	98	103	PVC	Observation
115	76391	1.0	Glacial	123	118	123	PVC	Observation
116	76392	1.0	Glacial	24	19	24	PVC	Observation
117	76393	1.0	Glacial	44	39	44	PVC	Observation
118	76394	1.0	Glacial	63	58	63	PVC	Observation
119	76395	1.0	Glacial	82	77	82	PVC	Observation
120	76396	1.0	Glacial	100	95	100	PVC	Observation
121	76397	1.0	Glacial	123	118	123	PVC	Observation
122	76398	1.0	Glacial	107	102	107	PVC	Observation
123	76399	1.0	Glacial	122	117	122	PVC	Observation

Table No. 2-1 (continued)

MONITORING WELLS AROUND BROOKHAVEN LANDFILL

	Well	Diameter (inches)	Aquifer	Depth (feet)	Screen		Casing Material	Status
					Top	Bottom		
124	76400	2.0	Glacial	69	64	69	Steel	Observation
125	76401	2.0	Glacial	89	84	89	Steel	Observation
126	78151	4.0	Magothy	164	156	161	PVC	Observation
127	95302	2.0	Glacial	147	142	147	PVC*	Observation
128	95303	2.0	Glacial	105	100	105	PVC*	Observation
129	95304	2.0	Glacial	141	136	141	PVC*	Observation
130	95305	2.0	Glacial	107	102	107	PVC*	Observation
131	95306	2.0	Glacial	143	138	143	PVC*	Observation
132	95307	2.0	Glacial	80	75	80	PVC*	Observation
133	95308	2.0	Glacial	143	138	143	PVC*	Observation
134	95309	2.0	Glacial	113	108	113	PVC*	Observation
135	95310	2.0	Glacial	142	137	142	PVC*	Observation
136	95311	2.0	Glacial	81	76	81	PVC*	Observation
137	95312	2.0	Glacial	75	70	75	PVC*	Observation
138	95313	2.0	Glacial	147	142	147	PVC*	Observation
139	95314	2.0	Glacial	76	71	76	PVC*	Observation
140	95315	2.0	Glacial	147	142	147	PVC*	Observation
141	95318	2.0	Glacial	75	70	75	PVC*	Observation
142	95319	2.0	Glacial	75	70	75	PVC*	Observation
143	95320	2.0	Glacial	145	140	145	PVC*	Observation
144	95321	2.0	Glacial	85	80	85	PVC*	Observation
145	95322	2.0	Glacial	95	90	95	PVC*	Observation
146	95323	2.0	Glacial	35	30	35	PVC*	Observation
147	95324	2.0	Glacial	45	40	45	PVC*	Observation
148	95325	2.0	Glacial	85	80	85	PVC*	Observation
149	95326	2.0	Glacial	85	80	85	PVC*	Observation
150	96201	2.0	Glacial	75	70	75	PVC*	Observation
151	96202	2.0	Glacial	148	143	148	PVC*	Observation

* These wells used threaded casing; all other PVC wells used chemical adhesives to join the casing.

2.4 Nature and Extent of Problem

Information used to determine the nature and extent of ground water contamination in the vicinity of the Brookhaven landfill was gathered primarily from the Town of Brookhaven and the United States Geological Survey. References for this information are contained in Section 8.0. Provided below is a brief description of historical water quality problems in the area of the landfill which was obtained from these references.

2.4.1 Historical Water Quality Problems in the Area

Early in the landfill's history, leachate was discovered overflowing the underliner along the eastern boundary of the site. The leachate was sampled in 1975 and again in 1978 and was found to contain high levels of iron, manganese and lead. Since 1976, the Town has routinely monitored ground water contiguous to the landfill, the results of which were provided to the New York State Department of Environmental Conservation and indicated elevated concentrations of iron, manganese and mangnesium.

In 1983, the USGS, in a study undertaken in cooperation with the Town, reported ground water contamination by both inorganic and organic chemicals, which prompted the Town of Brookhaven to supply public water to residences downgradient of the landfill. (The results of this study are discussed in more detail in Sections 2.4.2 and 2.4.3 below.) In 1985, the USGS sampled leachate and found elevated levels of benzene, 1,4-dichlorobenzene, ethylbenzene, toluene, phenols and lead. (It should be noted that the Brookhaven landfill was approved by NYSDEC to accept gasoline and oil-contaminated soil which may be a source of these contaminants.)

According to a Potential Hazardous Waste Site Preliminary Assessment report prepared by the United States Environmental Protection Agency (USEPA) in 1983 (Phase I Investigation, Appendix 1.4-13), there is contamination of the glacial aquifer downgradient of the Brookhaven landfill. According to this report, contamination was limited to iron, chloride and nitrate.

2.4.2 Leachate Parameters

Currently, the Town of Brookhaven samples selected wells near the Brookhaven landfill approximately twice a year for the parameters listed in Table No. 2-2. These parameters can be used to characterize landfill leachate and, with sufficient data, can also assist in defining plumes of ground water contaminated by leachate.

Table No. 2–2

LIST OF LANDFILL LEACHATE PARAMETERS ROUTINELY MONITORED BY THE TOWN OF BROOKHAVEN

pH	at 20°C
Specific Conductance	(umho/cm)
Total Alkalinity	(mg/l)
Bicarbonate Alkalinity	(mg/l)
Chloride	(mg/l)
Ammonia	(mg/l)
Nitrite	(mg/l)
Nitrate	(mg/l)
Sulfate	(mg/l)
Total Dissolved Solids	(mg/l)
Total Kjeldahl Nitrogen	(mg/l)
Calcium	(mg/l)
Iron	(mg/l)
Potassium	(mg/l)
Magnesium	(mg/l)
Manganese	(mg/l)
Sodium	(mg/l)
Lead	(mg/l)
Selenium	(mg/l)

The USGS (Kimmel and Braids [1980]) has shown that the concentration of each of the major cations and anions is usually less than 10 mg/l in natural, uncontaminated ground water in the upper glacial aquifer in southern Suffolk County. Chemical analyses of native water in this area is given in Table No. 2-3.

Kimmel and Braids found that native ground water is altered by increased concentrations of bicarbonate (HCO_3-), sulfate (SO_4-), chloride (Cl-) and sodium (NA+), and high measurements of specific conductance as a result of landfill leachate. However, alterations of ground water quality can also result from on-site sewage disposal and road salt used for deicing, as well as other sources of contamination.

The above factors can complicate source identification when analyzing data. Therefore, it is not always possible to determine whether the source of elevated concentrations of any single parameter is attributable to leachate emanating from a landfill source. However, when these parameters taken as a whole are elevated, indications are that the source is landfill leachate. The USGS has found that leachate-enriched ground water generally has greater dissolved solids and corresponding higher specific conductance.

Based on the cooperative ground water investigation conducted by the Town of Brookhaven and USGS from 1981 to 1983, which involved the collection of samples from 74 on-site and off-site wells for analysis of inorganic leachate indicator parameters, an area of ground water with levels of bicarbonate, sulfate, chloride and sodium above ambient conditions were found to extend about 3,000 feet downgradient of the landfill.

In addition to the four leachate indicators discussed above, elevated concentrations of iron, manganese, magnesium and lead were also found in the area of impacted ground water. The plume of ground water contamination as defined by chloride in 1982, is illustrated in Figure No. 2-7.

2.4.3 Volative Organic Compounds

As part of the joint Town and USGS ground water investigation conducted in 1982, 23 of the 74 monitoring wells were sampled and analyzed for USEPA priority pollutant volatile, base neutral and acid-extractable organic compounds, dissolved organic carbon (DOC), and selected inorganic constituents. As shown in Table No. 2-4, 13 priority pollutants were detected, including benzene, chlorobenzene, ethylbenzene and napthalene.

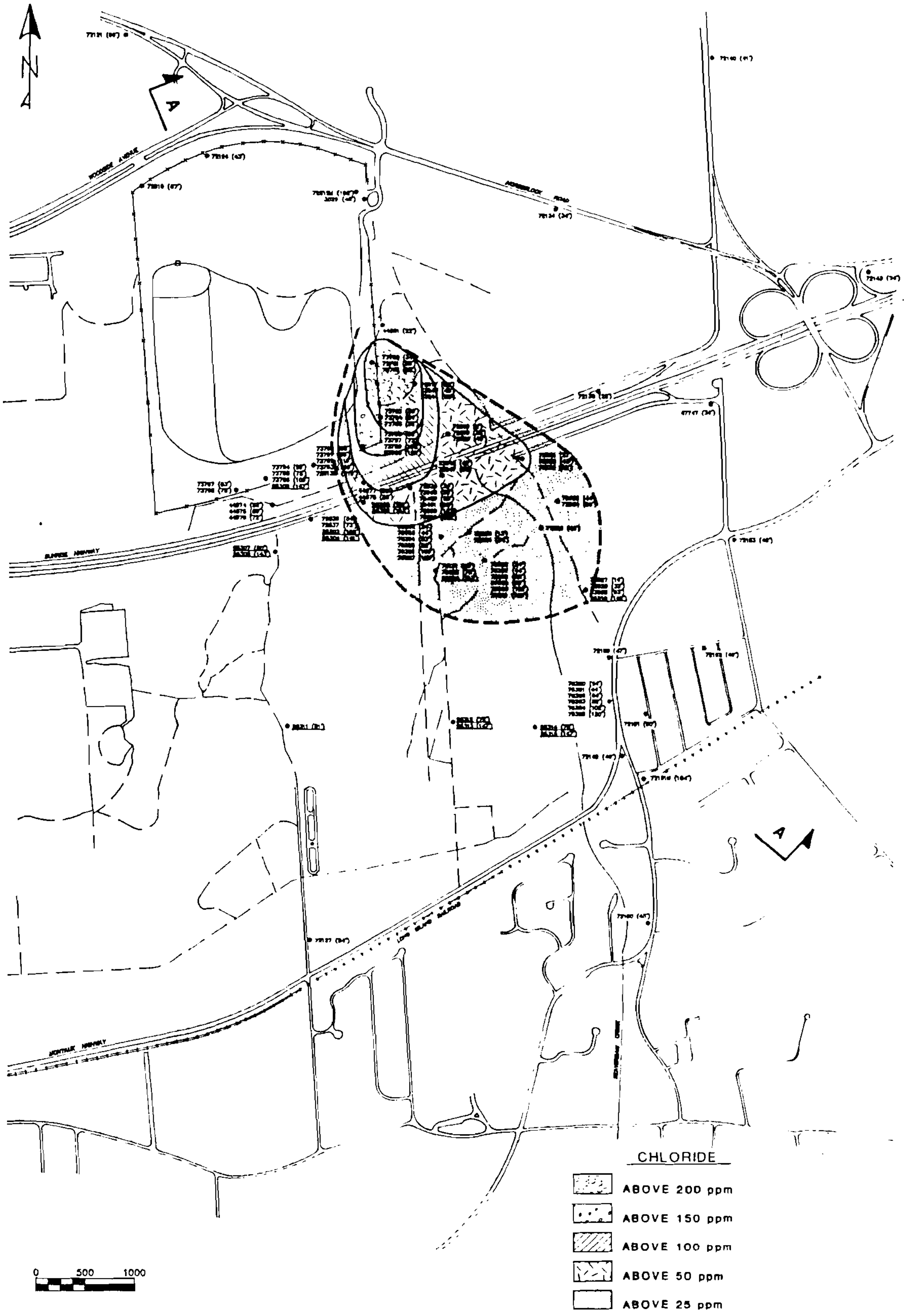
Constituents and characteristics	Well No and date of sample collection						
	B17C - 68	11C - 99	15A - 28	17A - 33	18A - 25		134D - 130
	2 - 9 - 72	3 - 9 - 72	2 - 17 - 72	11 - 16 - 73	2 - 24 - 72	5 - 16 - 73	10 - 19 - 73
Major constituents (mg/L)							
Silica (SiO_2)	13	12	7.9	4.6	6.1	6.0	14
Iron (Fe), total	2.2	.1	.05	.58	.05	.15	.21
Manganese (Mn)	.04	.07	.0	.0	.02	.10	.02
Calcium (Ca)	4.2	2.0	3.5	5.0	1.7	2.2	2.2
Magnesium (Mg)	1.0	.8	1.8	1.7	.8	.9	1.2
Sodium (Na)	4.7	4.0	5.6	4.5	3.5	3.7	4.0
Potassium (K)	.70	.4	1.5	.6	.6	.4	.5
Bicarbonate (HCO_3)	16	10	9.0	7.0	2.5	3.0	15
Sulfate (SO_4)	8.0	.5	13	10	7.5	8.0	.4
Chloride (Cl)	6.7	7.0	6.7	6.2	5.5	6.0	4.5
Fluoride (F)	.0	.1	.0	.1	.0	.6	.2
Nitrate as N	.27	.20	.80	.54	.10	------	.03
Nitrite as N	.02	.005	.24	.0	.002	------	.0
Ammonia as N	.13	.04	.54	.01	.080	------	.01
Nitrogen, organic as N	.29	.35	.45	.09	.520	.0	.0
Phosphorus, as P	.04	.06	.28	.0	.10	.0	.01
Trace elements (µg/L)							
Arsenic (As)	0.0	3	11	0.0	0.0	------	------
Copper (Cu)	0	0	0	0	0	------	------
Lead (Pb)	4.0	.8	4.0	0	2	------	------
Mercury (Hg)	<.5	<.5	<.5	.8	.8	------	------
Nickel (Ni)	2.0	4.0	4.0	------	7	------	------
Selenium (Se)	0.0	2.0	.0	------	8	------	------
Zinc (Zn)	20	.0	40	30	20	.0	50
Other characteristics							
Dissolved solids (sum, mg/L)	47	33	51	36	28	29	34
Specific conductance (µmho/cm at 25°C)	66	45	73	72	43	46	73
pH	6.8	6.7	6.4	5.9	5.4	5.3	7.2
Temperature (°C)	11	11	13	12	11	11	11
Depth of screen below water table (ft)	65	67	12	13	14	14	110

SOURCE: USGS PROFESIONAL PAPER 1085, 1980

Dvirka
and
Bartilucci
CONSULTING ENGINEERS

CHEMICAL ANALYSIS OF NATIVE LONG ISLAND GROUNDWATER

TABLE 2-3



TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

Dvirka
and
Bartilucci
CONSULTING ENGINEERS

LINES OF EQUAL CONCENTRATION
CHLORIDE - 1982

FIGURE NO. 2-7

TABLE NO. 2-4

ORGANIC "PRIORITY POLLUTANTS" DETECTED IN LEACHATE AND GROUND WATER IN VICINITY OF BROOKHAVEN LANDFILL SITE, JULY AND AUGUST 1983

	Sampling date											
	7-6-83				8-24-83						8-25-83	
Constituent	Leachate	S72817	S73750	S73759	S72826	S72834	S73750	S73753	S73759	S73954	S73757	S73758
Volatile organic compounds												
Benzene (μg/L)	9	<1	9	<1	<1	3	13	5	<1	<1	4	9
Chlorobenzene (μg/L)	23	<1	21	<1	<1	<1	23	7	<1	<1	<1	8
Ethylbenzene (μg/L)	55	<1	27	<1	<1	6	34	7	<1	<1	<1	28
Toluene (μg/L)	4	<1	3	<1	<1	<1	<1	<1	<1	<1	<1	<1
Methylene chloride (μg/L)	<1	<1	2	<1	<1	<1	28	<1	<1	<1	<1	17
Trichloroethylene (μg/L)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	11
Chloroform (μg/L)	<1	<1	1	<1	4	<1	<1	<1	<1	5	<1	<1
Base/neutral-extractables												
Napthalene (μg/L)	19	<1	5	<1	<1	<1	8	<1	<1	<1	<1	<1
1,4-Dichlorobenzene (μg/L)	<1	<1	<1	<1	<1	2	5	2	<1	<1	<1	7
Diethyl phthalate (μg/L)	<1	<1	18	13	<1	<1	4	<1	10	<1	5	<1
2-Ethylhexyl phthalate (μg/L)	<1	<1	20	<1	<1	8	<1	<1	<1	<1	<1	<1
Di-n-butyl phthalate (μg/L)	<1	<1	7	<1	<1	<1	<1	<1	<1	<1	<1	<1
n-Nitrosodimethylamine (μg/L)	<1	<1	6	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dissolved organic carbon (mg/L)	410	36	180	16	32	21	160	53	13	3.4	35	31

ORGANIC NONPRIORITY POLLUTANTS DETECTED IN LANDFILL LEACHATE IN VICINITY OF BROOKHAVEN LANDFILL, JULY 6, 1983

Compound	Concentration (μg/L)
1,2-Dimethylbenzene	11.0
1,7,7-Trimethylbicyclo(2.2.1)heptan-2-one	178.0
1,3-Isobenzofurandione	23.6
3,5-Dimethylbenzoic acid	212.0
N-(1,1-Dimethylethyl)-4-methylbenzamide	83.6
4-Methylbenzenesulfonyl chloride	35.0
3-[(3,5-Dimethyl-4-isoxazoly)methyl]-2,4-pentanedione	77.2
2(3H)-Benzathiazolone	430.0

The most commonly detected compound was benzene, which was found in the leachate and in samples from five wells. The priority pollutant having the highest concentration (55 ug/l in landfill leachate) was ethylbenzene. No TCDD (dioxin) or vinyl chloride were detected in any of the samples (1 ug/l detection limit).

A sample from a well along the eastern boundary of the site (Well No. 737501) was the most contaminated of all samples tested. Eleven priority pollutants and the highest DOC concentration of all wells were found in the sample from this well. Other wells along the eastern and southern boundaries of this site also contained detectable concentrations of priority pollutants. A sample from one well (72834), 500 feet south and downgradient of the site, contained priority pollutant concentrations totaling less than 20 ug/l. Samples from two wells 2,000 feet downgradient of the site contained trace amounts of chloroform, but this is not believed to be associated with the landfill and may be the result of laboratory contamination. DOC concentrations decrease rapidly downgradient of the landfill and approach background values 1/2 mile from the site.

2.4.4 Results Recent Analysis of Water Quality

In 1989, again as part of a Town of Brookhaven and USGS cooperative ground water investigation, 57 monitoring wells were sampled for leachate indicator parameters and 17 of the same wells were sampled and analyzed for organic compounds (volatile organic chemicals).

Levels of leachate indicators, in particular ammonia, were elevated beyond expected concentrations for native Long Island ground water in a number of wells in the immediate vicinity of and downgradient of the landfill.

Based on data from the 57 wells sampled in 1989, which is provided in Table Nos. 2-5, 2-6 and 2-7, leachate parameters that exceed New York State water quality standards and guidelines are primarily total dissolved solids, ammonia, iron, manganese and lead.

Figure No. 2-8 illustrates the definition of the landfill leachate plume resulting from the 1989 sampling program as defined by the chloride levels above ambient conditions. As shown in this figure, it appears that the plume has migrated about 2,500 feet since 1982 (a migration rate of approximately 1 foot per day), and now extends 5,000 to 5,500 feet downgradient from the landfill.

TABLE NO. 2-5

Brookhaven Landfill
Ground Water Sampling
Summer/Fall 1989 Leachate Parameter Results
(0 - 50 Feet)

												Upgradiant Well Results	
Well Number:		72138	72152	72153	72821	72822	72827	72828	76381	76393	NYSDEC Class GA	3529	72124
Well Depth:		28'	49'	48'	23'	43'	14'	33'	44'	44'	Ground Water	45'	43'
Sample Date:		August 24	August 22	August 22	August 24	August 24	August 22	August 22	August 23	August 24	Standards/Guidelines* (mg/L)	October 24	August 24
Parameters													
pH		4.67	5.12	4.67	5.4	5.28	5.24	5.41	6.38	6.56	—	5.40	4.91
Specific Conductance	(umho/cm)	49	296	147	322	214	178	334	900	1650	—	409	393
Total Alkalinity	(mg/L)	2	38	9	88	83	20	70	327	573	—	3	5
Bicarbonate Alkalinity	(mg/L)	2	38	9	88	63	20	70	327	573	—	3	5
Chloride	(mg/L)	7	55	29	43	20	18	47	85	156	250.0 ST	102	103
Ammonia as N	(mg/L)	< 0.04	2.6	0.05	7.0	2.6	1.8	8.9	42.0	84.8	—	< 0.04	0.84
Nitrite	(mg/L)	0.02	0.01	0.01	< 0.01	< 0.01	0.01	0.01	< 0.01	0.02	—	< 0.04	< 0.01
Nitrate	(mg/L)	< 0.04	< 0.04	0.32	< 0.04	0.53	< 0.04	< 0.04	< 0.04	< 0.04	10.0 ST	0.38	3.8
Sulfate	(mg/L)	4	26	15	25	10	28	22	3	3	250.0 ST	14	7
Total Dissolved Solids	(mg/L)	31	138	76	170	113	95	151	438	728	—	230	210
Total Kjeldahl Nitrogen	(mg/L)	< 0.04	3.5	0.40	10.1	3.6	2.5	10.9	45.6	90.8	—	< 0.4	6.6
Calcium	(mg/L)	6.3	11.2	10.4	16.1	13.3	8	14.9	18.1	21.0	—	6.2	12.1
Iron	(mg/L)	0.07	1.3 **	0.40 **	0.08	0.11	1.1 **	0.20	0.05	30.2 **	0.3 ST	< 0.1	0.21
Potassium	(mg/L)	< 0.4	1.1	< 0.40	8.7	7.0	2.4	5.6	32.6	83.3	—	< 5	1.1
Magnesium	(mg/L)	2.0	4.8	3.6	6.4	4.5	6.6	5.8	10.3	20.6	35.0 GV	< 5	3.8
Manganese	(mg/L)	0.02	2.1 **	0.05	22.2 **	16.2 **	0.25	0.66 **	23.5 **	3.9 **	0.3 ST	0.25	1.6 **
Sodium	(mg/L)	5.2	35.9	17.7	13.3	10.4	15.8	34.2	58.0	119	—	59.5	58.8
Lead	(mg/L)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.025 ST	< 0.02	< 0.02
Selenium	(mg/L)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.020 ST	< 0.005	< 0.005
Test Laboratory		Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest		Nytest	Nytest

* ST = Standard GV = Guidance Value

** Exceeded the NYSDEC Class GA Ground Water Standard or Guideline Value.

TABLE NO. 2-6

Brookhaven Landfill
Ground Water Sampling
Summer/Fall 1989 Leachate Parameter Results
(50 - 160 Feet)

Well Number:		72127	72136	72151	72833	72836	72837	73751	73752	73754	73757	NYSDEC Class GA	Upgradiant Well Results 72816
Well Depth:		54'	63'	50'	72'	54'	73'	55'	85'	54'	73'	Ground Water	67'
Sample Date:		August 22	August 24	August 22	August 22	August 22	August 22	October 11	October 11	August 28	August 29	Standards/Guidelines* (mg/L)	August 24
Parameters													
pH		4.67	5.23	5.50	6.31	6.11	6.09	6.13	6.33	6.43	6.81	—	5.12
Specific Conductance	(umho/cm)	54	106	336	1164	290	669	118	190	133	1826	—	52
Total Alkalinity	(mg/L)	4	9	105	372	88	235	4	7	35	444	—	6
Bicarbonate Alkalinity	(mg/L)	4	9.	105	372	88	235	4	7	35	444	—	6
Chloride	(mg/L)	8	15	44	159	19	63	28	9	19	212	250.0 ST	16
Ammonia as N	(mg/L)	< 0.04	0.79	1.0	3.2	14.4	36.2	< 0.04	< 0.04	6.2	110	—	< 0.04
Nitrite	(mg/L)	< 0.01	0.06	< 0.01	< 0.01	0.01	0.01	< 0.04	< 0.04	< 0.01	0.03	—	< 0.01
Nitrate	(mg/L)	< 0.04	2.0	< 0.04	< 0.04	< 0.04	< 0.04	0.27	6.58	0.18	< 0.04	10.0 ST	< 0.04
Sulfate	(mg/L)	36	9	4	5	17	5	7	34	12	13	250.0 ST	11
Total Dissolved Solids	(mg/L)	47	54	169	690	105	328	73	117	45	737	—	29
Total Kjeldahl Nitrogen	(mg/L)	0.32	3.2	1.5	5.4	16.1	39.8	< 0.4	3.3	8.2	116	—	0.52
Calcium	(mg/L)	6.9	10.8	26.4	62.8	6.9	13.7	< 5	14.9	5.8	16.4	—	8
Iron	(mg/L)	0.08	0.16	0.57 **	1.4 **	8.6 **	26.9 **	< 0.1	< 0.1	0.72 **	9.1 **	0.3 ST	0.18
Potassium	(mg/L)	< 0.40	1.1	0.99	5.5	12.9	28.3	< 5	< 5	6.3	79.4	—	1.8
Magnesium	(mg/L)	2.1	4.6	13.0	25.7	2.6	6.4	< 5	7.7	1.5	13.1	35.0 GV	2.4
Manganese	(mg/L)	0.02	0.03	0.03	75.1 **	1.5 **	4.2 **	0.02	0.01	0.11	8.32 **	0.3 ST	0.12
Sodium	(mg/L)	4.7	8.0	21.3	94.9	22.4	42.5	18.4	8.4	13.1	99.6	—	5.4
Lead	(mg/L)	< 0.02	< 0.02	0.0353 **	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.025 ST	< 0.02
Selenium	(mg/L)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.020 ST	< 0.005
Test Laboratory		Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest		Nytest

* ST = Standard GV = Guidance Value

** Exceeded the NYSDEC Class GA Ground Water Standard or Guideline Value.

TABLE NO. 2-6

Brookhaven Landfill
Ground Water Sampling
Summer/Fall 1989 Leachate Parameter Results
(50 - 160 Feet)

													Upgradiant Well Results
Well Number:		73759	73760	73761	73763	73765	73766	73767	73768	73945	73954	NYSDEC Class GA	72816
Well Depth:		123'	65'	85'	140'	78'	108'	63'	79'	50'	64'	Ground Water	67'
Sample Date:		August 29	August 29	October 11	August 29	August 29	August 29	August 24	August 24	August 23	August 22	Standards/Guidelines* (mg/L)	August 24
Parameters													
pH		6.35	6.22	7.06	6.37	6.64	6.50	6.33	6.18	6.63	5.70	—	5.12
Specific Conductance	(umho/cm)	1961	1837	1810	2200	2110	1940	688	1030	1563	178	—	52
Total Alkalinity	(mg/L)	63	32	796	53	466	65	202	358	672	14	—	6
Bicarbonate Alkalinity	(mg/L)	63	32	796	53	466	65	202	358	672	14	—	6
Chloride	(mg/L)	267 **	162	124	303 **	226	239	74	104	151	9	250.0 ST	16
Ammonia as N	(mg/L)	35.8	109	102	61	139	104	33.8	46.2	88.8	< 0.04	—	< 0.04
Nitrite	(mg/L)	< 0.01	0.03	< 0.04	0.04	0.02	0.03	< 0.01	< 0.01	0.03	< 0.01	—	< 0.01
Nitrate	(mg/L)	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	0.28	< 0.04	< 0.04	4.92	10.0 ST	< 0.04
Sulfate	(mg/L)	3	19	5	5	10	5	31	4	4	32	250.0 ST	11
Total Dissolved Solids	(mg/L)	1100	696	1070	1100	1210	797	269	421	614	89	—	29
Total Kjeldahl Nitrogen	(mg/L)	37.3	123	113	64	139	115	32.4	40.8	84.0	6.4	—	0.52
Calcium	(mg/L)	108	33.4	17.1	100	18	34.5	15.5	19.2	23.3	16.1	—	8
Iron	(mg/L)	66.8 **	45.4 **	21.2 **	43.8 **	18.7 **	23.6 **	11.1 **	34.4 **	10.6 **	0.09	0.3 ST	0.18
Potassium	(mg/L)	26.1	76.5	86.1	27.6	86.2	62.2	27.4	39	80.5	0.58	—	1.8
Magnesium	(mg/L)	46.4 **	17	14.6	43.1 **	12.3	13.6	6.5	17.4	16.3	7.1	35.0 GV	2.4
Manganese	(mg/L)	25.5 **	4 **	8.3 **	7.8 **	2 **	3.9 **	2.0 **	12.3 **	0.62 **	0.08	0.3 ST	0.12
Sodium	(mg/L)	129	88.5	155	145	114	109	47.3	81.7	112	11.5	—	5.4
Lead	(mg/L)	< 0.02	0.0473 **	< 0.02	< 0.02	0.0472 **	< 0.02	< 0.02	< 0.02	< 0.02	0.0325 **	0.025 ST	< 0.02
Selenium	(mg/L)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.020 ST	< 0.005
Test Laboratory		Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest		Nytest

* ST = Standard GV = Guidance Value

** Exceeded the NYSDEC Class GA Ground Water Standard or Guideline Value.

TABLE NO. 2-6

Brookhaven Landfill
Ground Water Sampling
Summer/Fall 1989 Leachate Parameter Results
(50 - 160 feet)

												Upgradiant Well Results
Well Number:		73955	76383	76385	76388	76390	76391	76395	76397	76399	95302	NYSDEC Class GA	72816
Well Depth:		63'	82'	120'	63'	103'	123'	82'	123'	122'	147'	Ground Water	67'
Sample Date:		August 24	August 23	August 23	August 29	August 29	August 29	August 24	August 24	August 23	October 25	Standards/Guidelines* (mg/L)	August 24
Parameters													
pH		6.12	5.94	5.43	6.73	6.48	6.36	6.37	6.42	6.21	6.7	—	5.12
Specific Conductance	(umho/cm)	629	487	54	1737	1173	941	998	1090	1110	1790	—	52
Total Alkalinity	(mg/L)	203	176	15	74	141	118	416	468	544	527	—	6
Bicarbonate Alkalinity	(mg/L)	203	176	15	74	141	118	416	468	544	527	—	6
Chloride	(mg/L)	77	58	3	192	114	101	99	99	121	237	250.0 ST	16
Ammonia as N	(mg/L)	< 0.04	< 0.04	< 0.04	85.0	0.36	< 0.04	1.4	0.17	3.6	36.1	—	< 0.04
Nitrite	(mg/L)	< 0.01	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.04	—	< 0.01
Nitrate	(mg/L)	< 0.04	< 0.04	< 0.04	0.09	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	10.0 ST	< 0.04
Sulfate	(mg/L)	16	2	4	3	4	3	2	2	2	3	250.0 ST	11
Total Dissolved Solids	(mg/L)	329	264	30	893	734	551	556	614	647	1070	—	29
Total Kjeldahl Nitrogen	(mg/L)	0.55	0.27	0.04	93.4	1.0	0.62	2.7	0.94	6.0	38.3	—	0.52
Calcium	(mg/L)	46.1	45.3	10.9	13.4	91.3	80.6	83.2	84.9	84.9	73.4	—	8
Iron	(mg/L)	0.21	0.28	0.25	0.06	0.07	0.84 **	38.7 **	2.5 **	0.10	58.2 **	0.3 ST	0.18
Potassium	(mg/L)	2.0	1.1	< 0.40	79.6	2.4	1.8	2.2	0.74	4.2	22.4	—	1.8
Magnesium	(mg/L)	20.1	20.1	2.4	13.2	46.4 **	43.0 **	35.5 **	39.7 **	37.8 **	35.4 **	35.0 GV	2.4
Manganese	(mg/L)	0.1	1.5 **	0.08	44.3 **	30.8 **	8.3 **	18.7 **	14.2 **	6.2 **	13.6 **	0.3 ST	0.12
Sodium	(mg/L)	49.6	21.4	4.5	99.4	59.0	40.9	57.8	85.7	67.7	184	—	5.4
Lead	(mg/L)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.025 ST	< 0.02
Selenium	(mg/L)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.020 ST	< 0.005
Test Laboratory		Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest		Nytest

* ST = Standard GV = Guidance Value

** Exceeded the NYSDEC Class GA Ground Water Standard or Guideline Value.

TABLE NO. 2-6

Brookhaven Landfill
Ground Water Sampling
Summer/Fall 1989 Leachate Parameter Results
(50 - 160 Feet)

												Upgradiant Well Results
Well Number:		95303	95304	95305	95306	95307	95308	95309	95310	95311	95312	NYSDEC Class GA	72816
Well Depth:		105'	141'	107'	143'	80'	143'	113'	142'	81'	75'	Ground Water	67'
Sample Date:		October 23	October 23	October 24	October 23	October 18	October 18	October 12	October 12	October 18	October 18	Standards/Guidelines* (mg/L)	August 24
Parameters													
pH		6.51	6.64	7.03	6.85	6.65	6.8	6.94	6.6	6.28	5.58	—	5.12
Specific Conductance	(umho/cm)	676	979	2300	831	740	765	1470	60.8	54.7	212	—	52
Total Alkalinity	(mg/L)	218	458	722	384	214	312	628	15	2	17	—	6
Bicarbonate Alkalinity	(mg/L)	218	458	722	384	214	312	628	15	2	17	—	6
Chloride	(mg/L)	79	69	143	54	88	90	105	79	5	34	250.0 ST	16
Ammonia as N	(mg/L)	19.5	26.6	118	< 0.04	18.7	0.26	19.1	< 0.04	0.06	0.06	—	< 0.04
Nitrite	(mg/L)	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	—	< 0.01
Nitrate	(mg/L)	0.04	< 0.04	< 0.04	< 0.04	< 0.04	0.38	< 0.04	< 0.04	< 0.04	0.09	10.0 ST	< 0.04
Sulfate	(mg/L)	< 1	3	5	< 1	7	8	< 1	< 1	9	26	250.0 ST	11
Total Dissolved Solids	(mg/L)	447	604	1400	511	529	507	903	34	31	135	—	29
Total Kjeldahl Nitrogen	(mg/L)	20.5	26.7	167	< 0.4	22.5	0.5	22	0.11	0.08	0.82	—	0.52
Calcium	(mg/L)	12.9	42.5	25.7	12.8	< 5	15.9	106	5.3	< 5	< 5	—	8
Iron	(mg/L)	37.6 **	1 **	8.8 **	37.7 **	< 0.1	< 0.1	2.4 **	0.35 **	< 0.1	< 0.1	0.3 ST	0.18
Potassium	(mg/L)	27.5	26.8	103	26.5	6.6	< 5	11.7	< 5	< 5	< 5	—	1.8
Magnesium	(mg/L)	10.9	26	15.4	10.9	< 5	0.4	35.6	< 5	< 5	< 5	35.0 GV	2.4
Manganese	(mg/L)	7	19.8	0.47	7	9	0.11	24.9	0.12	< 0.015	1.5 **	0.3 ST	0.12
Sodium	(mg/L)	59.8	58	157	59.8	18.4	17.4	128	< 5	< 5	7.5	—	5.4
Lead	(mg/L)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.02	< 0.02	0.02	0.06 **	0.03 **	0.025 ST	< 0.02
Selenium	(mg/L)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.020 ST	< 0.005
Test Laboratory		Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest	Nytest		Nytest

* ST = Standard GV = Guidance Value

** Exceeded the NYSDEC Class GA Ground Water Standard or Guideline Value.

TABLE NO. 2-6

Brookhaven Landfill
Ground Water Sampling
Summer/Fall 1989 Leachate Parameter Results
(50 - 160 Feet)

Well Number:		95313	95314	95315	NYSDEC Class GA
Well Depth:		147'	76'	147'	Ground Water
Sample Date:		October 17	October 12	October 17	Standards/Guidelines* (mg/L)
Parameters					
pH		6.57	6.87	6.55	--
Specific Conductance	(umho/cm)	56.1	938	52.9	--
Total Alkalinity	(mg/L)	12	364	14	--
Bicarbonate Alkalinity	(mg/L)	12	364	14	--
Chloride	(mg/L)	6	77.8	6	250.0 ST
Ammonia as N	(mg/L)	0.08	< 0.04	0.07	--
Nitrite	(mg/L)	< 0.04	< 0.04	< 0.04	--
Nitrate	(mg/L)	< 0.04	< 0.04	< 0.04	10.0 ST
Sulfate	(mg/L)	3	< 1	3	250.0 ST
Total Dissolved Solids	(mg/L)	32	592	41	--
Total Kjeldahl Nitrogen	(mg/L)	0.52	0.41	0.58	--
Calcium	(mg/L)	< 5	69.6	< 5	--
Iron	(mg/L)	< 0.1	0.02	< 0.1	0.3 ST
Potassium	(mg/L)	< 5	< 5	< 5	--
Magnesium	(mg/L)	< 5	38.4 **	< 5	35.0 GV
Manganese	(mg/L)	0.18	0.04	0.09	0.3 ST
Sodium	(mg/L)	< 5	89	< 5	--
Lead	(mg/L)	< 0.02	0.03 **	< 0.02	0.025 ST
Solenium	(mg/L)	< 0.005	< 0.005	< 0.005	0.020 ST
Test Laboratory		Nytest	Nytest	Nytest	

* ST = Standard GV = Guidance Value

** Exceeded the NYSDEC Class GA Ground Water Standard or Guideline Value.

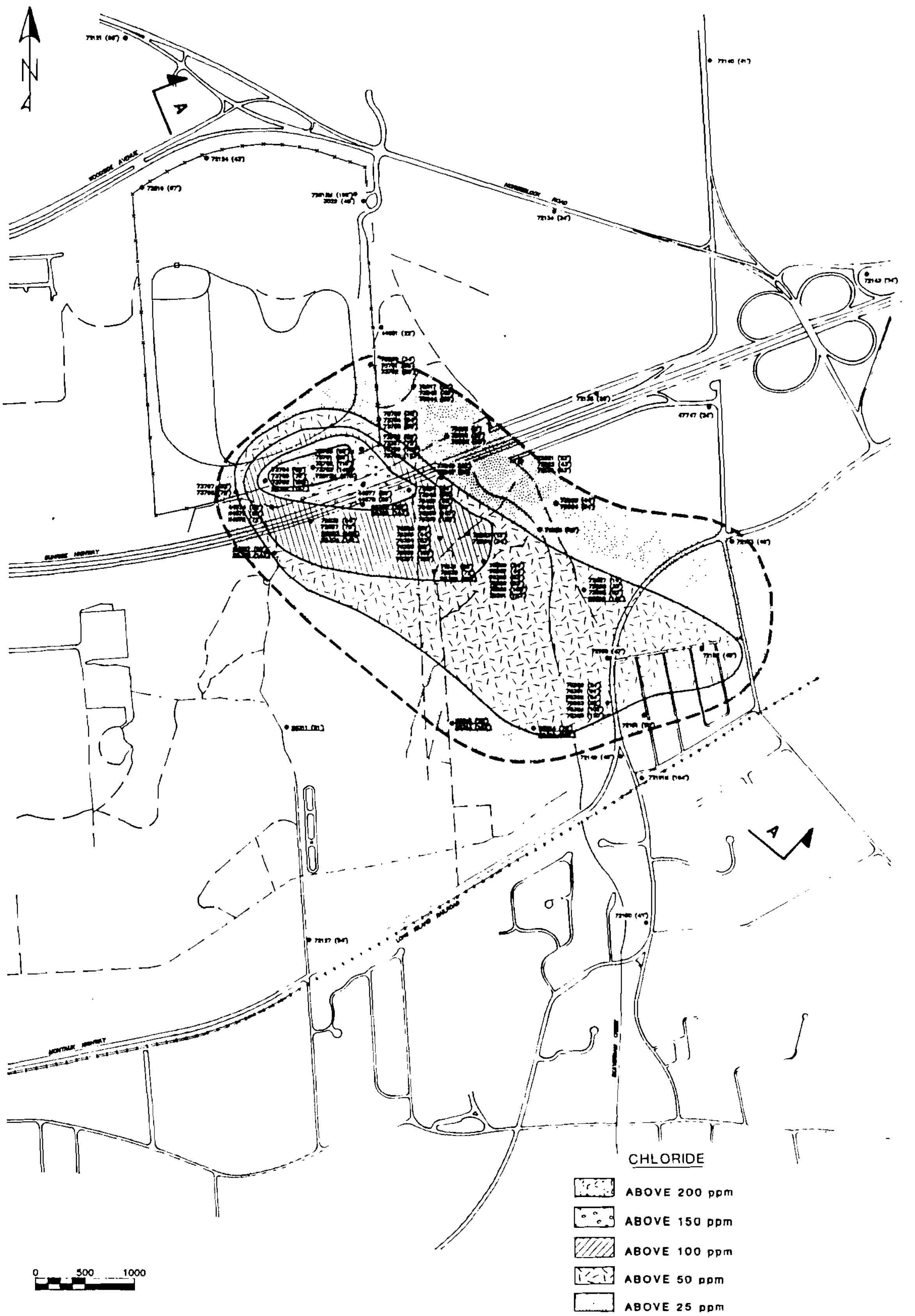
TABLE NO. 2-7

Brookhaven Landfill
Ground Water Sampling
Summer/Fall 1989 Leachate Parameter Results
(160 - 220 Feet)

					· Upgradiant Well Results
Well Number:		72813	78151	NYSDEC Class GA	72812
Well Depth:		219'	164'	Ground Water	198'
Sample Date:		August 28	August 24	Standards/Guidelines* (mg/L)	August 28
Parameters					
pH		5.52	5.77	--	6.08
Specific Conductance	(umho/cm)	53	67	--	75
Total Alkalinity	(mg/L)	13	22	--	41
Bicarbonate Alkalinity	(mg/L)	13	22	--	41
Chloride	(mg/L)	5	4	250.0 ST	7
Ammonia as N	(mg/L)	< 0.04	< 0.04	--	0.04
Nitrite	(mg/L)	< 0.01	< 0.01	--	< 0.01
Nitrate	(mg/L)	< 0.04	< 0.04	10.0 ST	2.7
Sulfate	(mg/L)	5	3	250.0 ST	2
Total Dissolved Solids	(mg/L)	31	44	--	41
Total Kjeldahl Nitrogen	(mg/L)	< 0.04	< 0.04	--	2.9
Calcium	(mg/L)	8.4	10.0	--	9.4
Iron	(mg/L)	0.72 **	0.23	0.3 ST	0.06
Potassium	(mg/L)	< 0.4	< 0.40	--	< 0.4
Magnesium	(mg/L)	2.2	2.8	35.0 GV	3.2
Manganese	(mg/L)	0.04	0.04	0.3 ST	< 0.01
Sodium	(mg/L)	5.4	5.1	--	7.3
Lead	(mg/L)	< 0.02	< 0.02	0.025 ST	< 0.02
Selenium	(mg/L)	< 0.005	< 0.005	0.020 ST	< 0.005
Test Laboratory		Nytest	Nytest		Nytest

* ST = Standard GV = Guidance Value

** Exceeded the NYSDEC Class GA Ground Water Standard or Guideline Value.



Dvirka and Bartilucci
CONSULTING ENGINEERS

TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

LINES OF EQUAL CONCENTRATION
CHLORIDE - 1989

FIGURE NO. 2-8

The results for volatile organic chemical analysis show levels above detectable limits for a number of aromatic compounds including benzene, toluene, xylene and ethylbenzene (see Table Nos. 2-8, 2-9 and 2-10). As illustrated in Figure No. 2-9, the wells in which these compounds were found in 1989, are located along the southern boundary of the landfill.

2.5 Site Reconnaissance

The landfill is owned by the Town of Brookhaven and the Town will provide authorization to enter the site. The landfill is controlled by a chain-link fence which surrounds the site. Access to the site is gained through the controlled entrance to the landfill. Roadways provide access to the monitoring well and sampling locations on the landfill property. Access to off-site sampling locations, such as along the creek downgradient of the landfill, will also be provided by the Town. The specific sampling points will be readily accessible.

TABLE NO.2-8

Brookhaven Landfill
Ground Water Sampling
Summer/Fall 1989 Volatile Organic Results
(0 - 50 Feet)

Well Number:	72127	72821	72822	72827	72828	NYSDEC Class GA	Upgradiant Well Result 72124
Well Depth:	49'	23'	43'	14'	33'	Ground Water	43'
Sample Date:	August 22	August 24	August 24	August 22	August 22	Standards/Guidelines* (ug/L)	August 24
PARAMETERS (ug/L)							
Chloromethane	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
Bromomethane	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
Vinyl Chloride	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	5 ST	10.0 U.
Chloroethane	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
methylene Chloride	5.0 U.	3.0 JBT.	1.0 JBT.	5.0 U.	5.0 U.	50 GV	4.0 JT.
2-Propanone	10.0 U.	4.0 JBF.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
Carbon disulfide	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	--	5.0 U.
1,1-Dichloroethene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	0.07 GV	5.0 U.
1,1-Dichloroethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV	5.0 U.
1,2-Dichloroethene (total)	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	--	5.0 U.
Chloroform	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	100 ST	1.0 J.
1,2-Dichloroethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	0.8 GV	5.0 U.
2-Butanone	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
1,1,1-Trichloroethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV	5.0 U.
Carbon Tetrachloride	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5 ST	5.0 U.
Vinyl Acetate	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
Bromodichloromethane	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	50 GV	10.0 U.
1,2-Dichloropropane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV*	5.0 U.
cis-1,3-Dichloropropene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	--	5.0 U.
Trichloroethene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	10 ST	5.0 U.
Dibromochloromethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV	5.0 U.
1,1,2-Trichloroethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	0.6 GV	5.0 U.
Benzene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	ND ST**	5.0 U.
Trans-1,3-Dichloropropene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	--	5.0 U.
Bromoform	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV	5.0 U.
4-methyl-2-Pentanone	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
2-Hexanone	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	50 GV	10.0 U.
Tetrachloroethene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	0.7 GV	5.0 U.
1,1,2,2-Tetrachloroethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	0.2 GV	5.0 U.
Toluene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV	5.0 U.
Chlorobenzene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	20 GV	5.0 U.
Ethylbenzene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV	5.0 U.
Styrene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	931 ST***	5.0 U.
Xylene (total)	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV****	5.0 U.
Total Volatiles (Knowns)	U	7.0	1.0	U.	U.	--	5.0
Other: total conc. [# of cmpds]							
Unknown Alkane	U	U	U	U	U	--	U
Unknown Alkene	U	U	U	U	U	--	U
Unknown	U	U	U	U	U	--	U
Total Volatiles (Knowns + TICs)	U	7.0	1.0	U	U	--	5.0

TABLE NO. 2-9

Brookhaven Landfill
Ground Water Sampling
Summer/Fall 1989 Volatile Organic Results
(50 - 160 Feet)

Well Number:	72136	72836	72837	73760	73763	73765	73766	73767	73768	73955	NYSDEC Class GA	Upgradiant Well Results 72616
Well Depth:	83'	54'	73'	65'	140'	78'	108'	63'	79'	63'	Ground Water	67'
Sample Date:	August 24	August 22	August 22	August 29	August 29	August 29	August 29	August 24	August 24	August 24	Standards/Guidelines* (ug/L)	August 24
PARAMETERS (ug/L)												
Chloromethane	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
Bromomethane	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
Vinyl Chloride	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	5 ST	10.0 U.
Chloroethane	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
Methylene Chloride	4.0 JBT.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	3.0 JBT.	2.0 JBT.	5.0 BT.	50 GV	4.0 JBT.
2-Propanone	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	7.0 JBF.	4.0 JBF.	5.0 JBF.	--	10.0 U.
Carbon disulfide	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	--	5.0 U.
1,1-Dichloroethene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	0.07 GV	5.0 U.
1,1-Dichloroethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV	5.0 U.
1,2-Dichloroethene (total)	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	--	5.0 U.
Chloroform	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	100 ST	2.0 J.
1,2-Dichloroethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	0.8 GV	5.0 U.
2-Butanone	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
1,1,1-Trichloroethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV	5.0 U.
Carbon Tetrachloride	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5 ST	5.0 U.
Vinyl Acetate	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
Bromodichloromethane	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	50 GV	10.0 U.
1,2-Dichloropropane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV*	5.0 U.
cis-1,3-Dichloropropene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	--	5.0 U.
Trichloroethene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	10 ST	5.0 U.
Dibromochloromethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV	5.0 U.
1,1,2-Trichloroethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	0.6 GV	5.0 U.
Benzene	5.0 U.	5.0 U.	5.0 U.	4.0 J.**	2.0 J.**	5.0 U.	5.0 U.	2.0 J.**	4.0 J.**	5.0 U.	ND ST**	1.0 J.**
Trans-1,3-Dichloropropene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	--	5.0 U.
Bromoform	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV	5.0 U.
4-methyl-2-Pentanone	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	--	10.0 U.
2-Hexanone	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	10.0 U.	50 GV	10.0 U.
Tetrachloroethene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	0.7 GV	5.0 U.
1,1,2,2-Tetrachloroethane	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	0.2 GV	5.0 U.
Toluene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	3.0 J.	6.0	8.0	5.0 U.	3.0 J.	5.0 U.	50 GV	5.0 U.
Chlorobenzene	5.0 U.	5.0 U.	5.0 U.	7.0	5.0 U.	5.0 U.	5.0 U.	2.0 J.	5.0 U.	5.0 U.	20 GV	5.0 U.
Ethylbenzene	5.0 U.	5.0 U.	5.0 U.	3.0 J.	9.0	5.0 U.	5.0 U.	5.0 U.	1.0 J.	5.0 U.	50 GV	5.0 U.
Styrene	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	5.0 U.	931 ST***	5.0 U.
Xylene (total)	5.0 U.	5.0 U.	5.0 U.	9.0	5.0 U.	9.0	5.0 U.	5.0 U.	5.0 U.	5.0 U.	50 GV****	5.0 U.
Total Volatiles (Knowns)	4.0	U.	U.	23.0	14.0	15.0	8.0	14.0	14.0	10.0	--	7.0
Other: total conc. [# of cmpds]												
Unknown Alkane	U	U	6.0 J [1]	U	U	U	U	U	U	U	--	U
Unknown Alkene	U	U	8.0 J [1]	23.0 J [1]	U	U	U	U	U	U	--	U
Unknown	U	U	U	35.0 J [3]	35.4 J [3]	18.7 J [2]	16.4 J [2]	U	U	U	--	U
Total Volatiles (Knowns + TICs)	4.0	U	14.0	81.0	49.4	33.7	24.4	14.0	14.0	10.0	--	7.0

TABLE NO. 2-10

Brookhaven Landfill

Definition of Data Qualifiers

ORGANIC QUALIFIERS

U - Indicates that the compound was analyzed for but not detected.

J - Indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but greater than zero.

B - This flag is used when the analyte is found in the method blank as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.

F - Indicates that the analyte is found in the field blank as well as the sample. For TCLP analysis, indicates that the analysis is found in the extraction blank blank as well as the sample.

T - Indicates that the analyte is found in the trip blank as well as the sample.

TIC - Tentatively identified compound.

** - Exceeded the NYSDEC Class GA ground water standard or guideline value.

NYSDEC STANDARD/GUIDELINE QUALIFIERS

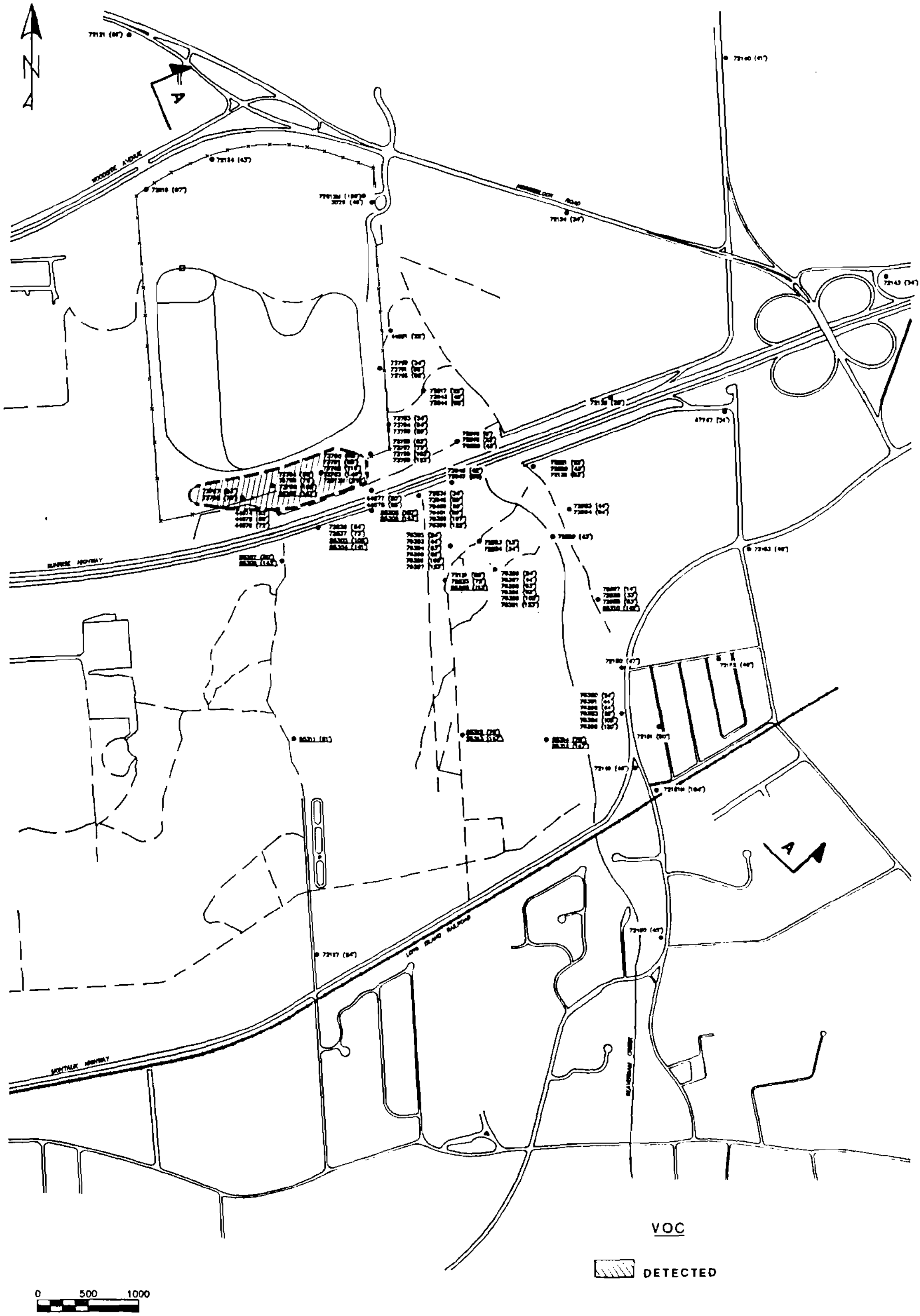
* - GV = Guidance Value ST = Standard

+ - Applies to sum of Dichloropropane isomers.

++ - Not Detectable

+++ - Styrene not included in 100 ug/l summation criteria for Class GA.

++++ - Applies to sum of isomers.



TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

LINES OF EQUAL CONCENTRATION

VOLATILES ORGANIC COMPOUNDS - 1989

FIGURE NO. 2-9

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Section 3

3.0 PHASE II/PART 360 HYDROGEOLOGIC INVESTIGATION SAMPLING PROGRAM

3.1 Introduction

In order to meet the requirements of both a Phase II Investigation and Part 360 Hydrogeologic Investigation for the Brookhaven landfill, a program has been designed to include sampling of ground water and soil from 20 new monitoring wells on the site, as well as the sampling of landfill leachate, and surface water and surface water sediment downgradient from the landfill. This section presents the specific components and associated activities of this sampling program.

3.2 Geophysical Survey

A geophysical survey will not be conducted during the field program. The boundaries of the landfill are well known and there is no indication of the presence of any hazardous waste or drums on the site. This is supported by the findings of the NYSDEC Phase I Investigation and USEPA Potential Hazardous Waste Site Preliminary Assessment documenting the historical disposal of waste at this site.

With regard to the utilization of a future geophysical survey, it is recommended that the results of this investigation be obtained and analyzed first in order to determine the need for and scope of any survey in the future (if required).

3.3 Well Drilling/Installation

The primary purpose of the installation of monitoring wells at the site of the landfill is to obtain and evaluate subsurface data. Subsurface data will include ground water quality and soil information which will assist in establishing current/background conditions, identifying the geology and hydrogeology of the site, and determining if there has been a release of contamination, as well as to support a closure plan and landfill expansion permit application.

Although there are numerous monitoring wells at and downgradient of the landfill, the existing wells are constructed of steel or PVC using chemical adhesives or without an impermeable seal in the annular space between the borehole and well casing which are not in conformance with current NYSDEC policy. The NYSDEC requirements for Phase II and Part 360 Hydrogeologic Investigations stipulate that PVC-cased wells must be constructed without adhesives and contain seals above the well screen. Therefore, for the purpose of this investigation, new monitoring wells will be constructed in accordance with NYSDEC requirements.

Data obtained from this investigation will assist NYSDEC in the determination of the appropriate classification for this waste disposal site and to support the permit application requirements for both closure of the existing landfill and expansion of the landfill to the west of the current landfilling operation (see Figure No. 3-1).

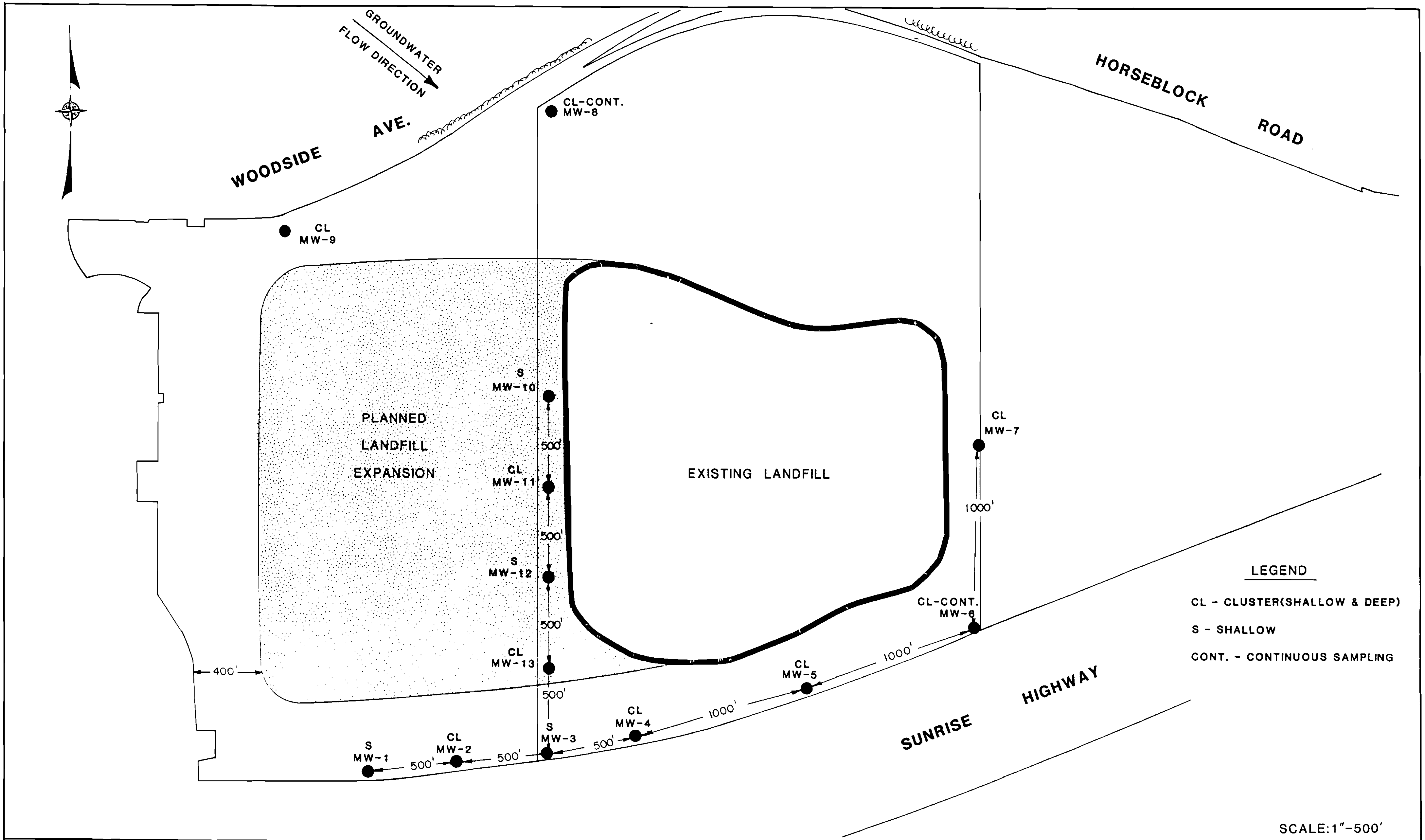
3.3.1 Well Depths

The monitoring well program will involve the installation of 20 wells at varying depths, four of which will be single wells and 16 will be constructed in clusters at eight locations. Each well cluster will consist of two individual wells, screened at different depths at the same location. The utility of the single shallow wells and well clusters in this investigation will be to define the three-dimensional flow system within the critical stratigraphic section, which is the upper glacial aquifer, and the horizontal and vertical distribution of contaminants in this section in the immediate area of the landfill.

The shallow wells will be of a depth of approximately 40 feet below ground surface in the surficial glacial deposits, and will be installed at each well location. The water table at the site lies approximately 30 feet below ground surface.

A deep well shall be installed at each cluster location at approximately 140 feet below ground in Pleistocene glacial deposits, and will be installed at the lithologic interface of the glacial deposits and the Magohty-Mattawan Group, immediately above the Gardiners clay if it exists in the area of the well.

The selection of 140 feet as the deepest wells is based on the results of previous investigations which indicate the presence of the Gardiners clay at this depth, and ground water quality results from wells screened below the clay layer which do not indicate contamination by landfill leachate (see Figure No. 3-2). In addition, water level data above the clay layer in the glacial aquifer indicates horizontal ground water flow, and according to the USGS, flow in the Magothy below the clay is in an upward direction, all of which would impede the migration of contaminants below 140 feet.

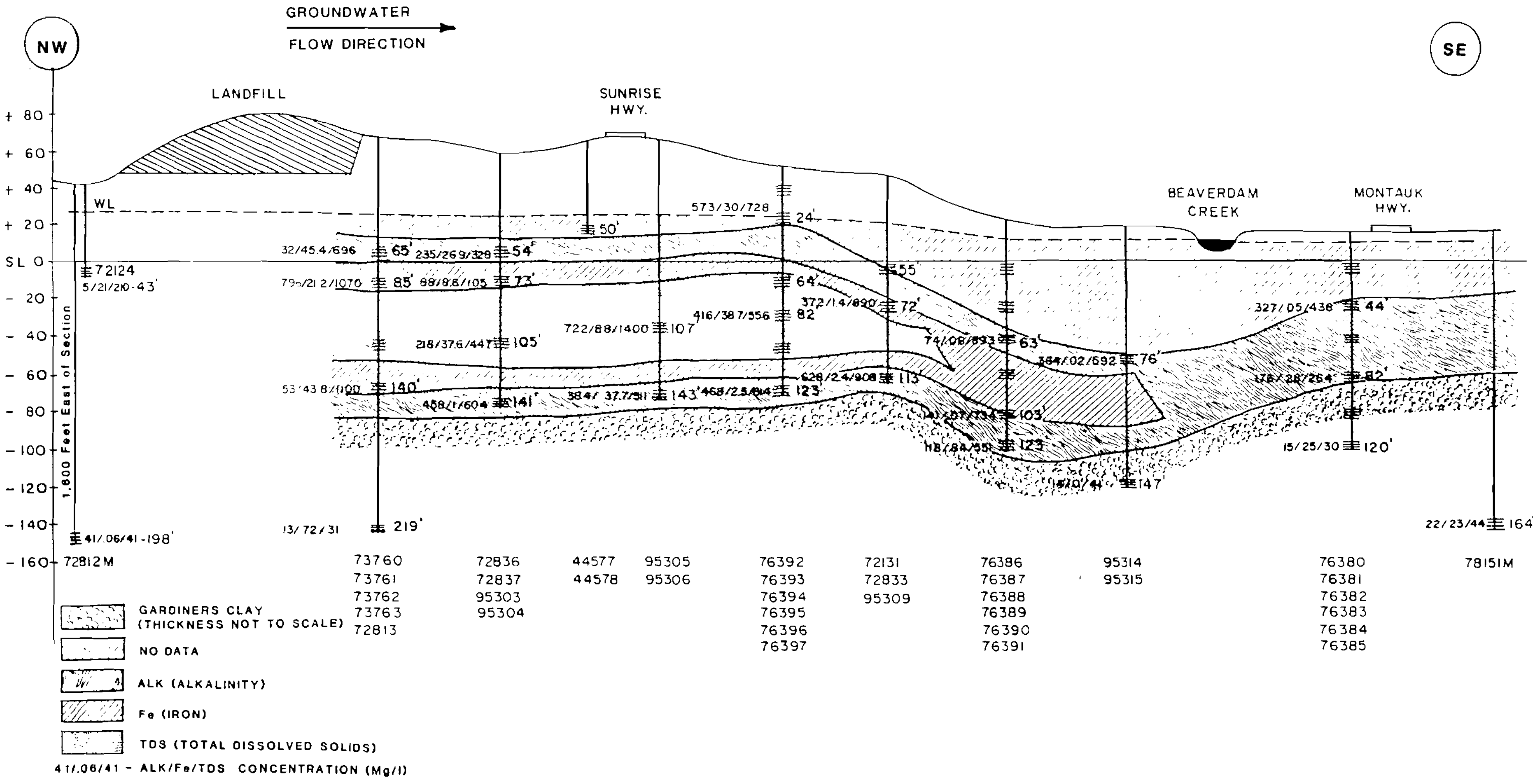


TOWN OF BROOKHAVEN

NEW WELL LOCATIONS

Dvirka and Bartilucci
CONSULTING ENGINEERS

FIGURE NO. 3-1



REFER TO PLANS

TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

LONGITUDINAL SECTION IN DIRECTION OF GROUNDWATER FLOW

Dvirka
and
Bartilucci

FIGURE NO. 3-2

3.3.2 Drilling Locations

This section of the work plan provides a brief discussion of the rationale for selecting the proposed monitoring well locations. One well cluster will be placed upgradient of the landfill, two clusters and three single shallow wells will be installed between the existing landfill and the area planned for expansion, one cluster and one shallow well will be installed downgradient of the landfill expansion area, and four clusters will be installed downgradient of the existing landfill. The well locations are shown in Figure No. 3-1 and the depths described in Table No. 3-1.

The rationale for the well cluster locations proposed in this work plan is based in part on the Part 360 requirements for preparation of a landfill permit application, requirements for a Phase II Investigation and on the analytical data obtained from prior investigations.

The well clusters, MW-8 and MW-9, are upgradient of the existing landfill and proposed expansion, and are located in an area where ground water quality previously sampled has been found to be representative of ambient Long Island conditions.

With regard to closure and investigation of the existing landfill, it is recommended that four well clusters (MW-4, MW-5, MW-6 and MW-7) be installed at 1,000 foot intervals downgradient along the southern and eastern boundaries of the existing landfill, and that selected existing wells (see Figure No. 3-3) be used to supplement these new wells at about the 500 foot interval location, if necessary.

For landfill expansion, it is proposed to install wells every 500 feet in downgradient locations along the eastern and southern boundaries of the planned expansion, alternating between shallow wells and well clusters (MW-1, MW-2, MW-3, MW-10, MW-11, MW-12 and MW-13).

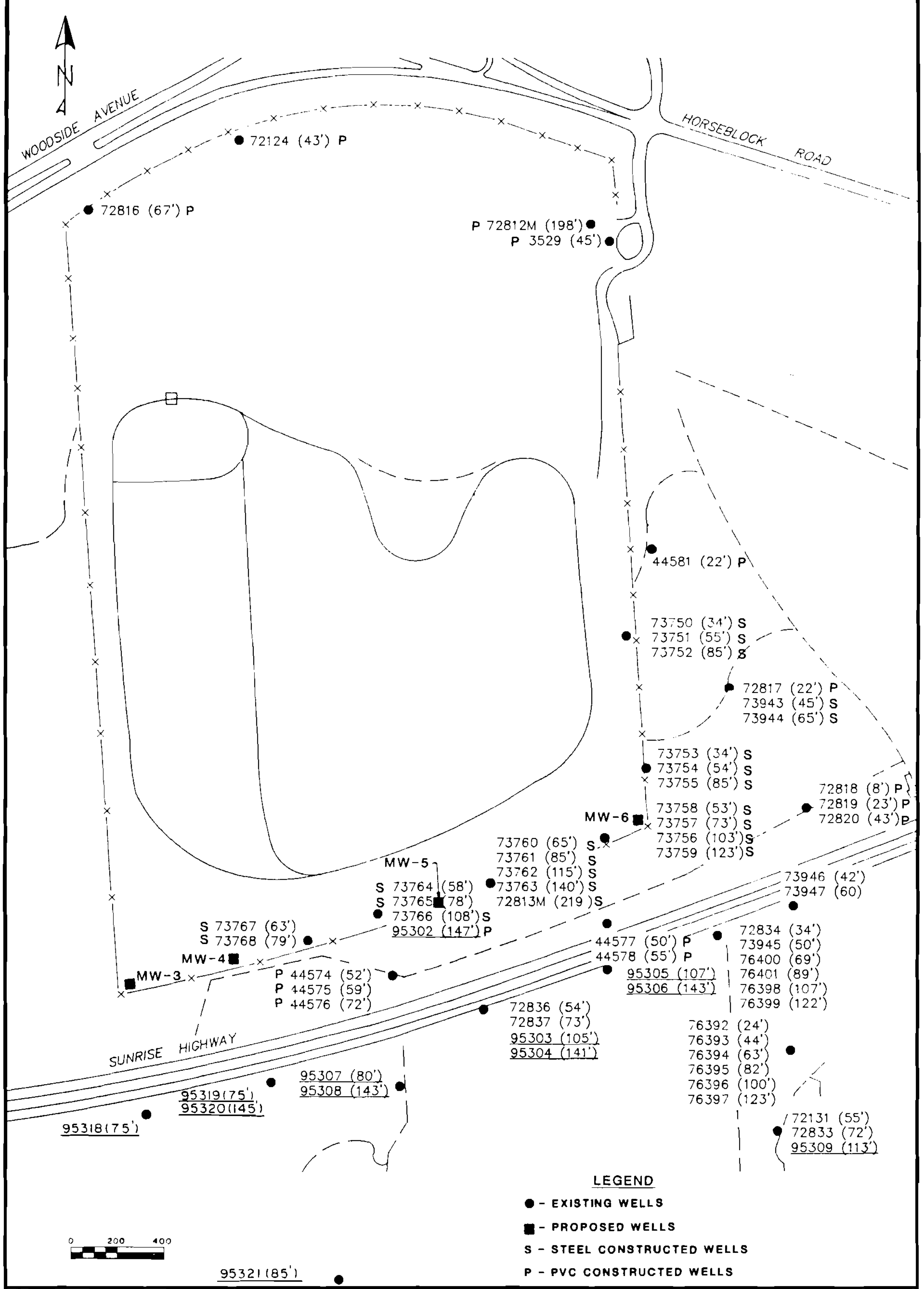
With regard to fulfilling the requirements of a Phase II Investigation, the wells described above should more that meet the intent of such an investigation which typically requires the installation of four well clusters: one upgradient of the site and three downgradient.

Table No. 3–1

DESCRIPTION OF PROPOSED MONITORING WELLS

Well No.	Description	Depth (feet)*	Ground Water Sampling Point	Soil Sampling
MW–1S	Shallow	40	Water Table	None
MW–2S	Shallow	40	Water Table	None
MW–2D	Deep	140	Glacial/Magothy Interface	Every 5 feet
MW–3S	Shallow	40	Water Table	None
MW–4S	Shallow	40	Water Table	None
MW–4D	Deep	140	Glacial/Magothy Interface	Every 5 feet
MW–5S	Shallow	40	Water Table	None
MW–5D	Deep	140	Glacial/Magothy Interface	Every 5 feet
MW–6S	Shallow	40	Water Table	None
MW–6D	Deep	140	Glacial/Magothy Interface	Continuous
MW–7S	Shallow	40	Water Table	None
MW–7D	Deep	140	Glacial/Magothy Interface	Every 5 feet
MW–8S	Shallow	40	Water Table	None
MW–8D	Deep	140	Glacial/Magothy Interface	Continuous
MW–9S	Shallow	40	Water Table	None
MW–9D	Deep	140	Glacial/Magothy Interface	Every 5 feet
MW–10S	Shallow	40	Water Table	None
MW–11S	Shallow	40	Water Table	None
MW–11D	Deep	140	Glacial/Magothy Interface	Every 5 feet
MW–12S	Shallow	40	Water Table	None
MW–13S	Shallow	40	Water Table	None
MW–13D	Deep	140	Glacial/Magothy Interface	Every 5 feet

*Approximate depth below ground surface.



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TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

EXISTING MONITORING WELLS CONTIGUOUS TO THE LANDFILL

FIGURE NO. 3-3

In addressing downgradient ground water contamination, the Town of Brookhaven and the USGS have developed an investigation plan for 1990, which will involve the installation of additional wells and sampling of both the new wells and selected existing wells in an effort to better define the horizontal and vertical extent of the plume and threat to water supply.

3.3.3 Monitoring Well Installation

Each monitoring well will be designed to intercept and effectively monitor the water table system and interface between the Pleistocene glacial deposits and the Magothy aquifer in the Magothy-Mattawan group. As previously described in Section 3.3.1, it is estimated that each shallow well will be approximately 40 feet deep and the deep wells will be set at the top of the Gardiners clay or at approximately 140 feet deep.

Both the shallow and deep wells will be constructed by the auger method, or by driven or spin casing.

At each cluster location, borings will first be advanced through the glacial deposits for the deep well to determine the geologic characteristics at the well site. Depending upon the geology, as well as split spoon organic vapor measurements, the final well depths may vary from the approximate depths described above and contained in Table No. 3-1. For example, if there is a clay lens at 100 feet or high organic vapor readings are obtained from soil samples at this depth, the deep well screen will be set, with the approval of the NYSDEC field supervisor, at this depth rather than at 140 feet.

Well construction will consist of a 2 inch diameter stainless steel screen and threaded, flush joint PVC casing. Ten feet of stainless steel wire wrapped screen with 0.01 inch openings (or as required as a function of formation and/or sand pack) will be installed in the deep borehole and a 20 foot screen will be installed in the shallow borehole (5 feet above the water table and 15 feet below).

A 2 inch diameter PVC riser will extend from the top of the screen to ground surface elevation and be contained in flush mounted vaults.

The annulus of the borehole in the area of the screen will be sand-packed using a tremie pipe to a height of 2 feet above the screened interval with clean silica sand. A 3 foot seal of bentonite slurry will be placed immediately above the filter material using a tremie pipe. The remaining annulus will be grouted to the surface with a cement/bentonite slurry, also using a tremie pipe to prevent bridging and to ensure filling of all voids.

A 4 inch diameter protective outer steel surface casing with locking cover and a surface cement pad will be installed, except in situations where flush mounted vaults will be required. Figure No. 3-4 provides an illustration of well construction. A more detailed description of well construction and installation is contained in the Technical Specifications in Appendix A.

Wells will be developed until a turbidity of 50 NTUs (nephelometric turbidity units) is attained or until the NYSDEC field supervisor approves termination of development. Well development will be supplemented by measurement of temperature, pH and specific conductance, and will continue until stabilization of these parameters is achieved, or as approved by the NYSDEC supervisor.

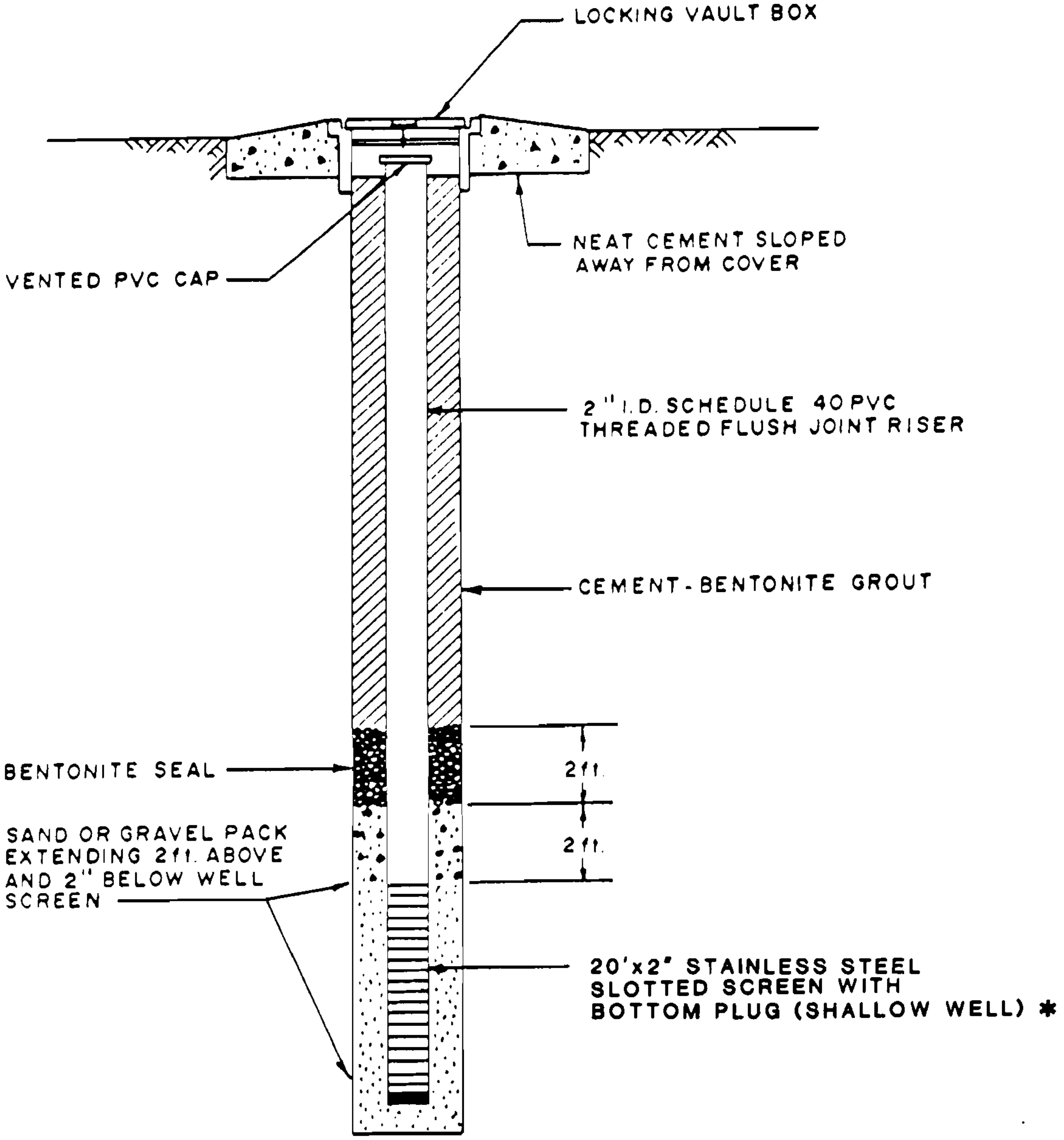
Vertical (to the nearest 0.01 foot) and horizontal controls, using USGS benchmarks, will be established for all wells.

3.4 Selection of Sampling Locations

Five different activities will comprise the sampling program for this investigation.

Soil - During construction of the deep monitoring well boreholes, split spoon soil samples will be obtained at five foot intervals beginning at ground surface (and at changes in lithology) except for upgradient borehole (MW-8) and downgradient borehole (MW-6) which will be sampled continuously. These samples will provide detailed stratigraphic information on the landfill site. (Soil samples will not be obtained from any of the shallow boreholes.)

Soil samples obtained from the split spoons will be observed for geologic characteristics and screened with a portable organic vapor analyzer, either a Century OVA and/or Photovac Tip. Should the organic vapor measurements warrant a chemical analysis of the split spoon sample, analysis will be for the Target Compound List (TCL) +30 parameters. Selection of soil samples for chemical analysis (if necessary) will be made with the approval of the NYSDEC field supervisor. Provision has been made in this Work Plan for the collection of 16 soil samples for chemical analysis (two from each deep borehole).



*** NOTE:** **10'x2" STAINLESS STEEL SLOTTED SCREEN WITH BOTTOM PLUG FOR DEEP WELL**

BROOKHAVEN MUNICIPAL LANDFILL SITE

PLAN FOR CONSTRUCTION OF MONITORING WELLS WITH LOCKING VAULT

Dvirka and Bartilucci CONSULTING ENGINEERS

FIGURE NO. 3-4

In addition to visual characterization and selective chemical analysis of soils, grain size and Atterberg limits analysis will be conducted on representative non-cohesive and cohesive units, respectively. It is anticipated that a total of 22 samples will be obtained for this analysis (one sample from each of the boreholes). The samples for grain size will be obtained at the depth of the screen and samples for Atterberg limits will be at the depth of a confining unit, if encountered. If 20% of the material passes the No. 200 sieve size, a hydrometer analysis will also be performed.

Ground Water - Each of the 22 wells installed as part of this investigation will be sampled and analyzed for TCL +30 and leachate indicator parameters which are described in Table No. 3-2.

Leachate - In order to determine if there has been a release of hazardous chemicals from the landfill, the leachate produced at the landfill will be sampled and analyzed. Once the contaminants of concern are identified from the leachate data, the information will be used to indicate where landfill contamination exists in the surrounding area, as well as to define the analytes of concern for long-term monitoring. Samples will be obtained from the leachate collection points of Cell Nos. 1, 2 and 3 (see Figure No. 3-5).

Surface Water - A chemical evaluation of surface water samples in the stream flowing southeast of the landfill (Beaverdam Creek) will assist in determining if contamination of the stream exists and if the source of contamination is in the landfill. Three surface water samples will be collected from this creek. The approximate locations of these samples are illustrated in Figure No. 3-6; however, final location selection will be based upon the direction of the NYSDEC field supervisor.

Surface Water Sediment - Analyzing sediment samples downgradient of the landfill site could provide information on impacts of the landfill and contaminants of concern in the study area. Samples will be taken just below the sediment surface in the stream bed. Three samples will be collected. These sediment samples will be obtained from the same locations as the surface water samples (see Figure No. 3-6).

Water Level Measurements - Stabilized ground water level measurements will be obtained from each of the 22 wells installed as part of this investigation. Measurements will be obtained prior to well evacuation and sample collection. In addition, surface water elevations and flows will be obtained at the surface water/sediment locations when the samples are collected.

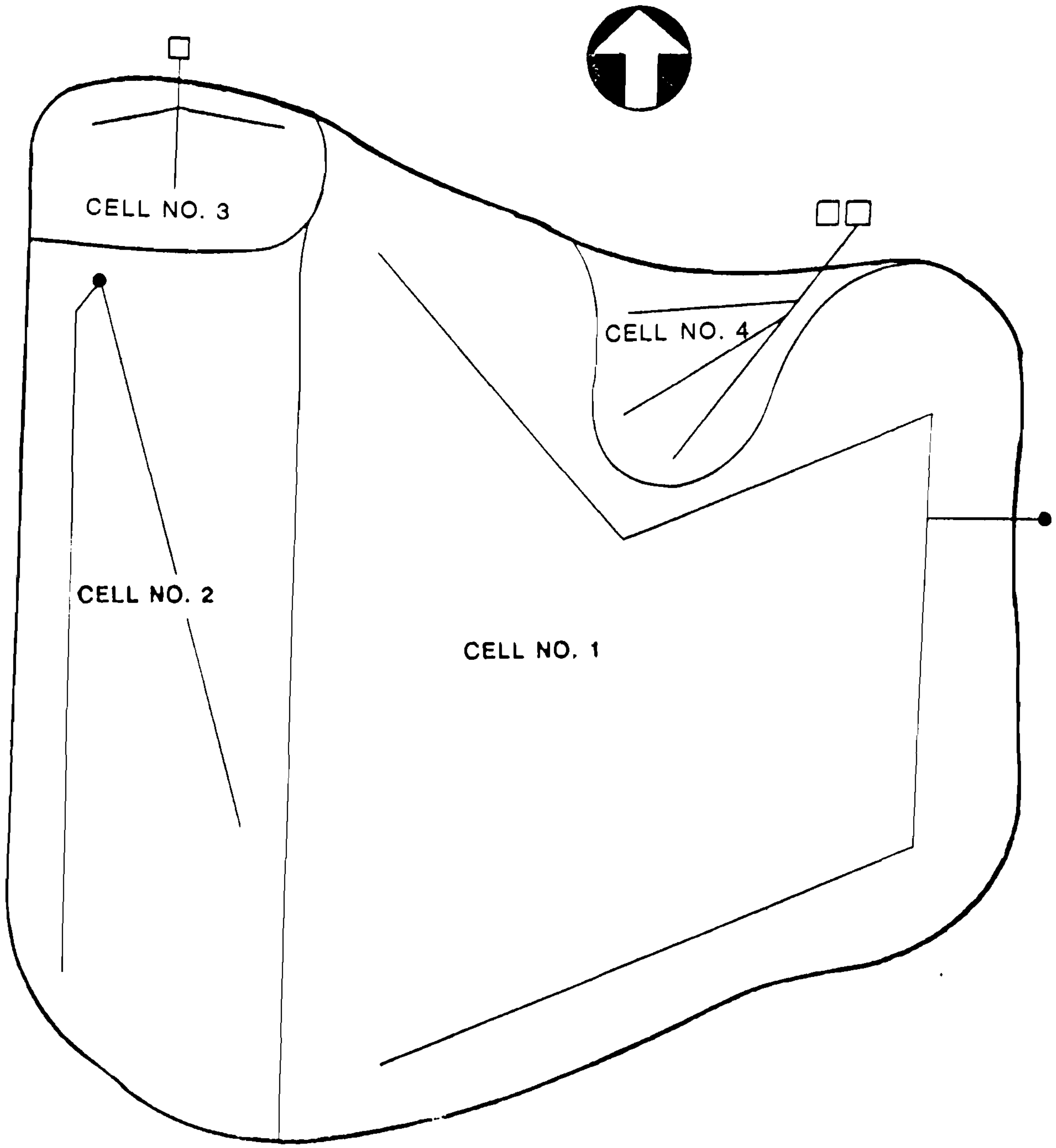
Table No. 3–2

NYSDEC RECOMMENDED PART 360 BASELINE LEACHATE INDICATOR PARAMETERS

Boron
Total Kjeldahl Nitrogen*
Ammonia*
Nitrate*
Biochemical Oxygen Demand (5–Day)
Chemical Oxygen Demand
Total Organic Carbon
Total Dissolved Solids*
Sulfate*
Chromium (Hexavalent)
Detergent (Mythl Blue Active Substances)
Alkalinity
Color
Odor
Hardness (Total)
Chloride*
Phenols*
Dissolved Oxygen (Field Parameter)
Specific Conductivity (Field Measured)*
Total Volatile Solids (Leachate Only)
pH (Field Measured)
Eh (Field Measured)
Turbidity

*Routinely monitored by the Town of Brookhaven.

Note: Other Baseline Parameters, such as metals (potassium, sodium, iron, manganese, magnesium, lead, cadmium, aluminum, calcium, toxic metals and cyanide) and organic compounds (including volatile organics) are included in the TCL+30 list of parameters. It is not planned to analyze for dioxins and furans.



☐ ● SAMPLE POINTS

SOURCE: LOUIS K. McLEAN ASSOC., P.C.

TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

Dvirka and Bartilucci CONSULTING ENGINEERS

LEACHATE COLLECTION SYSTEM AND SAMPLE POINTS

FIGURE NO. 3-5

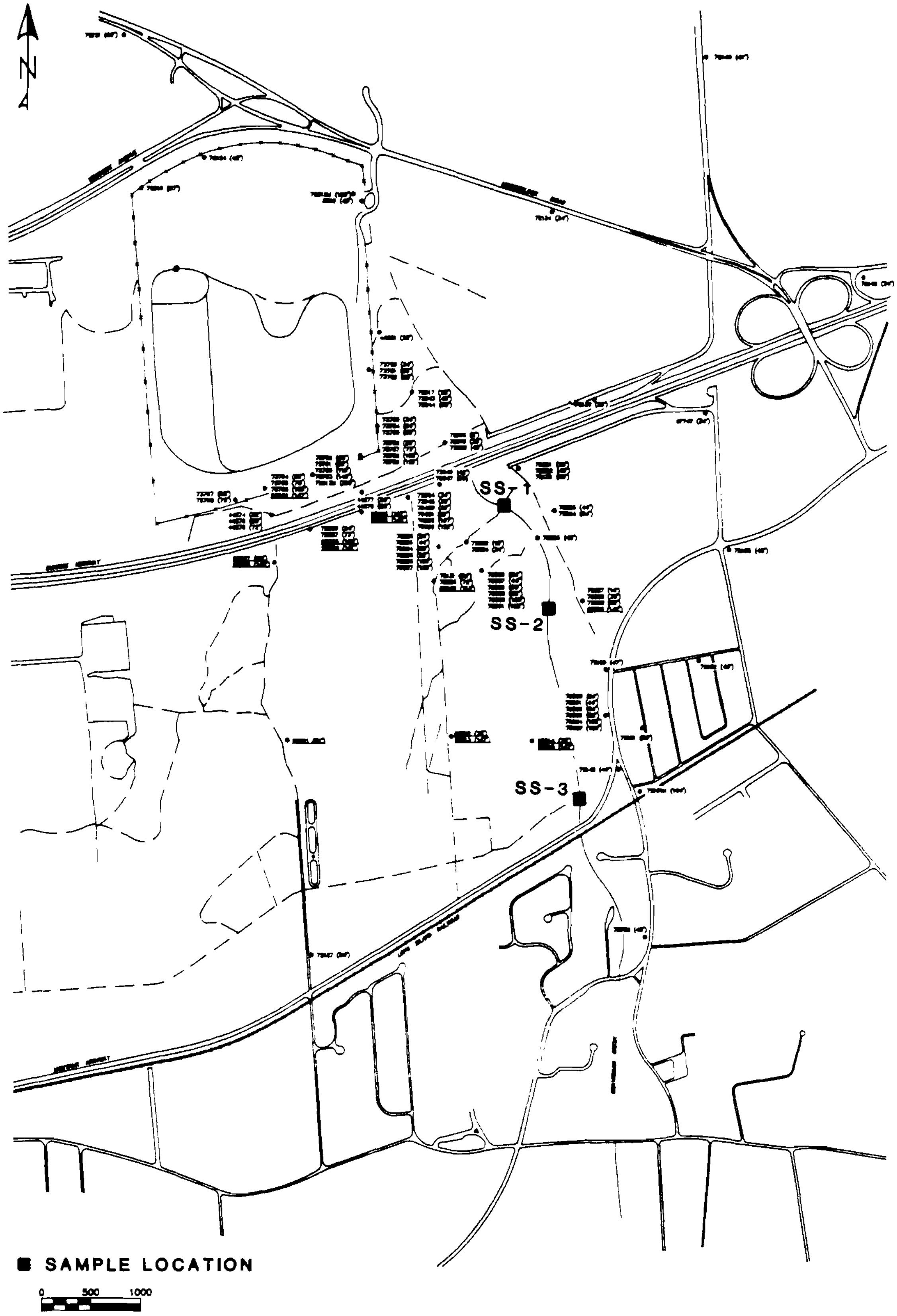


FIGURE NO. 3-6

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TOWN OF BROOKHAVEN

SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

In Situ Permeability Tests - Slug tests will be performed in representative wells. For this work plan, it is anticipated that these tests will be conducted for a total of 10 of the wells at the direction of the NYSDEC field supervisor.

Air Monitoring - According to previous investigations undertaken by NYSDEC (Phase I Investigation) and USEPA (Field Investigation Team), the presence of total organic vapors above ambient has not been detected; therefore, collection of air samples will not be performed as part of this investigation. However, total organic vapors using either a portable flame ionization or photoionization instrument (Century OVA-128 or Photovac Tip II, respectively), oxygen, flammable gases and hydrogen sulfide using a multi-gas (Ecotox-40), and dust using a Mini Ram Dust Indicator will be measured at each of the boreholes to be constructed as part of this investigation and at the leachate collection pools.

Biota - Sampling of biota will not be performed as part of the investigation since there does not appear to be stressed wildlife habitats outside of the landfill property. Future sampling of biota (if any) will be determined by the results of the sampling program contained in this work plan.

A summary of the field sampling program is provided in Table No. 3-3. A detailed description of sampling and sample handling procedures, equipment decontamination procedures and equipment calibration procedures is provided in Sections 4.6, 4.7 and 4.10 of the Quality Assurance/Quality Control section of this work plan, respectively. Handling and disposal of investigation derived wastes, such as drill cuttings, and development and purge water, are described in Section 5.8 of the Health and Safety Plan.

3.5 Analytes of Concern

All samples collected as part of this investigation (soil, sediment, ground water, surface water and landfill leachate) will be analyzed for TCL+30 as defined by NYSDEC in the September 1989 Analytical Services Protocol (ASP). The list includes: metals, cyanide, volatile organic compounds, acid extractables, base neutrals, pesticides and PCBs. In addition, ground water, surface water and leachate will be analyzed for NYSDEC leachate parameters (see Table No. 3-2). No samples will be analyzed for dioxin or furans.

Table No. 3-3

SUMMARY OF BROOKHAVEN LANDFILL
PHASE II AND PART 360 HYDROGEOLOGIC INVESTIGATION SAMPLING/ANALYTICAL PROGRAM

Sampling Area/ Environmental Media	Sample Location	Sample Point	No. of Samples	Depth	Procedure	Equipment	Analytical Parameter	Remarks
Soil	Deep boreholes constructed as part of this investigation	Borehole	18 (2 from each deep borehole)	Where indicated by organic vapor measurements and visual characteristics	See Section 4.6.1 of QA/QC Plan	Split spoon	TCL +30, and grain size or Atterberg limits* for 22 samples at depth of well screens and confining units, respectively	Also slug (hydraulic conductivity) tests for 10 wells
Ground Water	Upgradient, expansion area and downgradient monitoring wells installed as part of this investigation	Monitoring Well	22	Immediately below water surface after evacuation of three well volumes	See Section 4.6.2 of QA/QC Plan	Teflon bailer	TCL +30 and NYSDEC Baseline Leachate Parameters	Also water level measurements from each of the 22 wells installed as part of this investigation
Leachate	Landfill Cell Nos. 1, 2 and 3	Leachate collection pools	3	Immediately below leachate surface	See Section 4.6.3 of QA/QC Plan	Teflon bailer (dedicated)	TCL +30 and NYSDEC Baseline Leachate Parameters	None
Surface Water	Beaverdam Creek	Along length of creek	3	Immediately below water surface	See Section 4.6.4 of QA/QC Plan	Sample bottle directly	TCL +30 and NYSDEC Baseline Leachate Parameters	Also water level (staff gauge) and flow measurements of creek (same time when samples are obtained)
Surface Water Sediment	Beaverdam Creek	Along length of creek (same locations as surface water samples)	3	Immediately below sediment surface	See Section 4.6.5 of QA/QC Plan	Stainless steel ladle or scoop	TCL +30	None
Air	Boreholes constructed as part of this investigation and Landfill Cell Nos. 1, 2 and 3	Borehole and leachate collection pools	Continuous	Immediately in the vicinity of sample point	See Section 4.6.6 of QA/QC Plan	Organic vapor analyzer, multi gas meter and dust indicator	Total organic vapors, oxygen, flammable gases and hydrogen sulfide and dust	None

*A hydrometer analysis will also be performed if 20% of the sample is less than No. 200 sieve size.

3.6 Location of Background Sampling Points

This investigation is designed to determine if the Brookhaven landfill site is a source of surface and/or ground water contamination in the study area and to establish ambient/existing water quality conditions. This effort will serve to provide information to NYSDEC in order to reclassify the site from its present classification of 2a and to provide existing water quality conditions and hydrogeologic characteristics for the landfill closure plan and Part 360 permit application for expansion. During this investigation, ground water and subsurface soil samples will be collected upgradient from the landfill as a control in the program. See Figure No. 3-2 for the locations of MW-8 and MW-9, the upgradient ground water and subsurface soil control sample locations. It should be noted that upgradient/upstream surface water and sediment samples will not be obtained since entire Beaverdam Creek is located downgradient from the landfill.

Section 4

QUALITY ASSURANCE AND QUALITY CONTROL PLAN APPROVAL FORM

PHASE II INVESTIGATION
AND
PART 360 HYDROGEOLOGIC INVESTIGATION

BROOKHAVEN LANDFILL

TOWN OF BROOKHAVEN
SUFFOLK COUNTY, NEW YORK

Approved by:

QA/QC Officer ______________________________ Date __________
Dvirka and Bartilucci Consulting Engineers

Project Manager ______________________________ Date __________
Dvirka and Bartilucci Consulting Engineers

QA/QC Officer ______________________________ Date __________
New York State Department of Environmental Conservation

Project Manager ______________________________ Date __________
New York State Department of Environmental Conservation

4.0 QUALITY ASSURANCE/QUALITY CONTROL PLAN

4.1 Objective and Scope

The purpose of this Phase II and Part 360 Hydrogeologic Investigation is to determine if hazardous wastes have been released to the environment from the Brookhaven landfill in order to provide information to NYSDEC to reclassify the site from its current classification of 2a under the New York State Superfund Program, and to provide hydrogeologic, and water and soil quality data as part of the landfill Closure Plan and permit application for expansion. This goal will be achieved by conducting a field sampling program addressing soil, ground water, leachate, surface water and sediment.

For a more detailed discussion of site history and background refer to Section 2.0 of this work plan.

4.2 Data Usage

The data generated from the field sampling program will be used to determine if the Brookhaven landfill is a source of contamination in the area, and if so, the nature and extent of contamination on a preliminary basis. The data generated from this program will also be used to establish current subsurface soil, ground water, landfill leachate and surface water and sediment quality in the vicinity of the landfill for the purposes of facility design, monitoring and contingency planning.

4.3 Monitoring Network Design and Rationale

As described in Section 3.0 of this work plan, the sampling program for chemical analysis is as follows:

- o Soil – In general, during deep borehole construction, split spoon samples will be taken every five feet or where lithology changes significantly to characterize the geology of the site. (Continuous split spoon samples will be obtained from selected deep wells.) Depending on the results of infield observations and organic vapor readings obtained from the split spoon samples, provision is made for laboratory analysis of selected soil samples to determine the nature of contamination of the contaminated zone, if any.

- Ground Water – Samples will be taken from monitoring wells installed as part of this investigation to determine the vertical and horizontal extent of contamination in the aquifer of concern, if any.

- Landfill Leachate – Samples will be obtained from the leachate collection pools located in the landfill to determine if direct discharges from the site are sources of contamination.

- Surface Water – Samples will be taken of Beaverdam Creek located southeast of the landfill to determine if contamination of this water body is occurring.

- Surface Water Sediment – Samples will be taken from Beaverdam Creek to determine the nature and the extent of contamination in the stream bed, if any.

4.4 Project Organization and Responsibility

See Table No. 6–1 and Figure Nos. 6–1 and 6–2 in Section 6.0 of this work plan.

4.5 Data Quality Requirements and Assessments

Table No. 4–1, Monitoring Parameters, contains required sample container types, preservation techniques and holding times required for analyses of the Target Compound List (TCL)+30 compounds and the NYSDEC Leachate Parameters (see Table No. 4–2). Data quality requirements are provided in Table No. 4–3, which includes the detection limit for each parameter and sample matrix. Note that quantitation limits, estimated accuracy, accuracy protocol, estimated precision and precision protocol are determined by the laboratory and must be in conformance with the requirements of the 1989 NYSDEC Analytical Services Protocol (ASP). The laboratory to be used for this analytical program (Nytest Environmental) is approved by NYSDEC. Since Nytest is an approved laboratory, specific analytical procedures and laboratory QA/QC descriptions are not included in this work plan, but are available upon request.

4.5.1 Data Representativeness

The sampling program described in Section 4.0 of this work plan is designed to provide data representative of site conditions.

Table No. 4-1

MONITORING PARAMETERS

Sample Location	Sample Type	Sample Matrix	Sample Fraction	Number of Samples	Frequency	Container Type/Size/No.	Sample Preservation	Holding Time*	Analytical Method
Monitoring Well Boreholes	Grab	Soil	Volatile Organics	18	1	Glass, clear/ 40 ml/2	Cool 4°C	7 days	1989 NYSDEC ASP, Method 624
	Grab	Soil	Acid and Base Neutral Extractable Organics	18	1	Glass, amber/ 150 ml/1	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 625
	Grab	Soil	Metals	18	1	Glass, amber/ 150 ml/1	Cool 4°C	26 days for Hg, 6 months for all others	1989 NYSDEC ASP, Method 200.7
	Grab	Soil	Pesticides/PCBs	18	1	Glass, amber/ 150 ml/1	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 608
	Grab	Soil	Cyanide	18	1	Glass, amber/ 150 ml/1	Cool 4°C	14 days	1989 NYSDEC ASP, Method 335.2

*The holding time period begins from the time of verifiable laboratory sample receipt.

Table No. 4-1 (continued)

MONITORING PARAMETERS

Sample Location	Sample Type	Sample Matrix	Sample Fraction	Number of Samples	Frequency	Container Type/Size/No.	Sample Preservation	Holding Time*	Analytical Method
Monitoring Wells	Grab	Ground Water	Volatile Organics	22	1	Glass, clear/ 40 ml/3	Cool 4°C	7 days	1989 NYSDEC ASP, Method 624
	Grab	Ground Water	Acid and Base Neutral Extractable Organics	22	1	Glass, amber/ 1l/1-2	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 625
	Grab	Ground Water	Metals	22	1	Plastic/1l/1	HNO_3 to pH <2, Cool 4°C	26 days for Hg, 6 months for all others	1989 NYSDEC ASP, Method 200.7
	Grab	Ground Water	Pesticides/PCBs	22	1	Glass, amber/ 1l/1-2	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 608
	Grab	Ground Water	Cyanide	22	1	Plastic/1l/1	NaOH to pH >12, Cool 4°C	14 days	1989 NYSDEC ASP, Method 335.2
	Grab	Ground Water	Leachate Parameters	22	1	See Table No. 4-2	See Table No. 4-2	See Table No. 4-2	1989 NYSDEC ASP (see Table No. 4-1a)

*The holding time period begins from the time of verifiable laboratory sample receipt.

Table No. 4-1 (continued)

MONITORING PARAMETERS

Sample Location	Sample Type	Sample Matrix	Sample Fraction	Number of Samples	Frequency	Container Type/Size/No.	Sample Preservation	Holding Time*	Analytical Method
Collection Pools	Grab	Leachate	Volatile Organics	3	1	Glass, clear/ 40 ml/3	Cool 4°C	7 days	1989 NYSDEC ASP Method 624
	Grab	Leachate	Acid and Base Neutral Extractable Organics	3	1	Glass, amber/ 11/1-2	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP Method 625
	Grab	Leachate	Metals	3	1	Plastic/11/1	HNO_3 to pH <2, Cool 4°C	26 days for Hg, 6 months for all others	1989 NYSDEC ASP, Method 200.7
	Grab	Leachate	Pesticides/PCBs	3	1	Glass, amber/ 11/1-2	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 608
	Grab	Leachate	Cyanide	3	1	Plastic/11/1	NaOH to pH >12, Cool 4°C	14 days	1989 NYSDEC ASP, Method 335.2
	Grab	Leachate	Leachate Parameters	3	1	See Table No. 4-2	See Table No. 4-2	See Table No. 4-2	1989 NYSDEC ASP (see Table No. 4-1a)

*The holding time period begins from the time of verifiable laboratory sample receipt.

Table No. 4-1 (continued)

MONITORING PARAMETERS

Sample Location	Sample Type	Sample Matrix	Sample Fraction	Number of Samples	Frequency	Container Type/Size/No.	Sample Preservation	Holding Time*	Analytical Method
Beaverdam Creek	Grab	Surface Water	Volatile Organics	3	1	Glass, clear/ 40 ml/3	Cool 4°C	7 days	1989 NYSDEC ASP, Method 624
	Grab	Surface Water	Acid and Base Neutral Extractable Organics	3	1	Glass, amber/ 11/1-2	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 625
	Grab	Surface Water	Metals	3	1	Plastic/11/1	HNO_3 to pH <2, Cool 4°C	26 days for Hg, 6 months for all others	1989 NYSDEC ASP, Method 200.7
	Grab	Surface Water	Pesticides/PCBs	3	1	Glass, amber/ 11/1-2	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 608
	Grab	Surface Water	Cyanide	3	1	Plastic/11/1	NaOH to pH >12, Cool 4°C	14 days	1989 NYSDEC ASP, Method 335.2
	Grab	Surface Water	Leachate Parameters	3	1	See Table No. 4-2	See Table No. 4-2	See Table No. 4-2	1989 NYSDEC ASP (see Table No. 4-1a)

*The holding time period begins from the time of verifiable laboratory sample receipt.

Table No. 4-1 (continued)

MONITORING PARAMETERS

Sample Location	Sample Type	Sample Matrix	Sample Fraction	Number of Samples	Frequency	Container Type/Size/No.	Sample Preservation	Holding Time*	Analytical Method
Beaverdam Creek	Grab	Sediment	Volatile Organics	3	1	Glass, clear/ 40 ml/2	Cool 4°C	7 days	1989 NYSDEC ASP, Method 624
	Grab	Sediment	Acid and Base Neutral Extractable Organics	3	1	Glass, amber/ 150 ml/1	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 625
	Grab	Sediment	Metals	3	1	Glass, amber/ 150 ml/1	Cool 4°C	26 days for Hg, 6 mos. for all others	1989 NYSDEC ASP, Method 200.7
	Grab	Sediment	Pesticides/PCBs	3	1	Glass, amber/ 150 ml/1	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 608
	Grab	Sediment	Cyanide	3	1	Glass, amber/ 150 ml/1	Cool 4°C	14 days	1989 NYSDEC ASP, Method 335.2

*The holding time period begins from the time of verifiable laboratory sample receipt.

Table No. 4-1 (continued)

MONITORING PARAMETERS

Sample Location	Sample Type	Sample Matrix	Sample Fraction	Number of Samples**	Frequency***	Container Type/Size/No.	Sample Preservation	Holding Time*	Analytical Method
Site	Field Blank	Water	Volatile Organics	3	1	Glass, clear/ 40 ml/3	Cool 4°C	7 days	1989 NYSDEC ASP, Method 624
	Field Blank	Water	Acid and Base Neutral Extractable Organics	3	1	Glass, amber/ 1l/1-2	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 625
	Field Blank	Water	Metals	3	1	Plastic/1l/1	HNO_3 to pH <2, Cool 4°C	26 days for Hg, 6 months for all others	1989 NYSDEC ASP, Method 200.7
	Field Blank	Water	Pesticide/PCBs	3	1	Glass, amber/ 1l/1-2	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 608
	Field Blank	Water	Cyanide	3	1	Plastic/1l/1	NaOH to pH >12, Cool 4°C	14 days	1989 NYSDEC ASP, Method 335.2
	Field Blank	Water	Leachate Parameters	3	1	See Table No. 4-2	See Table No. 4-2	See Table No. 4-2	1989 NYSDEC ASP (see Table No. 4-1a)

* The holding time period begins from the time of verifiable laboratory sample receipt.

** Best estimate approximation based on sampling program (from bailer, scoop/ladle and split spoon samples).

*** As required in accordance with 1989 NYSDEC ASP, will be analyzed only when decontaminating reusable sampling equipment (once from each type of sampler).

Table No. 4-1 (continued)

MONITORING PARAMETERS

Sample Location	Sample Type	Sample Matrix	Sample Fraction	Number of Samples**	Frequency***	Container Type/Size/No.	Sample Preservation	Holding Time*	Analytical Method
Site	Trip Blank	Water	Volatile Organics	3		Glass, clear/ 40 ml/3	Cool 4°C	7 days	1989 NYSDEC ASP, Method 624

* The holding time period begins from the time of verifiable laboratory sample receipt.
** Best estimate approximation based on sampling program.
*** As required in accordance with 1989 NYSDEC ASP, will be analyzed only when transporting water samples.

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Table No. 4-1 (continued)

MONITORING PARAMETERS

Sample Location	Sample Type	Sample Matrix	Sample Fraction	Number of Samples**	Frequency***	Container Type/Size/No.	Sample Preservation	Holding Time*	Analytical Method
Site	Matrix Spike/Matrix Spike Duplicate	Liquid****	Volatile Organics	2		Glass, clear/ 40 ml/3	Cool 4°C	7 days	1989 NYSDEC ASP, Method 624
		Liquid	Acid Base Neutral Extractable Organics	2		Glass, amber/ 1l/1-2	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 625
		Liquid	Metals	2		Plastic/1l/1	HNO_3 to pH <2, Cool 4°C	26 days for Hg, 6 months for all others	1989 NYSDEC ASP, Method 200.7
		Liquid	Pesticides/PCBs	2		Glass, amber/ 1l/1-2	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 608
		Liquid	Cyanide	2		Plastic 1l/1	NaOH to pH >12, Cool 4°C	14 days	1989 NYSDEC ASP, Method 335.2
		Liquid	Leachate Parameters	2		See Table No. 4-2	See Table No. 4-2	See Table No. 4-2	1989 NYSDEC ASP (see Table No. 4-1a)

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* The holding time period begins from the time of verifiable laboratory sample receipt.
** Best estimate approximation based on sampling program.
*** As required in accordance with 1989 NYSDEC ASP.
**** Water and leachate.

Table No. 4-1 (continued)

MONITORING PARAMETERS

Sample Location	Sample Type	Sample Matrix	Sample Fraction	Number of Samples**	Frequency***	Container Type/Size/No.	Sample Preservation	Holding Time*	Analytical Method
Site	Matrix Spike/Matrix Spike Duplicate	Solid****	Volatile Organics	1		Glass, clear/ 40 ml/3	Cool 4°C	7 days	1989 NYSDEC ASP, Method 624
		Solid	Acid Base Neutral Extractable Organics	1		Glass, amber/ 150 ml/1	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 625
		Solid	Metals	1		Glass, amber/ 150 ml/1	Cool 4°C	26 days for Hg, 6 months for all others	1989 NYSDEC ASP, Method 200.7
		Solid	Pesticides/PCBs	1		Glass, amber/ 150 ml/1	Cool 4°C	5 days for extraction, 40 days for analysis	1989 NYSDEC ASP, Method 608
		Solid	Cyanide	1		Glass, amber/ 150 ml/1	Cool 4°C	14 days	1989 NYSDEC ASP, Method 335.2

* The holding time period begins from the time of verifiable laboratory sample receipt.
** Best estimate approximation based on sampling program.
*** As required in accordance with 1989 NYSDEC ASP.
**** Sediment or soil.

Table No. 4–1a

MONITORING PARAMETERS AND METHODS

Parameter	Method
Ammonia	Method 350.3
Total Organic Carbon	Method 415.1
Total Dissolved Solids	Method 160.1
Alkalinity	Method 310.1
Chloride	Method 325.3
pH	Method 150.1
Specific Conductance	Method 120.1
Total Kjeldahl Nitrogen	Method 351.3
Nitrate	Method 352.1
Biochemical Oxygen Demand	Method 405.1
Chemical Oxygen Demand	Method 410.1
Sulfate	Method 375.4
Chromium (hexavalent)	Method 218.5
Detergent (MBAS)	Method 425.1
Color	Method 110.2
Odor	Method 140.1
Hardness (total)	Method 130.2
Total Volatile Solids	Method 160.4
Turbidity	Method 180.1
Boron	Method 212.3
Dissolved Oxygen	Method 360.1

Table No. 4–2

LEACHATE PARAMETERS
METHOD OF ANALYSIS, PRESERVATION AND HOLDING TIMES*

Parameter	Method of Analysis	Preservation	Container	Holding Time
Ammonia	Method 350.3	H_2SO_4 to pH <2; Cool to 4°C	Plastic or Glass	26 days
Total Organic Carbon	Method 415.1	HCl or H_2SO_4 to pH <2; Cool to 4°C	Glass	5 days
Total Dissolved Solids	Method 160.1	Cool to 4°C	Plastic or Glass	26 days
Alkalinity	Method 310.1	Cool to 4°C	Plastic or Glass	12 days
Chloride	Method 325.3	None Required	Plastic or Glass	26 days
pH	Method 150.1	None Required	Glass	Field Measurement
Specific Conductance	Method 120.1	None Required	Glass	Field Measurement
Total Kjedahl Nitrogen	Method 351.3	H_2SO_4 to pH <2; Cool to 4°C	Plastic or Glass	26 days
Nitrate	Method 352.1	H_2SO_4 to pH <2; Cool to 4°C	Plastic or Glass	26 days
BOD (5–day)	Method 405.1	Cool to 4°C	Plastic or Glass	24 hours
COD	Method 410.1	H_2SO_4 to pH <2; Cool to 4°C	Plastic or Glass	26 days

*1989 NYSDEC ASP

Table No. 4–2 (continued)

LEACHATE PARAMETERS
METHOD OF ANALYSIS, PRESERVATION AND HOLDING TIMES*

Parameter	Method of Analysis	Preservation	Container	Holding Time
Sulfate	Method 375.4	Cool to 4°C	Plastic or Glass	26 days
Chromium (hexavalent)	Method 218.5	Cool to 4°C	Plastic or Glass	24 hours
Detergent (Methyl Blue Active Substances)	Method 425.1	Cool to 4°C	Plastic or Glass	24 hours
Color	Method 110.2	Cool to 4°C	Plastic or Glass	24 hours
Odor	Method 140.1	Cool to 4°C	Glass	Analyze immediately
Hardness (total)	Method 130.2	HNO_3 to pH <2;	Plastic or Glass	6 months
Total Volatile Solids	Method 160.4	Cool to 4°C	Plastic or Glass	5 days
Turbidity	Method 180.1	None required	Plastic or Glass	Field Measurement
Boron	Method 212.3	None required	Plastic	26 days
Dissolved Oxygen**	Method 360.1	None required	Glass	Field Measurement
Eh	—	None required	Glass	Field Measurement

* 1989 NYSDEC ASP
** Surface water only.

Table No. 4-3

DATA QUALITY REQUIREMENTS

Parameter	Sample Matrix	CRDL* (ug/l)**	Estimated Accuracy	Accuracy Protocol**	Estimated Precision	Precision Protocol**
Volatile Organics	Liquid Sediment	5-10 5-10	0.87 - 1.18 ug/l	Vol. III, Part XIV, Method 624, Table 6	0.11 - 0.84 ug/l	Vol. III, Part XIV, Method 624, Table 6
Acid Extractables	Liquid Sediment	10-50 330-1600	0.29 - 1.23 ug/l	Vol. III, Part XII, Method 625, Table 7	0.13 - 1.055 ug/l	Vol. III, Part XII, Method 625, Table 7
Base Neutrals	Liquid Sediment	10-50 330-1600	0.29 - 1.23 ug/l	Vol. III, Part XII, Method 625, Table 7	0.13 - 1.05 ug/l	Vol. III, Part XII, Method 625, Table 7
Pesticides/PCBs	Liquid Sediment	0.5-1.0 8.0-160	0.66 - 0.97 ug/l	Vol. III, Part XII, Method 608, Table 4	0.15 - 0.47 ug/l	Vol. III, Part XIV, Method 608, Table 4
Inorganics (except cyanide)	Liquid Sediment	0.2-5000 0.2-5000	--	Vol. III, Part XIV, Method 200.7, Table 4	--	Vol. III, Part XIV, Method 200.7, Table 4
Cyanide	Liquid Sediment	10 10	85% - 102% of recovery	Vol. III, Part XV, Method 335.2, Subpart 10	±0.005 - +0.094 mg/l	Vol. III, Part XV, Method 335.2, Subpart10
Ammonia	Liquid	50	91% - 96% of recovery	Vol. III, Part XV, Method 350.3, Table 7, Subpart 8	±0.003 - ±0.038 mg N/l	Vol. III, Part XV, Method 350.3, Subpart 8
Total Organic Carbon	Liquid	2,000	0.75 - 1.08 mg/l	Vol. III, Part XV, Method 415.1, Subpart 9	3.93 - 8.32 mg/l	Vol. III, Part XV, Method 415.1, Subpart 9
Total Dissolved Solids	Liquid	10,000	--	Vol. III, Part XIII, Method 160.1, Subpart 9	--	Vol. III, Part XIII, Method 160.1, Subpart 9
Alkalinity	Liquid	<0***	-9.3 - +2.0 mg/l	Vol. III, Part XV, Method 310.1, Subpart 8	1.14 - 5.36 mg/l	Vol. III, Part XV, Method 310.1, Subpart 8
Chloride	Liquid	5,000	-4.7 - ±0.6 mg/l	Vol. III, Part XV, Method 325.3, Subpart 8	1.54 - 11.80 mg/l	Vol. III, Part XV, Method 325.3, Subpart 8
pH	Liquid	--	-0.002 - +0.07 pH units	Vol. III, Part XIII, Method 150.1, Subpart 10	0.10 - 0.20 pH units	Vol. III, Part XIII, Method 150.1, Subpart 10

* Contract Required Detection Limits
** 1987 NYSDEC CLP to be changed to 1989 NYSDEC ASP
*** Working Detection Limits Utilized by Analytical Laboratories

Table No. 4-3 (continued)

DATA QUALITY REQUIREMENTS

Parameter	Sample Matrix	CRDL* (ug/l)**	Estimated Accuracy	Accuracy Protocol**	Estimated Precision	Precision Protocol**
Specific Conductance	Liquid	0.20 umhos/cm***	-87.9 - -2.0 umhos/cm	Vol. III, Part XIII, Method 120.1, Subpart 10	7.55 - 119 umhos/cm	Vol. III, Part XIII, Method 120.1, Subpart 10
Total Kjeldahl Nitrogen	Liquid	100	-0.08 - +0.03 mg N/l	Vol. III, Part XV, Method 351.3, Subpart 10	0.197 - 1.191 mg N/l	Vol. III, Part XV, Method 351.3, Subpart 10
Nitrate	Liquid	100	+0.092 - +0.214 mg N/l	Vol. III, Part XV, Method 352.1, Subpart 9	-0.01 - +0.04 mg N/l	Vol. III, Part XV, Method 352.1, Subpart 9
Biochemical Oxygen Demand	Liquid	2,000	--	Vol. III, Part XV, Method 405.1, Subpart 4	±0.7 - ±26 mg/l	Vol. III, Part XV, Method 405.1, Subpart 4
Chemical Oxygen Demand	Liquid	1,000	-4.7%	Vol. III, Part XV, Method 410.1, Subpart 9	±17.76 mg/l	Vol. III, Part XV, Method 410.1, Subpart 9
Sulfate	Liquid	5,000	-4.1 - +0.1 mg/l	Vol. III, Part XV, Method 375.4, Subpart 8	1.78 - 11.8 mg/l	Vol. III, Part XV, Method 375.4, Subpart 8
Chromium (hexavalent)	Liquid	10	94%	Vol. III, Part XIV, Method 218.5, Subpart 12	±1.0 - ±2.7 mg/l	Vol. III, Part XIV, Method 218.5, Subpart 12
Detergent (MBAS)	Liquid	100	--	Vol. III, Part XV, Method 425.1, Subpart 4	±0.036 - ±0.272 mg/l	Vol. III, Part XV, Method 425.1, Subpart 4
Color	Liquid	<5 color units***	--	Vol. III, Part XIII, Method 110.2, Subpart 10	--	Vol. III, Part XIII, Method 110.2, Subpart 10
Odor	Liquid	0***	--	Vol. III, Part XIII, Method 140.1, Subpart 9	--	Vol. III, Part XIII, Method 140.1, Subpart 9
Hardness (total)	Liquid	2,000***	-14.3 - -0.003 mg/l	Vol. III, Part XIII, Method 130.2, Subpart 9	2.52 - 9.73 mg/l	Vol. III, Part XIII, Method 130.2, Subpart 9

* Contract Required Detection Limits
** 1987 NYSDEC CLP to be changed to 1989 NYSDEC ASP
*** Working Detection Limits Utilized by Analytical Laboratories

Table No. 4-3 (continued)

DATA QUALITY REQUIREMENTS

Parameter	Sample Matrix	CRDL* (ug/l)**	Estimated Accuracy	Accuracy Protocol**	Estimated Precision	Precision Protocol**
Total Volatile Solids	Liquid	--	--	Vol. III, Part XIII, Method 160.4, Subpart 5	±11 mg/l	Vol. III, Part XIII, Method 160.4, Subpart 5
Turbidity	Liquid	0.2-0.5 NTU***	--	Vol. III, Part XIII, Method 180.1, Subpart 9	±0.6 - ±4.7 NTU	Vol. III, Part XIII, Method 180.1, Subpart 9
Boron	Liquid	--	0%	Vol. III, Part XIV, Method 212.3, Subpart 4	22.8%	Vol. III, Part XIV, Method 212.3, Subpart 4
Dissolved Oxygen	Liquid	200***	±1%	Vol. III, Part XV, Method 360.1, Subpart 9	0.1 mg/l	Vol. III, Part XV, Method 360.1, Subpart 9
Eh	Liquid	--	--	--	--	--

* Contract Required Detection Limits
** 1987 NYSDEC CLP to be changed to 1989 NYSDEC ASP
*** Working Detection Limits Utilized by Analytical Laboratories

4.5.2 Data Comparability

All data will be presented in the units designated by the methods specified by Nytest Environmental, which is a NYSDEC certified laboratory, and the 1989 NYSDEC ASP, and other analytical methodologies, such as Standard Methods, where appropriate. In addition, sample location, collection procedures and analytical methods from earlier studies will be evaluated for comparability with current procedures and methods.

4.5.3 Data Completeness

The acceptability of 100% of the data is designed as a goal for this project. The acceptability of less than 100% complete data, meeting all laboratory QA/QC protocols and standards, will be evaluated on a case-by-case basis.

4.6 Sampling Procedures

Five types of environmental samples will be collected from varying locations as part of the field investigation. These include: soil, ground water, landfill leachate, surface water and surface water sediment. Sampling procedures to be used for each of these sample types are outlined in the sections below. Sample containers, preservation techniques and maximum holding times can be found in Table No. 4-1, Monitoring Parameters. A summary of sample type and equipment can be found in Table No. 4-4. All appropriate field forms will be prepared for each sample and location as discussed in Section 4.9. All samples will be delivered to the laboratory within 24 to 48 hours from the day of collection.

4.6.1 Soil

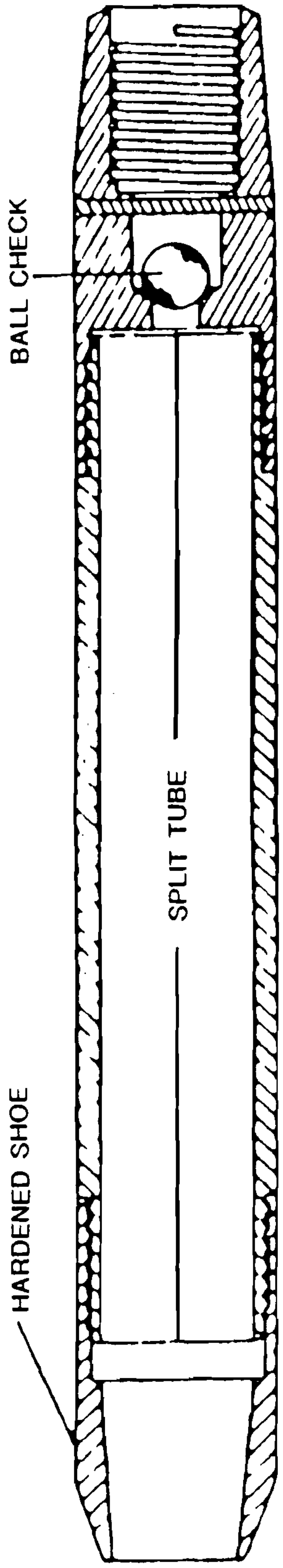
(1) Be certain that sample location is noted on Location Sketch (see Section 4.9.1).

(2) Unless using disposable equipment, be certain that the sampling equipment, split spoon (see Figure No. 4-1), has been decontaminated as per the procedure outlined in Section 4.7.

Table No. 4-4

SAMPLING EQUIPMENT

Sample Type	Equipment
Soil	Split Spoon
Ground Water	Teflon Bailer
Leachate	Teflon Bailer (Dedicated)
Surface Water	Sample Bottle (Directly)
Surface Water Sediment	Stainless Steel Scoop or Ladle



FIELD EQUIPMENT

SPLIT SPOON SAMPLER

FIGURE NO. 4-1

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(3) Remove the laboratory pre-cleaned sample bottle from the sampler cooler, label bottle with an indelible marker, fill out Sample Information Record (see Section 4.9.2) and Chain of Custody Form (see Section 4.9.3).

(4) Wear disposable gloves and eye protection.

(5) Auger into the soil to the desired depth and drive the split spoon sampler.

(6) Retrieve the split spoon and immediately after opening the split spoon, obtain an organic vapor measurement. Fill out Boring Log Form (see Section 4.17). Sample aliquots will be removed from the split spoon using a disposable sterile wooden tongue depressor and placed in the open sample bottle. Close sample bottle.

(7) Return sample bottle to sample cooler.

(8) Decontaminate the split spoon according to procedures described in Section 4.7, or equivalent, and safely dispose of tongue depressor.

4.6.2 Ground Water

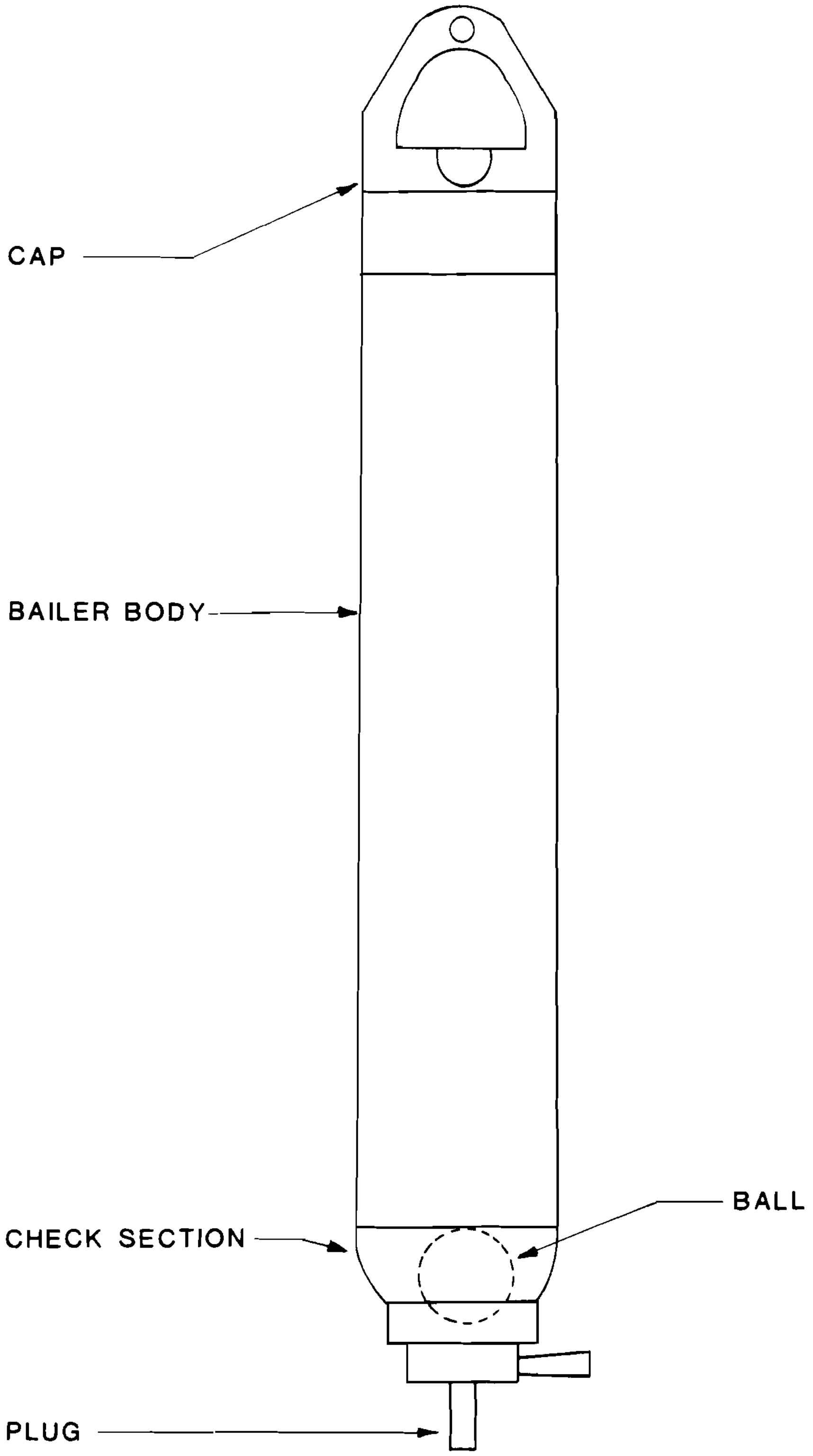
(1) Be certain that sample location is noted on Location Sketch (see Section 4.9.1).

(2) Measure the depth to water using a decontaminated weighted steel tape or electronic measuring device. Compute the volume of standing water in the well.

(3) Remove the laboratory pre-cleaned sample bottle from the sample cooler, label bottle with an indelable marker, fill out Sample Information Record (see Section 4.9.2) and Chain of Custody Record (see Section 4.9.3).

(4) Wear disposable gloves and eye protection.

(5) Remove three times the volume of standing water from each well with a decontaminated teflon bailer (see Figure No. 4-2) utilizing a braided nylon rope, or a pump using dedicated polyethylene tubing. Measure the pH, temperature and specific conductance of the ground water to confirm adequate well purging.



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FIELD EQUIPMENT
BAILER

FIGURE NO. 4-2

(6) Fill all of the individual sample containers (preservatives added previously by the analytical laboratory where appropriate). Gently pour the sample into the sample bottle taking care not to spill sample on outside of bottle or overfill bottle, and replace the cover on the sample bottle. Samples for volatile organic analyses will have no air space in the sample vial prior to sealing. This is accomplished by filling the vial such that there is a meniscus on top. Carefully, slide the septum, teflon side down, onto the top of the vial. Cap the vial. Check for bubbles by turning the vial upside down and tapping it lightly. If bubbles appear, reopen the vial, remove the septum and add more sample (or resample). Replace the septum, recap the bottle and check for bubbles. Continue until vial is bubble-free.

(7) Return sample bottle to sample cooler.

(8) Decontaminate the bailer or pump as per the procedures outlined in Section 4.7.

4.6.3 Leachate

(1) Make sure location is noted on Location Sketch (see Section 4.9.1).

(2) Make sure that the sampler has been decontaminated utilizing the procedures outlined in Section 4.7.

(3) Remove the laboratory pre-cleaned sample bottle from the sample cooler, label bottle with an indelable marker, fill out Sample Information Record (see Section 4.9.2) and Chain of Custody Record (see Section 4.9.3).

(4) Wear disposable gloves and eye protection.

(5) Lower the bailer (see Figure No. 4-2) into the leachate pool making sure that the sample is taken just below the surface of the leachate.

(6) Raise the bailer out of the leachate pool.

(7) Gently pour the sample into the sample bottle taking care not to spill sample on outside of bottle or overfill bottle, and replace the cover on the sample bottle. For volatile organic samples, make sure that there are no air bubbles in the sample vial after it has been capped. This is accomplished by filling the vial such that there is a meniscus on top. Carefully slide the septum, teflon side down, onto the top of the vial and cap the vial. Check for bubbles by turning the vial upside down and tapping it lightly. If bubbles appear, reopen the vial, remove septum and add more sample (or resample). Replace septum, recap the bottle and check for bubbles. Continue until vial is bubble-free.

(8) Return sample bottle to sample cooler.

(9) If the bailer is not dedicated, decontaminate the sampler as per the procedures outlined in Section 4.7.

4.6.4 <u>Surface Water</u>

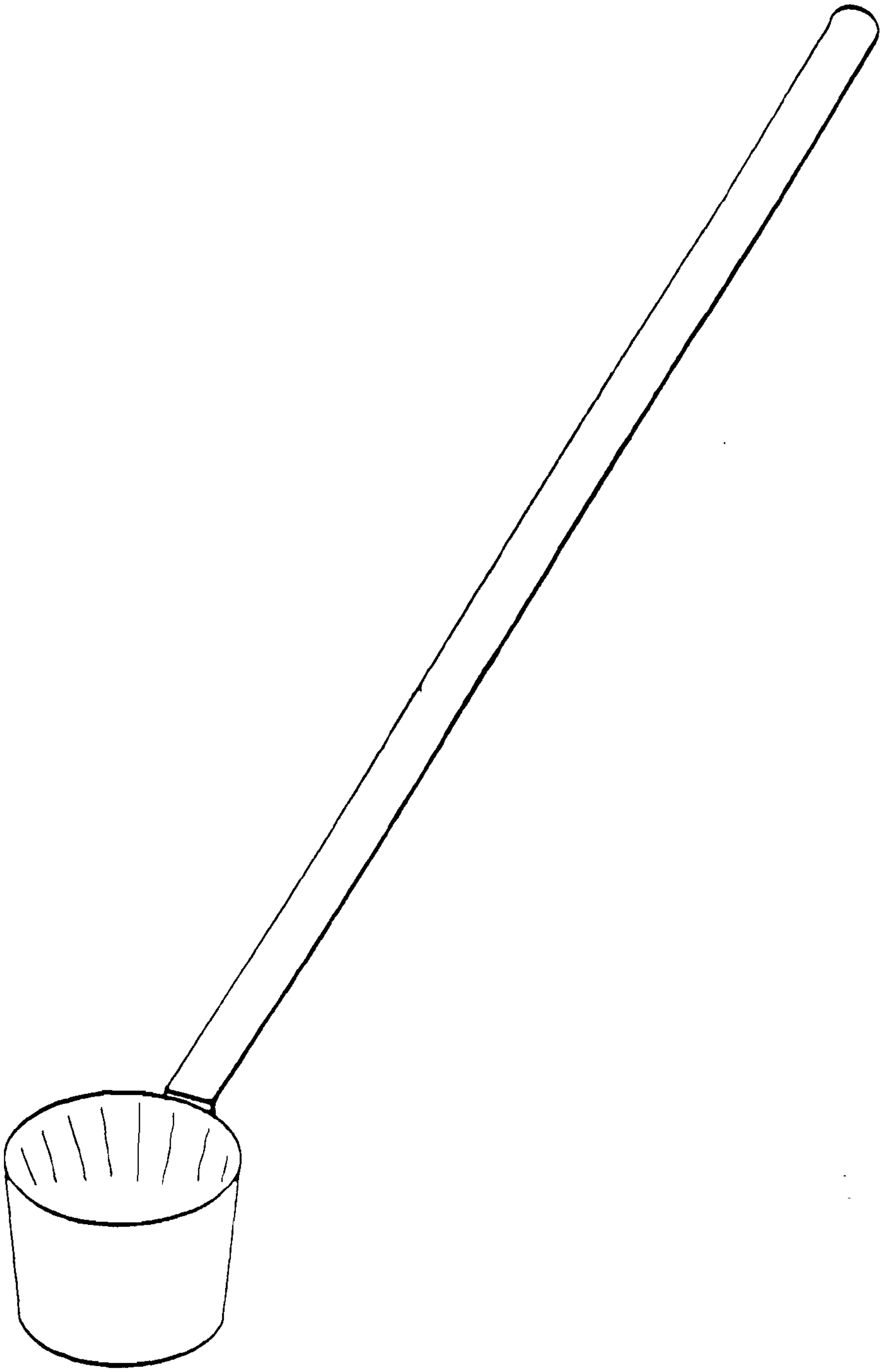
(1) Be certain that sample location is noted on Location Sketch (see Section 4.9.1).

(2) Unless the sample is to be collected directly into the sample container, be certain that the sampler, either the ladle or scoop (see Figure Nos. 4-3 and 4-4) has been decontaminated utilizing the procedures outlined in Section 4.7.

(3) Remove the laboratory pre-cleaned sample bottle from the sample cooler, label bottle with an indelible marker, fill out Sample Information Record (see Section 4.9.2) and Chain of Custody Form (see Section 4.9.3).

(4) Wear disposable gloves, and boots if it is necessary to enter the water.

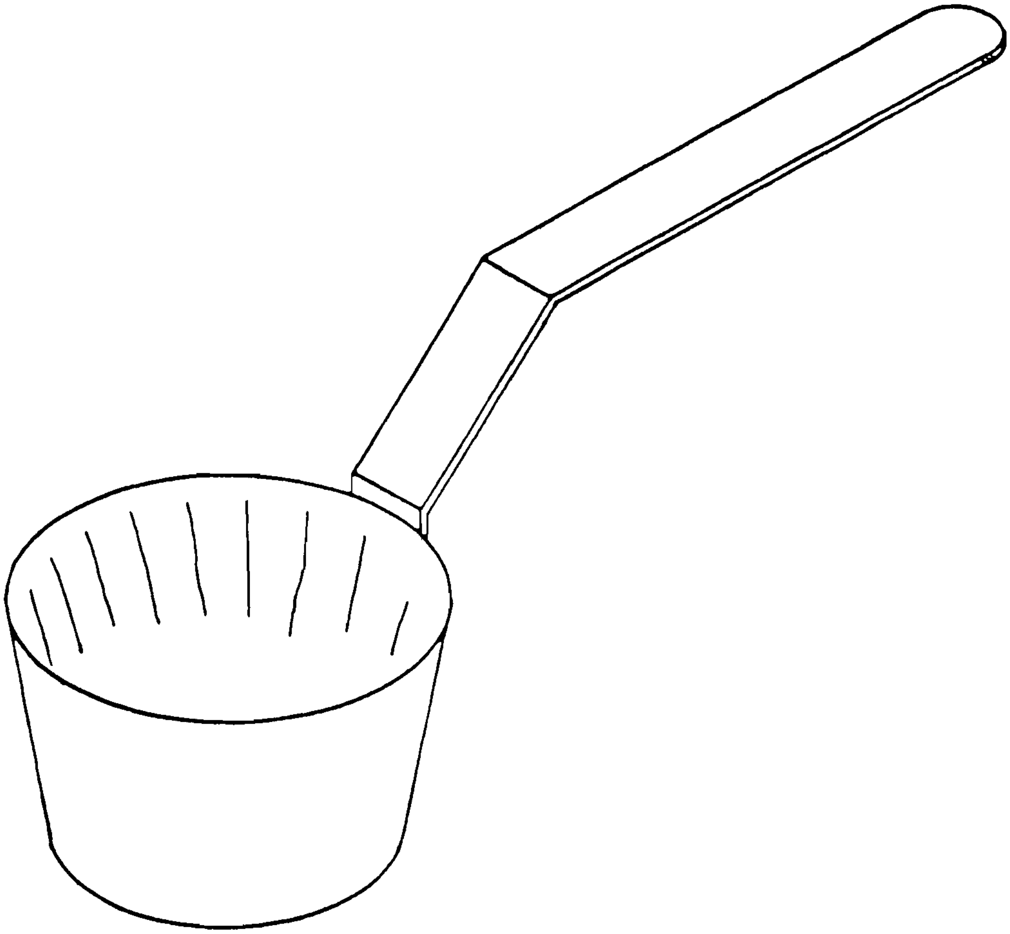
(5) Enter the water downstream of the sample location with minimum disturbance of the sediment and lower the sampler (or glass sample bottle) slowly into the water making sure that the sample is taken just below the surface of the water (or at the water/air interface if there is a sheen present) and raise the sample out of the water. Sample surface water first at the most downstream location and move sequentially upstream. (Also sample water before sediment to avoid introduction of sediment into the water column.)



FIELD EQUIPMENT
LONG HANDLE SCOOP

Dvirka
and
Bartilucci
CONSULTING ENGINEERS

FIGURE NO. 4-3



Dvirka and Bartilucci CONSULTING ENGINEERS

FIELD EQUIPMENT

LADLE

FIGURE NO. 4-4

(6) Gently pour the sample into the sample bottle if not sampled directly, taking care not to spill the sample on outside of bottle or overfill bottle, and replace the cover on the sample bottle. For volatile organic samples, make sure that there are no air bubbles in the sample vial after it has been capped. This is accomplished by filling the vial such that there is a meniscus on top. Carefully slide the septum, teflon side down, onto the top of the vial and cap the vial. Check for bubbles by turning the vial upside down and tapping it lightly. If the bubbles appear, reopen the vial, remove septum and add more sample (or resample). Replace septum, recap the bottle and check for bubbles. Continue until vial is bubble-free.

(7) Return sample bottle to sample cooler. If sample is obtained directly with a sample bottle, dry the exterior of the bottle before placing into cooler.

(8) If a scoop or ladle is used, decontaminate the sampler as per the procedures outlined in Section 4.7.

4.6.5 Surface Water Sediments

(1) Be certain that sample location is noted on Location Sketch (see Section 4.9.1).

(2) Unless using disposable equipment, be certain that the sampler has been decontaminated utilizing the procedures outlined in Section 4.7.

(3) Remove the laboratory pre-cleaned sample bottle from the sample cooler, label bottle with an indelible marker, fill out Sample Information Record (see Section 4.9.2) and Chain of Custody Form (see Section 4.9.3).

(4) Wear disposable gloves, and boots if it is necessary to enter the water.

(5) Choose either the ladle or scoop (see Figure Nos. 4-3 and 4-4) depending on site specific conditions.

(6) Insert scoop or ladle into sediment and remove sample.

(7) With the aid of a disposable sterile wooden tongue depressor, transfer the sample into the open sample bottle taking care not to spill sample on the outside of the bottle or overfill bottle. Close the sample bottle.

(8) Return sample bottle to sample cooler.

(9) Decontaminate the sample equipment according to procedures outlined in Section 4.7 and safely dispose of the tongue depressor.

4.6.6 Air

(1) For the total organic vapor analyzer (OVA) and multi-gas meter, place the instrument directly over the borehole or sampling point and allow the instrument readings to stabilize (if possible). For the dust indicator, place the instrument about 20 feet from the borehole during drilling and allow the readings to stabilize (again, if possible).

(2) If readings on the OVA and gas meter are above background, move the meter into the vicinity of the breathing zone of workers at the borehole/sample site, and allow readings to stabilize (if possible).

(3) Record instrument readings on the Air Monitoring Form (see Sections 4.9.8 and 5.12).

(4) If readings of organic vapors, gases and dust are above the action levels as provided in Section 5.4.3, appropriate measures will be undertaken as described in this same section.

4.7 Decontamination Procedures

Prior to sampling, all reusable field sampling equipment must be decontaminated according to NYSDEC protocol as follows:

(1) Equipment will be washed thoroughly with non-residual detergent (alconox) and tap water using a brush to remove any particulate matter or surface film.

(2) Rinse equipment thoroughly with tap water.

(3) Rinse equipment thoroughly with distilled water.

(4) Rinse equipment with hexane (pesticide grade) or methanol (pesticide grade) and air dry.

(5) Rinse equipment thoroughly with distilled water and air dry.

(6) Wrap equipment completely with aluminum foil (shiny side out) to prevent contamination during storage and/or transport to or in the field.

(7) Remove residue and rinse the sampling equipment thoroughly with tap water in the field as soon as possible after use.

Submersible pumps, if used to evacuate the wells, will be decontaminated by wiping down with detergent and water, placing in a clean plastic trash can and pumping ten volumes of clean tap water through the unit, including all tubing and appurtenances. Care must be taken to observe safety precautions if the pump is hooked up to a power source.

Drilling rig and split spoon decontamination procedures.

(1) Wash thoroughly with non-residual detergent (alconox) and tap water using a brush to remove particulate material or surface film.

(2) Steam clean (212°F).

Sampling and drilling equipment will be decontaminated at a "decon" pad located on the landfill site. For small sampling items, such as spatulas and scoops, decontamination will take place over a drum specifically used for this purpose. All equipment will be decontaminated before proceeding to the work area.

4.8 Laboratory Sample Custody Procedures

Nytest Environmental is a NYSDEC approved laboratory meeting the requirements for sample custody procedures, including cleaning and handling sample containers and analytical equipment.

4.9 Field Management Procedures

Proper management of field activities is essential to assure that all the necessary work is conducted in accordance with the sampling plan in an efficient manner. Field management procedures include following proper chain-of-custody procedures to track a sample from collection through analysis, noting when and how samples are split, if required, preparing a Location Sketch, a Sample Information Record Form, a Chain of Custody Form, Boring and Well Construction Logs, maintaining a Field Log Book daily, preparing Daily Field Activity Reports, completing Field Change Forms and filling out an Air Monitoring Form. A discussion of these procedures follows.

4.9.1 Location Sketch

All sampling locations are to be noted on the Location Sketch, with reference to permanent reference points (if possible). A copy of this form can be found in Section 4.19.

4.9.2 Sample Information Record

At each sampling location, the Sample Information Record form is filled out and maintained providing the following information:

- Site name
- Sample crew
- Sample location/well number
- Field sample identification number
- Date
- Time
- Weather
- Temperature
- Sample type/method of collection
- Well information (ground water only)
- Field test results
- Constituents sampled
- Remarks

A copy of the form can be found in Section 4.19.

4.9.3 Chain of Custody

Sample custody is integral to reliable field and laboratory operation. A sample is considered to be in an individual's custody if any of the following conditions are met:

- It is in the individual's physical possession, or
- It is in the individual's view after being in his or her physical possession, or
- It is secured by the individual so that no one can tamper with it, or
- The individual puts it in a designated and identified secure area.

In general, Chain of Custody Forms are provided by the laboratory contracted to perform the analytical services. At a minimum, the following information should be provided on these forms:

- Project name and address
- Project number
- Sample number
- Date
- Time
- Sample location
- Sample type
- Analysis
- Number of containers
- Remarks
- Type of waste
- Sampler(s) name(s) and signature(s)
- Spaces for relinquished by/received by signatures and date/time

For this investigation, forms provided by Nytest Environmental will be utilized. A copy of this form can be found in Section 4.19.

The Chain of Custody Form is filled out and signed by the person performing the sampling. The original of the form travels with the sample and is signed each time the sample is relinquished to another party, until it reaches the laboratory or analysis is completed. The field sampler keeps one copy and a copy is retained for the project file.

All samples and the Chain of Custody Form will be delivered to the laboratory 24 to 48 hours from day of collection. The sample bottle must also be labeled with a water proof marker with a minimum of the following information:

- Sample number
- Analysis to be performed
- Date

A copy of the completed form is returned by the laboratory with the analytical results.

4.9.4 Split Samples

Whenever samples are being split with another party, a Receipt for Samples Form must be completed and signed. A copy of this form can be found in Section 4.19. A copy of the Chain of Custody Form will accompany this form. This work plan does not provide for split samples.

4.9.5 Field Log Book

The Field Log Book is a bound book of consecutively numbered pages maintained for each project. The first page of this log contains the following information:

- Project name and address
- Name, address and phone number of field contact
- Waste generator and address, if different from above
- Type of process (if known) generating waste
- Type of waste
- Suspected waste composition, including concentrations

Daily entries are made for the following information:

- Purpose of sampling
- Location of sampling point
- Number(s) and volume(s) of sample(s) taken
- Description of sampling point and sampling methodology
- Date and time of collection

- Collector's sample identification number(s)
- Sample distribution and method of storage and transportation
- Calibration of equipment and results
- References such as maps of the sampling site or photographs of sample collection
- Field observations, including results of field analyses (e.g.: pH, Eh, temperature, specific conductance), water levels, drilling logs and borings
- Signature of personnel responsible for completing log entries

4.9.6 Daily Field Activity Reports

At the end of each day of field work, the Field Operations Officer completes this form summarizing the work performed that day, results of field analyses, problems and resolutions. A cross reference is made to the Field Log Book by page number, if appropriate. This form is then signed and is subject to review. A copy of the Daily Field Activity Report can be found in Section 4.19.

4.9.7 Field Changes

Whenever there is a required or recommended investigation/sampling plan change made in the field, a Field Change Form needs to be completed. This form is completed by the Field Operations Officer and NYSDEC field supervisor, and approved by the Project Manager for Dvirka and Bartilucci Consulting Engineers and NYSDEC Project Manager. A copy of this form is contained in Section 4.19.

4.9.8 Air Monitoring

Whenever air monitoring using an organic vapor analyzer or dust indicator is required, an Air Monitoring Form needs to be completed. A copy of this form is contained in Section 4.19.

4.10 Calibration Procedures and Preventative Maintenance

The following information/equipment will be maintained at the project site:

- Field and laboratory equipment checklists, and an equipment log book which will contain schedules, methods and records of usage, maintenance, calibration and repairs (see Appendix B of this work plan for Calibration Procedures and Standard Operating Procedures for using field instrumentation). Calibration of equipment will be performed on a daily basis except where expressly noted in the equipment manual(s). A record of equipment calibration will be recorded on a Daily Equipment Calibration Log, a copy of which is provided in Section 4.19.
- A schedule of preventive maintenance tasks that will be carried out to minimize downtime of the measurement equipment.
- Critical spare parts that will be on hand to minimize equipment downtime.

4.11 Documentation, Data Reduction and Reporting

Nytest Environmental is a NYSDEC approved laboratory meeting requirements for documentation, data reduction and reporting. All data will be catalogued according to sampling locations. NYSDEC "Sample Identification and Analytical Requirements Summary" and "Sample Preparation and Analysis Summary" forms will be completed and included with the data package. These forms are contained in Section 4.20. The sample tracking form will reflect the year of the NYSDEC Analytical Services Protocol used.

4.12 Data Validation

Nytest Environmental is a NYSDEC approved laboratory meeting requirements for data validation. As described in Section 4.11 above, summary documentation regarding data validation will be completed by the laboratory using NYSDEC forms contained in Section 4.20 and submitted with the data package.

Data validation will be performed in order to define and document analytical data quality in accordance with NYSDEC requirements that project data must be of known and acceptable quality. The analytical and validation processes will be conducted in conformance with the NYSDEC State Analytical Services Protocols, dated September 1989.

Because the NYSDEC Analytical Services Protocols are based in large part on the USEPA Contract Laboratory Protocols (CLP), USEPA Functional Guidelines for Evaluating Organics and Inorganics Analyses for the CLP will be utilized in formulating standard operating procedures (SOPs) for the data validation process. These SOPs are essentially consistent with, and equivalent to, procedures and requirements defined in the NYSDEC documents. Procedures will address validation of routine analytical services (RAS) results based on the NYSDEC ASP for standard sample matrices as well as non-routine (non-TCL or non-standard matrices such as ambient air VOC analyses) special analytical services (SAS) methodology.

The data validation process will provide an informed assessment of the laboratory's performance based upon contractual requirements and applicable analytical criteria. The report generated as a result of the data validation process will provide a base upon which the usefulness of the data can be evaluated by the end user of the analytical results. The overall level of effort and specific data validation procedure to be used will be equivalent to a "100% validation" of all analytical data in any given data package.

During the review process, it will be determined whether the laboratory submittals for sample results are supported by sufficient back-up data and QA/QC results to enable the reviewer to conclusively determine the quality of data. Each data package will be checked for completeness and technical adequacy of the data.

"Qualified" analytical results for any one field sample are established and presented based on the results of specific QC samples and procedures associated with its sample analysis group or batch. Precision and accuracy criteria (i.e., QC acceptance limits) are used in determining the need for qualifying data. Where test data have been reduced by the laboratory, the method of reduction will be described in the report. Reduction of laboratory measurements and laboratory reporting of analytical parameters shall be verified in accordance with the procedures specified in the NYSDEC program documents for each analytical method (i.e., recreate laboratory calculations and data reporting in accordance with the method specific procedure). The standard operating guidelines manuals and any special analytical methodology required are expected to specify documentation needs and technical criteria and will be taken into consideration in the validation process.

Upon completion of the review, a summary report will be developed to include a cover letter, a brief summary of each QA/QC parameter, the completed QA/QC check lists for each data package and the "qualified" analytical results for each sample analyzed. This summary report will be submitted to NYSDEC.

Examples of standard organics and inorganics data validation QA/QC inventory lists which are proposed for use on this project are contained in Section 4.22. These report forms will be modified as necessary and appropriate for any project specific or NYSDEC requirements.

The following is a description of the two-phased approach to data validation planned to be used in this project. The first phase is called checklisting and the second phase is the analytical quality review, with the former being a subset of the latter.

- Checklisting - The data package is checked for correct submission of the contract required deliverables, correct transcription from the raw data to the required deliverable summary forms and proper calculation of a number of parameters.

- Analytical Quality Review - The data package is closely examined to recreate the analytical process and verify that proper and acceptable analytical techniques have been performed. Additionally, overall data quality and laboratory performance is evaluated by applying the appropriate data quality criteria to the data to reflect conformance with the specified, accepted QA/QC standards and contractual requirements.

4.13 Performance and System Audits

Nytest Environmental is a NYSDEC approved laboratory satisfactorily completing performance audits and performance evaluation samples.

4.14 Corrective Action

Nytest Environmental is a NYSDEC approved laboratory meeting requirements for corrective action protocols.

Although highly unlikely, if the laboratory encounters samples with matrix interferences which prevent the achieving of ASP detection limits after utilizing the required ASP cleanup procedures and no target compounds are found, then the laboratory will notify Dvirka and Bartilucci Consulting Engineers and the NYSDEC QA/QC officer for guidance and with suggestions as to how to proceed with the analysis.

4.15 Trip Blanks

A trip blank is an aliquot of analyte-free water prepared in the laboratory, and transported to and from the field unopened. It is a check on sample contamination originating from laboratory decontamination procedures, handling and sample transport. A trip blank is provided daily, or for a 48-hour "batch" of samples. (NYSDEC allows samples to be held in the field for a maximum of 48 hours between the day of sample collection until delivery to the laboratory.) Trip blanks are analyzed only when collecting water samples and for volatile organic chemicals only.

4.16 Field Blanks

The field blank is an aliquot of analyte-free water which is opened in the field, and is generally poured over or through a sample collection device, (after it is decontaminated), collected in a sample container and returned to the laboratory as a sample for analysis. It is a check on sampling procedures and cleanliness (decontamination) of sample devices. Generally a field blank is collected daily or for a "batch" of sample matrices collected in the same manner (such as sediment, surface water, etc.) up to a maximum of 20 samples. Field blanks are analyzed for the suite of chemicals analyzed for in the environmental samples collected in that "batch". Field blanks do not need to be analyzed when using dedicated or disposable (one use only) sampling equipment.

4.17 Matrix Spikes/Matrix Spike Duplicates

Matrix spikes and matrix spike duplicates are used by Nytest Environmental as part of its Internal Quality Assurance/Quality Control Program (QA/QC). This QA/QC check is consistent with the New York State Department of Environmental Conservation Quality Control Laboratory Protocol. One liquid and one solid matrix spike sample will be collected and submitted for laboratory analysis for every 20 samples of a similar matrix. A matrix spike duplicate will also be collected and submitted for each matrix (liquid and solid).

4.18 Method Blanks

Method blanks are analyzed daily by the laboratory to check for contamination which may be introduced to the sample as a result of the analytical procedure itself. In instances where a particular compound is found in the method blank and in the environmental sample, the concentration in the environmental sample must be at least 10 times that of the method blank in order for the result to be valid.

4.19 Field Management Forms

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CONSULTING ENGINEERS

BORING LOG

PROJECT Nº

OWNER

PROJECT NAME

WELL / BORING Nº

SHEET OF

BY DATE

CHK'D DATE

DRILLING CONTRACTOR

DRILLER GEOLOGIST

DRILL RIG DRILLING METHOD

DATE STARTED DATE COMPLETED

BOREHOLE COMPLETION DEPTH

INITIAL HOLE DIA.

GROUND SURFACE EL.

FINISHED TOP EL.

MEASUREMENT POINT

DEPTH (ft.)	ABSOLUTE ELEVATION (msl)	SAMPLE Nº	SAMPLING INTERVAL (ft.)	PENETRATION (in.)	RECOVERY (in.)	BLOWS / 6"	OVA / HNU / TIP HEADSPACE READING (ppm)	SAMPLE DESCRIPTION	GRAPHIC LOG	WELL CONSTRUCTION

REMARKS:

STATIC WATER LEVEL DATE

LEVEL DATE

LEVEL DATE

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WELL CONSTRUCTION LOG

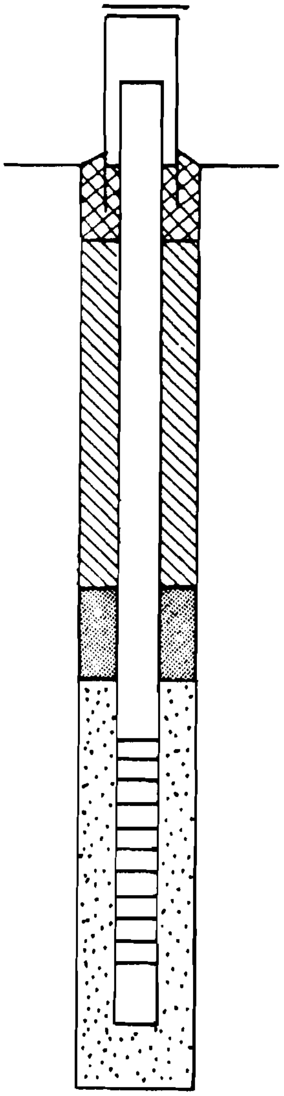
SITE ____________ JOB NO. ____________ WELL NO. ____________

TOTAL DEPTH ____________ SURFACE ELEV. ____________ TOP RISER ELEV. ____________

WATER LEVELS (DEPTH, DATE, TIME) ____________ DATE INSTALLED ____________

RISER DIA. ______ MATERIAL ____________ LENGTH ______
SCREEN DIA. ______ MATERIAL ____________ LENGTH ______ SLOT SIZE ______
PROT. CSG DIA. ______ MATERIAL ____________ LENGTH ______

SCHEMATIC



Surface Seal Type ____________

Grout Type ____________

Seal Type ____________

Sand Pack Type/Size ____________

______ Prot. Csg Stickup

______ Riser Stickup

Ground Surface

______ Bottom Surface Seal

______ Top Seal

______ Top Sand Pack

______ Top Screen

______ Bottom Screen

______ Bottom Sump/Wellpoint

______ Total Depth of Boring

Comments ____________

Driller ____________

Geologist ____________ NYS DEC Inspector ____________

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DAILY FIELD ACTIVITY REPORT

REPORT NO.: ____________ PROJECT NO.: ______________ DATE: ______________________

FIELD LOG BOOK PAGE NUMBER: ___________________________

PROJECT: ____

ADDRESS: ____

WEATHER: (AM) _________________________________ RAINFALL: (AM) __________ INCHES
(PM) _________________________________ (PM) __________ INCHES

TEMPERATURE: (AM) ___°F WIND SPEED: (AM) _____ MPH WIND DIRECTION: (AM) _____
(PM) ___°F (PM) _____ MPH (PM) _____

SITE CONDITION: ____

PERSONNEL ON SITE:

NAME	AFFILIATION

SUBCONTRACTOR
WORK COMMENCEMENT: (AM) ___________________________ (PM) ___________________________

SUBCONTRACTOR
WORK COMPLETION: (AM) ___________________________ (PM) ___________________________

Dvirka and Bartilucci
CONSULTING ENGINEERS

DATE: ____________________

DAILY FIELD ACTIVITY REPORT

WORK PERFORMED TODAY BY SUBCONTRACTOR(S) (INCLUDES EQUIPMENT AND LABOR BREAKDOWN): ____________________

Dvirka and Bartilucci
CONSULTING ENGINEERS

DATE: ______________________

DAILY FIELD ACTIVITY REPORT

GENERAL WORK PERFORMED TODAY BY D&B CONSULTING ENGINEERS: ______________________

LIST SPECIFIC INSPECTION(S) PERFORMED AND RESULTS (INCLUDE PROBLEMS AND CORRECTIVE ACTIONS): ______________________

LIST TYPE AND LOCATION OF TESTS PERFORMED AND RESULTS (INCLUDE EQUIPMENT USED AND MONITORING RESULTS): ______________________

VERBAL COMMENTS RECEIVED FROM SUBCONTRACTOR (INCLUDE CONSTRUCTION AND TESTING PROBLEMS, AND RECOMMENDATIONS/RESULTING ACTIONS): ______________________

PREPARED BY: ______________________ REVIEWED BY: ______________________

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CONSULTING ENGINEERS

DAILY EQUIPMENT CALIBRATION LOG

Project Name______________________________ Date______________________________

Project Number_____________________________ Calibrated by____________________

Instrument Name and Model #	Calibration Method	Time	Readings and Observations

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CONSULTING ENGINEERS

LOCATION SKETCH

Project ______________________ Sample Crew ______________________

Site Location ____

Sample Location(s) and/or Well Number(s) ______________________

____

Location of sample points, wells, borings, etc., with reference to three permanent reference points. Measure all distances, clearly label roads, wells and permanent features.

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SAMPLE INFORMATION RECORD

SITE ______________________ SAMPLE CREW ______________________

SAMPLE LOCATION/WELL NO. ______________________

FIELD SAMPLE I.D. NUMBER ______________ DATE ______________

TIME __________ WEATHER ______________ TEMPERATURE __________

SAMPLE TYPE:

GROUND WATER ______________ SEDIMENT ______________

SURFACE WATER/STREAM ______________ AIR ______________

SOIL ______________ OTHER (Describe, i.e., septage, leachate) ______________

WELL INFORMATION (fill out for groundwater samples):

DEPTH TO WATER __________ MEASUREMENT METHOD ______________

DEPTH OF WELL __________ MEASUREMENT METHOD ______________

VOLUME REMOVED __________ REMOVAL METHOD ______________

FIELD TEST RESULTS:

COLOR __________ pH __________ ODOR __________

TEMPERATURE (°F) __________ SPECIFIC CONDUCTANCE (umhos/cm) __________

OTHER (OVA, Methane meter, etc.) ______________________

____

CONSTITUENTS SAMPLED:

__________ __________ __________ __________

__________ __________ __________ __________

REMARKS: ______________________________________

____

____

WELL CASING VOLUMES

GAL/FT	1-1/4" = 0.077	2" = 0.16	3" = 0.37	4" = 0.65
	1-1/2" = 0.10	2-1/2" = 0.24	3-1/2" = 0.50	6" = 1.46

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CHAIN OF CUSTODY RECORD

PROJECT NAME: ____________________ **FIELD LOG BOOK REFERENCE NUMBER:** ____________

PROJECT ADDRESS: ____________________ **SHIPPED VIA:** ____________________

PROJECT NUMBER: ____________________ **SAMPLED BY:** ____________________

SAMPLE NUMBER	DATE	TIME	COMPOSITE	GRAB	LOG BOOK PAGE NUMBER	SAMPLE LOCATION	NUMBER OF CONTAINERS	ANALYSIS							REMARKS

Relinquished by: *(Signature)* (1)	Date/Time	Received by: *(Signature)* (1)	Relinquished by: *(Signature)* (2)	Date/Time	Received by: *(Signature)* (2)
Relinquished by: *(Signature)* (3)	Date/Time	Received by: *(Signature)* (3)	Relinquished by: *(Signature)* (4)	Date/Time	Received by: *(Signature)* (4)
Relinquished by: *(Signature)* (5)	Date/Time	Received for Laboratory by: *(Signature)*	Date /Time	Remarks	

SAMPLER (Signature) ____________________

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RECEIPT FOR SAMPLES

PROJECT NAME: ______________________ **FIELD LOG BOOK REFERENCE NUMBER:** ______________

PROJECT ADDRESS: ______________________ **SAMPLED BY:** ______________________

PROJECT NUMBER: ______________________ **SPLIT WITH:** ______________________

SAMPLE NUMBER	DATE	TIME	COMP	GRAB	SPLIT SAMPLES	LOG BOOK PAGE NO.	TAG NUMBERS	SAMPLE LOCATION	NO. OF CONTAINERS	REMARKS

Transferred by *(Signature)*	Received by *(Signature)* Telephone
Date Time	Title Date Time

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AIR MONITORING FORM

PROJECT NAME: ______________________________ DATE: ____________________

PROJECT NUMBER: ____________________________ INSTRUMENT: ________________

RECORDED BY: _______________________________ CALIBRATION DATE: __________

WEATHER CONDITIONS: ________________________ CALIBRATED BY: _____________

TIME	LOCATION	WIND SPEED AND DIRECTION	READING	OBSERVATIONS

RECORDING PROCEDURES/REMARKS: ____

____

____

____

____

Dvirka and Bartilucci CONSULTING ENGINEERS

FIELD CHANGE FORM

PROJECT NAME: ____________________

PROJECT NO.: __________ FIELD CHANGE NO.: __________

LOCATION: __________ DATE: __________

FIELD ACTIVITY DESCRIPTION: ____________________

REASON FOR CHANGE: ____________________

RECOMMENDED DISPOSITION: ____________________

FIELD OPERATIONS OFFICER (D&B CONSULTING ENGINEERS) (SIGNATURE) DATE

DISPOSITION: ____________________

ON-SITE SUPERVISOR (NYSDEC) (SIGNATURE) DATE

DISTRIBUTION: Project Manager (D&B)
Project Manager (NYSDEC)
Field Operations Officer
On-Site Supervisor (NYSDEC)

Others as required __________

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In-Situ Hydraulic Conductivity Test

Slug Test

Project:______________________________ Measured By:______________________

Type of Test:________________________ Water Level Measurement
Reference Point:_________________

Location:_____________________________

Test No:___________________________________

Date	Time	Depth to water (Ft)	Head (Ft)	Correction	Corrected Head (Ft)	Elapsed Time (Min)	Remarks

4.20 NYSDEC Sample Identification, Preparation and Analysis Summary Forms

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE IDENTIFICATION AND ANALYTICAL REQUIREMENT SUMMARY

Customer Sample Code	Laboratory Sample Code	Analytical Requirements*					
		*VOA GC/MS	*BNA GC/MS	*VOA GC	*PEST PCB	*METALS	*OTHER

*** Check Appropriate Boxes**

*** CLP, Non-CLP** (PLEASE INDICATE YEAR OF PROTOCOL)
*** HSL, Priority Pollutant**

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY
B/N-A
ANALYSES

SAMPLE ID	MATRIX	DATE COLLECTED	DATE REC'D AT LAB	DATE EXTRACTED	DATE ANALYZED

DU.OPREP.1

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY

ORGANIC ANALYSES

SAMPLE ID	MATRIX	ANALYTICAL PROTOCOL	EXTRACTION METHOD	AUXILARY CLEAN UP	DIL/CONC FACTOR

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY
VOA
ANALYSES

SAMPLE ID	MATRIX	DATE COLLECTED	DATE REC'D AT LAB	DATE EXTRACTED	DATE ANALYZED

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY
PESTICIDE/PCB
ANALYSES

SAMPLE ID	MATRIX	DATE COLLECTED	DATE REC'D AT LAB	DATE EXTRACTED	DATE ANALYZED

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY

INORGANIC ANALYSES

SAMPLE ID	MATRIX	METALS REQUESTED	DATE RECEIVED	DATE DIGESTED	DATE ANALYZED

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

:DU.IPFEF.1

SAMPLE PREPARATION AND ANALYSIS SUMMARY

INORGANIC ANALYSES

LABORATORY SAMPLE CODE	MATRIX	ANALYTICAL PROTOCOL	DIGESTION PROCEDURE	MATRIX MODIFIER	DIL/CONC FACTOR

4.21 Data Validation Reporting Forms

DATA VALIDATION-ORGANICS

Site Name:____________________ Laboratory Name:____________________

Reviewer:____________________ Date of Review:____________________

I. Data Deliverable Requirements

A.	Legible	Yes	No
B.	Paginated	Yes	No
C.	Arranged in order	Yes	No
D.	Consistent dates	Yes	No
E.	Case Narrative	Yes	No
F.	Chain-of-Custody Record	Yes	No
G.	Sample Data Complete	Yes	No
H.	Standard Date Complete	Yes	No
I.	Raw QC Data Complete	Yes	No

Comments:____

DATA VALIDATION-ORGANICS

Site Name:________________________ Laboratory Name:____________________________

Reviewer:_________________________ Date of Review:____________________________

II. Holding Times

Sample I.D.	Date Received	Date Extracted	Date Analyzed	Holding Time Exceeded ?

DATA VALIDATION-ORGANICS

Site Name:____________________ Laboratory Name:____________________

Reviewer:____________________ Date of Review:____________________

Fraction:____________________

III. Tune Summary

Tune File I.D. Number	Acceptable ?	Comments
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

DATA VALIDATION-ORGANICS

Site Name:____________________ Laboratory Name:____________________

Reviewer:____________________ Date of Review:____________________

Fraction:____________________

IV. Initial Calibration Summary (GC/MS[1])

Date of Calibration:____________

A. Standard Data Files

Standard 1 ID:____________________ Conc:____________________

Standard 2 ID:____________________ Conc:____________________

Standard 3 ID:____________________ Conc:____________________

Standard 4 ID:____________________ Conc:____________________

Standard 5 ID:____________________ Conc:____________________

B. 1. All SPCC met Criteria ?

Yes No

2. Calculate a SPCC average RRF

Comments:____

DATA VALIDATION-ORGANICS

Site Name:______________________ Laboratory Name:__________________________

Reviewer:_______________________ Date of Review:___________________________

Fraction:_______________________ Date of Calibration:______________________

IV. Initial Calibration Summary (continued)

2. All CCC met Criteria ?

Yes No

Comments:____

____

Calculate a CCC % RSD

C. 1. Was the tune for the initial calibration acceptable ?

Yes No

2. Was the calibration conducted within 12 hours of the tune ?

Yes No

Comments:____

____

____

D. Overall assessment of the initial calibration:
(list the associated samples)

____

____

____

DATA VALIDATION-ORGANICS

Site Name:______________________ Laboratory Name:__________________________

Reviewer:_______________________ Date of Review:___________________________

V. Pesticide Initial Calibration Summary

Column:_____________________ primary confirmation

Date of Calibration:_______________________

A. Analytical Sequence Check

Acceptable ? Yes No

Comments:____

____

____

B. Was the retention time of 4,4'-DDT greater than 12 minutes ?

Yes No

Comments:____

____

____

C. Was the linearity check criteria (± 10% RSD on the quantitation column) met ?

Yes No

Calculation

Comments:____

____

____

DATA VALIDATION-ORGANICS

Site Name:____________________ Laboratory Name:______________________

Reviewer:_____________________ Date of Review:_______________________

V. Pesticide Initial Calibration Summary (continued)

Date of Calibration:____________________

D. Was the breakdown of 4,4'-DDT and Endrin less than 20% ?

Yes No

(<20% each for the 1% column)
(<20% combined for the 3% OV-1 column)

Calculation

Comments:____

____

E. Were the retention times and retention time windows acceptable ?

Yes No

Comments:____

____

F. Overall assessment of the initial calibration:
(list the associates samples)

____

____

____

____

____

DATA VALIDATION-ORGANICS

Site Name:____________________ Laboratory Name:____________________

Reviewer:____________________ Date of Review:____________________

Fraction:____________________

VI. Continuing Calibration Summary (GC/MS)

Date of Initial Calibration:____________________

Date of Continuing Calibration:____________________ File ID:__________

A. 1. All SPCC met criteria ?

Yes No

Calculate a SPCC RRF

Comments:____

____

2. All CCC met criteria ?

Yes No

Calculate a CCC % D

Comments:____

____

B. Overall assessment of Continuing Calibration
(list associates samples)

____

____

DATA VALIDATION-ORGANICS

Site Name:________________ Laboratory Name:________________

Reviewer:________________ Date of Review:________________

VII. Pesticide continuing Calibration Summary

Column:________________ primary confirmation

Date of Initial Calibration:________________

Date of Continuing Calibration:________________ File ID:________

A. Did the pesticide standard compounds show a % D of the calibration factor of less than 15% if it was a quantitation run or 20% if it was a confirmation run for all compounds identified ?

Yes No

Calculate a compound's calibration factor for the standard.

Calculate a compound's % D value.

Comments:____

____

____

____

DATA VALIDATION-ORGANICS

Site Name:____________________ Laboratory Name:____________________

Reviewer:____________________ Date of Review:____________________

VII. Pesticide continuing Calibration Summary (continued)

Date of Continuing Calibration:____________________File ID:____________________

B. Did each compound's retention time fall within the window ?

Yes No

Comments:____

____

____

C. Were the DBC retention time shifts within the specified limits ? (± 2% for packed columns, ± 0.3% for capillary columns)

Yes No

Calibrate a DBC RT % D

Comments:____

____

____

D. Overall assessment of the continuing calibration:
(List the associated samples)

____

____

____

____

DATA VALIDATION-ORGANICS

Site Name:______________________ Laboratory Name:__________________________

Reviewer:_______________________ Date of Review:__________________________

Fraction:_______________________

VIII. Internal Standard Area Summary (GC/MS)

Were all internal standard peak areas within the contract limits ?

Yes No

If No, please note below.

Sample	Internal Standard Outside Limits	Amount Above Contract Requirement	Comments

DATA VALIDATION-ORGANICS

Site Name: ____________________ Laboratory Name: ____________________

Reviewer: ____________________ Date of Review: ____________________

Fraction: ____________________

IX. Blank Summary

Date/Time of Analysis: ____________________ File ID: ________________

Compound	Concentration	< CRQL	Comments

List the samples associated with this method blank.

____

____

____

____

DATA VALIDATION-ORGANICS

Site Name:______________________ Laboratory Name:__________________________

Reviewer:_______________________ Date of Review:__________________________

Fraction:_______________________

X. Surrogate Recovery Summary

Were all surrogate recoveries within the contract limits ?

Yes No

If No, please note below.

Sample	Surrogate Compound Outside Recovery Limits	Amount Above Contract Requirement	Comments

DATA VALIDATION-ORGANICS

Site Name:________________________ Laboratory Name:____________________________

Reviewer:_________________________ Date of Review:____________________________

Fraction:_________________________

XI. Matrix Spike/Matrix Spike Duplicate Summary

Sample ID:________________________ Matrix:____________________________

Did the MS/MSD recovery data meet the contract recommended requirements ?

Yes No

If No, please note below.

____

____

____

____

DATA VALIDATION-INORGANICS

Site Name:________________________ Laboratory Name:____________________________

Reviewer:_________________________ Date of Review:____________________________

I. Holding Times

Sample I.D.	Date Received	Date Extracted	Date Analyzed	Holding Time Exceeded ?

DATA VALIDATION-INORGANICS

Site Name:______________________ Laboratory Name:__________________________

Reviewer:______________________ Date of Review:__________________________

Associated Samples:____

II. Initial Calibration

1. Were all initial instrument calibrations performed?

Yes No

Comments:____

____

____

2. Were the initial calibration vertification standards analyzed at the contract specified frequency?

Yes No

Comments:____

____

____

3. Were the initial calibration results within the control limits listed below?

For tin and mercury: 80-120% of the true value
For all other metals: 90-110 of the true value

Yes No

If "No", note analytes____

DATA VALIDATION-INORGANICS

Site Name:____________________ Laboratory Name:____________________

Reviewer:____________________ Date of Review:____________________

Associated Samples:____

III. Continuing Calibration

1. Were the continuing calibration verification standards analyzed at the contract specified frequency?

Yes No

Comments:____

____

____

2. Were the continuing calibration results within the control limits listed below?

For tin and mercury: 80-120% of the true value
For all other metals: 90-110 of the true value

Yes No

If "No", note analytes____________________________________

DATA VALIDATION-INORGANICS

Site Name:____________________ Laboratory Name:____________________

Reviewer:____________________ Date of Review:____________________

IV. Blank Summary

A. Method Blanks

1. Was a method blank prepared and analyzed at the contract specified frequency?

   Yes No

2. Were all the analytes below the CRDL in the method blank?

   Yes No

Comments:____

____

____

B. Calibration Blanks

1. Were all initial and continuing calibration blanks analyzed at the contract specified frequency?

   Yes No

2. Were all the analytes below the CRDL in all the calibration blanks?

   Yes No

Comments:____

____

____

DATA VALIDATION-INORGANICS

Site Name:________________________ Laboratory Name:____________________________

Reviewer:_________________________ Date of Review:_____________________________

V. Duplicate Analysis

1. Was a duplicate prepared and analyzed at the contract specified frequency?

Yes No

Comments:____

____

____

2. Were control limits for the relative percent differences (RPD) met for each analyte?

Yes No

Comments:____

____

____

For sample values >5 times the CRDL, the RPD control limit is ±20%

For sample values <5 times the CRDL, the RPD control limit is ±CRDL.

If sample results were outside of the control limits, all data associated with that duplicate sample should have been flagged with a "*".

DATA VALIDATION-INORGANICS

Site Name:____________________ Laboratory Name:____________________

Reviewer:____________________ Date of Review:____________________

VI. Matrix Spike Analysis

1. Was a matrix spike prepared and analyzed at the contract specified frequency?

Yes No

Comments:____

____

____

2. Were the matrix spike recoveries within the contract specified control limits (75-125%)?

Yes No

If "No", note analytes__________________________________

Data should have been flagged with "N" for analytes our of control limits. If the sample concentration exceeds the spike concentration by a factor of four or more, no flag is required.

DATA VALIDATION-INORGANICS

Site Name:____________________ Laboratory Name:____________________

Reviewer:____________________ Date of Review:____________________

VII. ICP Interference Check Sample Summary

1. Was the ICP serial dilution analyzed at the contract specified frequency?

Yes No

Comments:____

2. Were the serial dilution differences within the contract specified limits of ±w-10%

Yes No

Comments:____

3. Was the ICP CRDL check standard analyzed at the contract specified frequency for the analytes required?

Yes No

Comments:____

DATA VALIDATION-INORGANICS

Site Name:
Laboratory Name:

Reviewer:
Date of Review:

VII. ICP Interference Check Sample Summary (continued):

1. Was the ICP serial dilution analyzed at the contract specified frequency?

Yes No

Comments:

5. Were the ICP interference check sample results within the control limit of ±w-20% of the mean value?

Yes No

If "No", note analytes

DATA VALIDATION-INORGANICS

Site Name:________________________ Laboratory Name:____________________________

Reviewer:_________________________ Date of Review:____________________________

VIII. Laboratory Control Sample Analysis

1. Was a laboratory control sample analyzed at the contract required frequency?

Yes No

Comments:____

____

____

2. Were the percent recoveries within the control limits of 80-120% (except for Ag and Sb) for each analyte?

Yes No

Comments:____

____

____

DATA VALIDATION-INORGANICS

Site Name:____________________ Laboratory Name:________________________

Reviewer:_____________________ Date of Review:_________________________

IX. Furance Atomic Absorption Analysis

1. Were duplicate injections performed for all analytes (except for the Method of Standard Addition [MSA] which requires single injections only)?

Yes No

Comments:____

____

____

2. Where the concentrations were above the CRDL, did the two runs agree within the 20% of the relative standard deviations for each analyte?

Yes No

If "No", note analytes____
and check to see if the analytes were run again. If readings are still outside the control limits, all data associated with that analysis should have been flagged with an "M".

3. Did the preparation blank analysis produce spike recoveries of 85-115%?

Yes No

Comments:____

____

____

DATA VALIDATION-INORGANICS

Site Name:_______________________ Laboratory Name:___________________________

Reviewer:________________________ Date of Review:___________________________

IX. Furnace Atomic Absorption Analysis (continued):

1. Were analysis (post digest) spikes performed on all required samples and concentration levels (2x CRDL)?

Yes No

Comments:____

____

____

5. For those samples whose initial spike recovery was less then 40%, was sample dilution and respiking performed?

Yes No

Comments:____

____

____

6. Was the MSA perfomed at the contract specified frequency and did it follow the contract specified criteria?

Yes No

Comments:____

____

____

Section 5

HEALTH AND SAFETY PLAN APPROVAL FORM

PHASE II INVESTIGATION
AND
PART 360 HYDROGEOLOGIC INVESTIGATION

BROOKHAVEN LANDFILL

TOWN OF BROOKHAVEN
SUFFOLK COUNTY, NEW YORK

Approved by:

Health and Safety Officer ______________________ Date __________
Dvirka and Bartilucci Consulting Engineers

Project Manager ______________________ Date __________
Dvirka and Bartilucci Consulting Engineers

Health and Safety Officer ______________________ Date __________
New York State Department of Environmental Conservation

Project Manager ______________________ Date __________
New York State Department of Environmental Conservation

5.0 HEALTH AND SAFETY PLAN

5.1 Introduction and Objectives

This plan establishes Dvirka and Bartilucci Consulting Engineers' (D&B) occupational health and safety requirements, responsibilities and procedures to protect workers during the Phase II and Part 360 Hydrogeologic Investigation for the Brookhaven landfill in The Town of Brookhaven, Suffolk County, New York. The site is contaminated with various organic and inorganic chemicals and leachates derived from municipal wastes in the landfill. The purpose of this investigation is to determine if there has been a release of hazardous substances from the site and, if so, the nature and extent of the contamination at the site and surrounding area on a preliminary basis, as well as to document current/baseline water and soil quality in the vicinity of the landfill prior to closure and expansion.

It is the policy of the firm to assure safe working conditions for all project site workers. This plan was developed to assure the protection of health and safety of employees at this waste site. It ensures that work can proceed with minimum risk to workers at the site.

5.1.1 Requirements

The requirements for worker health and safety are based on the following:

- The Standard Operating Safety Guides. US Environmental Protection Agency (EPA) Office of Emergency and Remedial Response, November 1984.
- The Occupational Health and Safety Administration (OSHA) regulations, 29 CFR Parts 1910 and 1926.
- Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. NIOSH, OSHA, USCG, and EPA. October 1985.
- Health and Safety Procedures for Hazardous Waste Sites. Dvirka and Bartilucci Consulting Engineers. September, 1986.

5.1.2 Applicability

The protection of workers' health and safety, and the environment are major concerns during this investigation. Personnel must be protected from the risk of incurring illness or injury during the field program at the site. Since every safety hazard associated with the site cannot be anticipated, precautions will be taken to prevent illness or injury to workers and the public. Work conditions can be expected to vary from task to task and to change as work progresses. Based on these considerations, this health and safety plan will be applicable for each task of this investigation. The application of this plan will be based on the judgement of the Project Manager and/or Site Health and Safety Officer who are responsible for the health and safety of the site personnel.

5.2 Site Information

5.2.1 Site Description and History

Description

The Brookhaven landfill is an active municipal landfill located approximately 0.6 mile northwest of the Village of Brookhaven, Suffolk County, New York. The landfill is between Horseblock Road, Woodside Avenue and Sunrise Highway (NYS Route 27). The landfill, which covers 90 acres, is on a 200 acre parcel of land which has been excavated in part to depths of 10 to 30 feet. The landfill is owned by the Town of Brookhaven. The landfill accepts about 585,000 tons of municipal solid waste per year. No liquid wastes are accepted, but treated sludge from the Southwest Sewer District is disposed of at the landfill. A methane collection system is in place. Leachate generated at the landfill is collected and disposed of at the sewer district. Further details regarding the site are given in the "Background and History" section (Section 2.0) of this work plan.

History and Background

The potential impact of the landfill on ground water has been a concern since 1975 when leachate was found overflowing the liner into the ground surface. In March 1979, NYSDEC issued a Consent Order to the Town of Brookhaven to address the leachate problem. In 1982, the Town began transporting leachate to the Southwest Sewer District's Bergen Point Treatment Plant. Currently, 35,000 gallons of leachate are pumped daily from the collection system.

In 1983, the United States Geological Survey (USGS) reported ground water contamination by inorganic chemicals in the vicinity of the landfill and the Town began supplying public water to the residents downgradient of the landfill. In 1985, the USGS found several volatile organic chemicals, and significant concentrations of phenols and several metals in the leachate. The USGS also found low levels of organic chemicals in the ground water contiguous to the landfill. In 1979, the Suffolk County Department of Health Services analyzed samples from 64 private wells downgradient of the landfill and found that they were not affected by the leachate plume. In 1982, tetrachloroethylene was found in a fire department well on Montauk Highway, south of the landfill. The leachate from the landfill could not be linked to that finding.

Work Areas

The on-site work areas for this investigation, in the vicinity of the Brookhaven landfill study area, will vary depending on the type of sample collection required and on the specific task of the investigation. Work areas will include the landfill site, leachate collection pools, and areas to the south, east, and north of the landfill. No significant differences in potential chemical hazards to workers are expected when working in these areas during well drilling and sampling. Therefore, these work areas will be treated equally from a health and safety perspective. Sampling of collection pools could result in splash exposures to leachate.

5.2.2 General Hazards Characterization

The general hazard potential of the Brookhaven landfill is characterized in Table No. 5-1. The primary concern at this site is to the public due to levels of leachate chemicals which may exceed drinking water standards. Results of recent monitoring are given in Table No. 5-2.

Based on current available data there is a confirmed release of contaminants to the ground water. Hazard rating scores for this site as determined by NYSDEC in the Phase I Report are as follows:

Migration Score	$S_M = 37.93$
Fire and Explosion Score	Not Applicable
Direct Contact Score	$S_{DC} = 0$

The general health and safety hazards to workers from the site contamination are low. Should landfill gas be encountered, guidelines related to subsurface gas activities will follow "A Compilation of Landfill Gas Laboratory and Field Practices and Procedures, October 1985," published by the Government Refuse, Collection, and Disposal Associations. No OSHA Permissible Exposure Limits or ACGIH Threshold Limit Values are expected to be exceeded for any volatile organic chemicals or other toxic chemicals currently found in the ground water (see Table No. 5-3).

5.3 Site Evaluation

5.3.1 On-site Activities

Activities of concern to worker health and safety at the Brookhaven landfill site include:

- Placement and construction of test borings and monitoring wells.
- Sampling and analysis of wells and ground water, soils, sediments, surface water and leachate.

Potential safety risks will vary with the specific activity and equipment used. Sampling activities as part of this investigation will include sampling borings and wells, sediments, surface water and leachate. Preliminary information indicates that any sampling activities involving soils, sediments, leachate and contaminated ground water and surface water will not likely be hazardous. However, sampling of leachate at collection points in the landfill should protect against direct dermal and eye contact. Wells in the direction of the landfill plume suggest volatile organic chemical contamination of ground water.

With the implementation of drilling activities, some risk of physical hazards inherent with these activities may be expected. Since the site is an active municipal landfill, there is a potential for release of methane gas during drilling and well construction. No handling of chemical drums, containers or concentrated spills is expected.

When any new data are collected, potential health and safety hazards will be evaluated and related to the activities at the site.

Table No. 5–1

SUMMARY OF GENERAL SITE CHARACTERISTICS AND HAZARDS

Type of Site	Active sanitary landfill
Apparent Hazard	Low
Potential Source	Landfill leachate
Status of Discharge	Active
Type of Discharge	Liquid organic and inorganic compounds, methane gas
Contamination Characteristics	Toxic, volatile
Form of Hazards	Dust, liquid, vapors, gas
Routes of Exposure	Inhalation, skin, eyes

Table No. 5–2

CHEMICALS OF CONCERN IN THE GROUND WATER AND LEACHATE AT THE BROOKHAVEN LANDFILL*

Ground Water Chemical Data	Range
Volatile Organic Compounds	ug/l
Benzene	2.0 –4.0
Chlorobenzene	2.0 - 7.0
Ethylbenzene	1.0 - 9.0
Toluene	3.0 - 8.0
Xylene (total)	9.0
Inorganic Parameters	mg/l
Iron	0.05 - 66.8
Magnesium	1.5 - 46.4
Manganese	ND - 75.1
Lead	ND - 0.0472**
Gases	
Methane	Data not available
Hydrogen sulfide	Data not available

Leachate Chemical Data	Cell No. 1	Cell No. 2
Volatile Organic Compounds	ug/l	ug/l
Benzene	6	Data not available
Chlorobenzene	24	Data not available
Ethylbenzene	15	Data not available
Xylene (total)	32	Data not available
Inorganic Parameters	mg/l	mg/l
Iron	21.9	280
Magnesium	56.7	34
Manganese	0.28	36
Lead	0.04	ND
Gases		
Methane	Data not available	
Hydrogen sulfide	Data not available	

* Based on 8/89 ground water analytical data, 12/89 Cell No. 1 leachate analytical data and 5/89 Cell No. 2 leachate analytical data (inorganic parameters only).

** Also detected in a field blank at a concentration of 0.039.

Table No. 5–3

INHALATION EXPOSURE LIMITS OF CHEMICALS KNOWN TO BE IN THE GROUND WATER AND LEACHATE IN THE BROOKHAVEN LANDFILL AREA

Chemical	ACGIH TLV(ppm)	Primary Health Effect
Volatile Organic Compounds		
Benzene	10*	Carcinogen
Chlorobenzene	75	Resp. system, kidney, CNS**
Ethylbenzene	100	Resp. system, CNS
Toluene	100	Liver, kidney, CNS
Xylene	100	Liver, kidney, CNS
Inorganic Parameters	**(mg/m3)**	
Iron	10.0	Inhalation
Magnesium	15.0	Inhalation
Manganese	5.0	Inhalation, blood, kidneys
Lead	0.05	CNS, kidneys, blood
Gases		
Methane	none	Asphyxiant, explosive
Hydrogen sulfide	10	CNS, resp. system

* The OSHA PEL is 1 ppm.

** CNS – Central nervous system toxin. Resp. system – Respiratory system.

5.3.2 Hazard Identification

Although the suspected source of contamination of the Brookhaven landfill site continues, the levels found in leachate and ground water are below levels expected to be an acute inhalation or dermal contact hazard. No significant health and safety hazards from the contamination are expected; however, as a precaution, continuous volatile organic monitoring will be observed during ground water and leachate sampling. A list of chemicals known to be contaminating the area is found in Table No. 5-2. Although some of these compounds may exceed ground water and/or drinking water standards in some wells and the leachate collection points, none are expected to volatilize in the breathing zone of workers at levels approaching the ACGIH Threshold Limit Values (TLVs) given in Table No. 5-2.

5.3.3 Potential Exposures

Potential exposure to toxic levels of chemicals listed in Table Nos. 5-2 and 5-3 is remote. Potential hazards consist of exposure to contaminated leachates, surface water, ground water, sediments and soils during sampling, and to soils and toxic particulates which may become airborne during well construction and equipment activity.

Most of the expected chemicals concentrations in the samples to be collected are so low that significant exposures are unlikely. These chemicals would pose a health hazard to site workers only as a result of continuous long-term exposure to levels well above those found in the area. Long-term exposure during this study will not occur since potential exposures will be short and intermittent over a period of several months. There is no expected risk to acute exposures of these chemicals during this investigation. Some exposures to soil dusts will occur during boring and drilling activities. The greatest potential for exposure would come from drilling and sampling operations. Potential hazards include:

- Presence of explosive levels of gases such as methane.
- Presence of noxious odors from putrefied wastes.
- Presence of toxic gases such as hydrogen sulfide.
- Presence of low levels of toxic gases from landfill gas.
- Contact with contaminated soil and water.

5.3.4 Routes of Exposure

No significant exposures expected through inhalation, ingestion, dermal contact or eye contact with toxic chemicals are expected, except during leachate sampling where direct skin and eye contact and accidental ingestion are possible. Known ground water concentrations are unlikely to pose inhalation, dermal or eye hazards to workers. If the volatile organic chemicals (VOCs) or toxic gas levels from well drilling should approach the TLV, then inhalation would be the primary route of exposure.

5.3.5 Physical Hazards

Potential physical hazards from routine drilling and sampling operations at the site are low, but may be of greater importance than exposure to toxic chemicals. However, these activities are not related to any potential chemical exposure hazard on the site. Improper or careless use of sampling and drilling equipment increases the risks of accidents.

5.3.6 Site Personnel

This project will require the interaction of government agencies, contractors and technical specialists, both on-site and off-site. The team will be composed of agency officials, the prime site contactor and subcontractors. The Project Manager will have overall responsibility to implement the Health and Safety Plan. Because of the low hazard potential of the site and the proposed activities, a site Health and Safety Officer will not be present on-site during all operations. However, the Health and Safety Officer will make periodic visits to the site, particularly during drilling phases, to review procedures and activities, if required. Any decisions requiring use or selection of personal protective equipment or monitoring devices will be approved by the Health and Safety Officer. The Project Manager will assure that all elements of this site-specific plan are implemented where applicable and that all on-site staff are protected and working in a safe manner. The Field Operations Manager will be responsible for implementing safety procedures in the field during all drilling and sampling phases.

5.4 General Procedures

5.4.1 General Work Practices

The following general health and safety requirements will apply to all persons working at the site:

1. All persons working on the site shall read, sign and become familiar with this Health and Safety Plan (a copy of the Acknowledgement Form is provided following Section 5.12). If any information is unclear, the reader shall contact the Project Manager for clarification prior to any field work. A copy of the plan will be available for review through the Project Manager or his designee.

2. No employee will be allowed on the site without the prior knowledge and approval of the Project Manager.

3. Sufficient backup personnel will be available for all site activities. At a minimum, two persons must be present at any work at the site.

4. All personnel working at the site shall notify the Project Manager or Field Operations Manager of any unsafe conditions or activities.

5. Standard hygiene practices will be undertaken such as no smoking, eating or drinking during site work activities, and thorough washing of hands and face prior to smoking, eating or drinking.

6. Workers will avoid unnecessary contamination such as walking through, sitting on, leaning on or kneeling in areas that are known or suspected to be hazardous.

7. All site personnel shall observe their partners for any signs of adverse effects associated with the work activity, and will inform their partner and supervisor of any unusual signs or symptoms that they are experiencing themselves.

5.4.2 Orientation and Training

Each field team member is trained and experienced in field sampling techniques and procedures. Any person who may be required to use respiratory protection will be medically approved, trained and fit tested with a NIOSH approved respirator. Each team member will participate in an orientation session prior to commencing of work at the site. The orientation training will include the following:

- Project goals and objectives
- Overview of the Health and Safety Plan
- Safety and health requirements and procedures
- Chemicals contaminating the site and their properties
- Potential health and safety hazards
- Safe sampling procedures
- First aid and emergency procedures
- Use of respiratory protection
- Decontamination procedures
- Waste disposal procedures

All field employees involved in hazardous waste activities attend the 40-hour health and safety training course required by OSHA as well as the 8-hour annual refresher and supervisory courses, as appropriate. Certificates of completion for those courses are kept in the company's files together with the medical surveillance records and are continuously monitored by a Health and Safety designated officer.

5.4.3 Special Contingencies

Although the expected hazards from chemical contamination are low at this site, the field team will be prepared for any unexpected changes in hazard potential conditions. No contingencies are foreseen that would impact the public in the residential areas in the vicinity of the site. Any contingency action will be documented and reported to the Project Manager and NYSDEC. The following guidelines will be implemented.

Should total volatile organic chemical (VOC) vapors exceed background (or 5 ppm) in the breathing zone, work at that location will be stopped until the need for respiratory protection is evaluated by the Project Manager and/or Health and Safety Officer.

Upon detection of 100 ppm VOC vapors during sampling, workers will leave the work site. A review of work procedures, air monitoring needs and use of SCBA respiratory protection will be performed. Work will proceed after appropriate corrective actions are taken or protection level is implemented. Continued work will consider protection of general public health and safety. During construction activities that generate dusts, air will be monitored for particulates. Particulate respirators should be used when air particulates exceed 10 mg/m^3.

5.4.4 Monitoring and Surveillance Equipment

Since the principle chemical hazards of concern consist of VOCs and since the potential hazards would be restricted to specific work sites where sampling activities are occurring, routine monitoring will be required only at the specific sampling sites. An Air Monitoring Form will be used to record VOC readings (a copy of the Air Monitoring Form is provided in Section 4.17, Field Management Forms). All monitoring and surveillance equipment will be operated, maintained and calibrated each working day in accordance with the manufacturer's manual and the firm's Quality Assurance (QA) procedures. Organic vapor monitoring will be undertaken prior to and following well construction and sampling at the site. The following monitoring equipment will be used:

- Century OVA portable flame ionization and/or Photo-Vac photoionization device for detection of organic vapors.
- Portable flammable and toxic gas/oxygen detector for determining lower explosive limits, and oxygen and hydrogen sulfide levels.
- Draeger gas detector for detecting specific hydrocarbons (chlorobenzene, ethylbenzene, toluene, xylene and benzene) should OVA readings exceed 5 ppm.
- Dust Indicator for the detection of particulate emissions.

5.4.5 Injuries and Emergencies

Any injured or overexposed person will be removed from the area immediately. Where applicable, first aid will be used and/or an emergency rescue team called. All injuries and emergencies will be reported immediately to the Field Operations Manager and Project Manager. An accident/injury report will be prepared, a copy of which is included following this section. Depending on the nature of the emergency, appropriate notifications listed in Section 7.10 Emergency Information will be made.

5.5 Levels of Protection

The Project Manager and Health and Safety Officer will determine the level of protection which is appropriate for each activity and phase of the project. Four specific protection levels (A, B, C and D) will be used as bench marks for selection of personal protective equipment.

Protection level A requires the highest degree of protection including a fully encapsulating, chemical resistant suit with full facepiece, SCBA or supplied air respirator. No situations are anticipated that will require this level of protection at this site.

Protection level B requires full chemical resistant clothing with a full facepiece SCBA or supplied air respirator. No levels of toxic chemicals are expected that would require this level of protection.

Protection level C requires full facepiece, air purifying canister-equipped respirator, or half facepiece cartridge respirator if specifically approved, and full chemical resistant clothing, or other protective clothing if specifically approved. Level of toxic chemicals are expected to be below those requiring this protection except under unusual situations.

Protection level D requires standard work clothes such as coveralls, boots, safety glasses and hard hat. Other protective clothing such as gloves, face shield or chemical splash goggles will be added depending on the work assignment at this level. This protection level applies to situations in which there is minimal risk to hazardous chemicals.

Due to the low hazard potential of the site, level D protection will be used for this investigation. As a contingency, level C will be invoked should the Threshold Limit Value (TLV) concentration for any of the VOCs be exceeded. However, if sampling results during the study indicate a need for higher protection levels, then the appropriate equipment will be provided. Level C protection equipment will be available at the site.

In addition, protection and first aid will be provided for common health hazards associated with outdoor work such as poison ivy, insect bites and stings, and ticks. Since ticks are known disease vectors, affected persons will report tick bites to the Health and Safety Officer. Poison ivy contact will be treated immediately. These potential hazards will depend on season of the year.

5.6 Personal Protective Equipment

All employees will be required to use appropriate personnel protective equipment for protection against potential hazards at the site. The following requirements will be applied and enforced.

5.6.1 Protective Clothing and Accessories

Protective clothing must be worn by all personnel while working at the site. Previous studies and mitigative actions give clear indications that work can proceed safely with a minimum of protective clothing. Standard required items include:

- Disposable coveralls
- Safety shoes
- Rubber boots
- Work gloves
- Vinyl gloves
- Hard hat or head cover
- Safety glasses or goggles
- Respirator
- Two-way radio
- Ear protection

Selection of specific chemical protective clothing and respirator will depend on the concentration and exposures to toxic chemicals that are likely to be encountered. Direct exposure to chemicals at the site is not expected.

The Project Manager will also consider the potential hazards of wearing cumbersome protective clothing since it hastens the onset of fatigue, increases heat stress during warmer weather and increases the time that personnel must spend in a high risk area.

Employees must compensate for the increased heat stress caused by wearing protective clothing in hot weather in order to prevent the onset of heat induced illnesses. Employees will maintain an appropriate water and salt balance and work-rest regimen by drinking fluids such as water and observing an 8 hour work day, including a 45 minute lunch break, and mid-morning and mid-afternoon breaks. During cold weather, employees must wear appropriate clothing to protect against cold injury.

5.6.2 Skin and Eye Protection

The expected level of toxic chemicals in the leachate, soil and ground water samples is not expected to pose a skin hazard or skin absorption problem. Standard work gloves and disposable cover suits, if required, will provide sufficient protection. Leachate samples may contain higher concentrations of chemicals and sampling collection pools may increase the risk of contact exposure. Face, hands and body should be fully covered. When collecting and handling samples, vinyl gloves and safety glasses/goggles will be utilized are recommended for added protection.

Safety goggles will be worn during sampling activities to provide appropriate eye protection when work activities may create a potential for eye injury and splash of leachate.

5.6.3 Respiratory Protection

A respirator will be provided for all site personnel who work in areas where a potential for inhalation of VOCs or toxic dusts. Respiratory protection will include the following:

- Properly cleaned, maintained, NIOSH approved air purifying respirators with organic vapor and dust cartridges.
- As a minimum, air-purifying cartridges will be replaced at the end of each shift when they are used.
- Only employees who have had qualitative respirator fit tests prior to issue will be allowed to work in atmospheres where respirators are required.

- Employees who wear respirators may leave work areas to wash their face and respirator facepiece as needed to prevent potential skin irritation associated with respirator use.

- Facial hair that may interfere with achieving a good facepiece seal is prohibited.

- Self Contained Breathing Apparatus (SCBA) must be worn on-site when:

  - Containers of unknown or known materials are being opened that may be a potential inhalation hazard.

  - When in enclosed spaces where hazardous materials are present, such as manholes and sewers which have received spilled chemicals.

  - When concentration of oxygen in a work space falls below 19.5%.

- Full or half-face cartridge respirators, which are easier to use but provide less protection than SCBA's, can be worn on-site when:

  - Hazardous materials in the air are not greater than 10 times the Permissible Exposure Level, and have good warning properties.

  - Respirators are needed as a precaution against generation of low levels of toxic substances in air due to sampling, handling, decontaminating or other operations.

  - Extended periods of use on-site would not cause the capacity of the cartridge to be exceeded.

5.7 Site Control and Security

5.7.1 Work Zones

Since the potential for adverse health effects to workers from the chemical contamination of the site is minimal, no requirements for Exclusion Zone restrictions are anticipated. Work zone requirements will be comparable to those required in a Contamination Reduction Zone. Since sampling will cover several locations and anticipated concentrations of toxic chemicals will likely be below permissible exposure limits, no specific delineation of work zones for worker protection is required.

5.7.2 Security

Maintaining a secure site promotes worker safety and limits access of visitors and the public who might otherwise become potentially exposed to hazardous conditions. A flagman with roadwork vest, signs, cones and high level warning signs shall be provided when it is necessary to control normal vehicular traffic due to vehicles entering or leaving the work areas, such as during drilling or other work activities. The following security procedures will be maintained:

- Post warning signs, if necessary.
- Control access to work areas.
- Permit only authorized personnel with appropriate identification to enter the work areas.
- Secure all equipment and facilities.
- Require all persons entering work areas to be subject to the health and safety requirements set forth by this site plan.
- Provide site surveillance.
- Enlist public enforcement agencies, where applicable.

5.7.3 Communication

Two sets of communication systems will be established for the site, an on-site system and an off-site system. On-site communication will include:

- Warning systems
- Visual signals
- Two-way radios
- Hand signals

Off-site systems will include:

- Telephones

The areas which contain, or are suspected of containing hazardous materials, will be clearly delineated and posted. The Field Operations Manager will establish applicable work zones for areas of different levels of potential personnel hazard. Only persons authorized by the Field Operations Manager may enter potentially hazardous work areas.

5.8 Investigation Derived Wastes

5.8.1 Solid Wastes

Noncontaminated disposable items such as coveralls, gloves, sampling supplies and general trash will be packed in plastic trash bags and disposed of as nonhazardous wastes. Disposable clothing/trash suspected to be contaminated with hazardous waste shall be placed in plastic bags and packed in a 55 gallon drum and properly disposed of in accordance with state and federal regulations. If the soils or boring wastes are determined by the New York State Department of Environmental Conservation (NYSDEC) to be hazardous wastes, then the material will be disposed of in accordance with state and federal regulations. If the soil/boring wastes are determined to be nonhazardous, it will be disposed of in proximity to the well or at the Brookhaven landfill with the approval of the NYSDEC field supervisor.

5.8.2 Liquid Wastes

Borehole flushing water (if generated), well development water and purge water will be pumped into DOT-approved 55 gallon "ring top drums" located near the well, if directed by the NYSDEC field supervisor. No water will be allowed to flow on the site surface, unless approved by NYSDEC. If the liquids are found to be hazardous, they will be contained in a tank or 55 gallon drums and disposed of in accordance with state and federal regulations. If the liquids are found to be nonhazardous by NYSDEC, they will be disposed to the ground within proximity of the well from which it was pumped, if possible.

5.9 Decontamination

5.9.1 Personnel

Personnel decontamination procedures will include good work practices, use of disposable clothing, personal hygiene and a field decontamination station, if required. Standard personnel procedures include the following:

- o Washing boots with soap and water before removal off-site. Removal of outer work gloves and washing before reuse.

- o Removal of disposable coveralls and placement in trash bag.

- o Removal of vinyl gloves and placement in trash bag.

- o Thorough washing of hands, face or exposed areas.

The decontamination station will consist of:

- o Long handled scrub brushes
- o Plastic sheeting
- o Plastic tubs for hand and face washing
- o Paper Towels
- o First aid kit
- o Portable eye wash station
- o Hand soap solution
- o Five gallon water container
- o Trash bags/containers

5.9.2 Equipment

All equipment shall be decontaminated before leaving the site. Heavy equipment such as trucks, drill rigs and excavation equipment, shall be either steam cleaned or be washed under high water pressure and scrubbed. Light construction equipment such as shovels, pails and hand tools, shall be either steam cleaned or scrubbed with soap and water, and rinsed. Sampling equipment shall be decontaminated in accordance with

NYSDEC approved procedures which are contained in the site-specific Quality Assurance and Quality Control Plan (Section 4.0).

5.10 Emergency Information

5.10.1 Emergency Procedures

The Project Manager will implement procedures to protect personnel in case of emergencies at the site. The emergency procedures include:

- Emergency personnel
- First aid
- Personal protective equipment
- Standard procedures
- Evacuation procedures
- Emergency services

No significant fire or explosion hazards are anticipated. Any fire protection requirements will be met by the local fire department. They will be notified of any potential or real emergency, fire or explosion.

5.10.2 Emergency Personnel and First Aid

A team member at the site (Field Operations Manager) will have training in emergency first aid and cardiopulmonary resuscitation, and be prepared to respond to emergency situations. A trained rescue team nearest the site will be notified of all work schedules at the site. The local rescue squad will be adequate for any foreseeable emergencies. Emergency personnel will include the Project Manager, Site Health and Safety Officer, Field Operations Manager and a designated physician.

5.10.3 Emergency Services and Notifications

The emergency procedures will include notifying emergency and other affected personnel and keeping their locations and emergency telephone numbers in a convenient and readily accessible area at the project site. In addition, a map showing the route from the project site to the nearest emergency medical facility will be provided at the project site. The route to the medical facility (hospital) is shown in Figure No. 5-1. Emergency services include:

Nearest Emergency Medical Facility
Brookhaven Memorial Hospital Medical Center
Patchogue, New York
(516) 654-7100

Ambulance, Emergency and Rescue Service
Call emergency - 911

Fire Department
Brookhaven Fire District
Call emergency - 911
Other calls (516) 286-0282

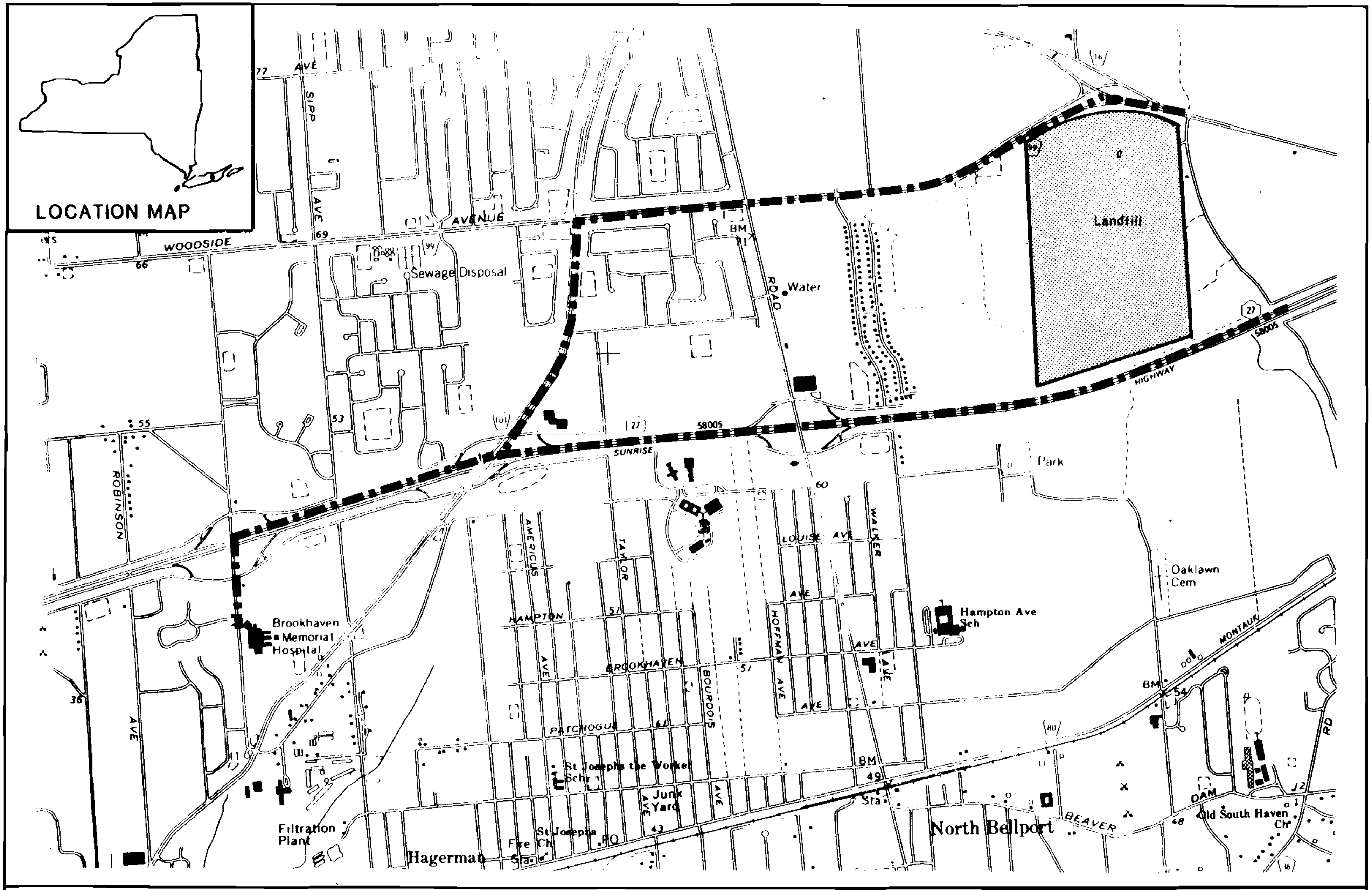
Police Department
Suffolk County Police Department
Call emergency - 911

Poison Control Center
(516) 542-2323

Designated On Call Physician
Dr. Ronald Rosen, MD
Center for Occupational and Preventative Health Care
(718) 470-8900

NYSDEC*
DEC Bldg. 40, SUNY Campus, Stony Brook
(516) 751-7900

*Contact unknown at this time.



TOWN OF BROOKHAVEN
BROOKHAVEN LANDFILL

HOSPITAL EMERGENCY ROUTE

Dvirka and Bartilucci
CONSULTING ENGINEERS

FIGURE NO. 5-1

All emergency services will be contacted prior to initiation of field work to explain the effort involved, site location and work schedule.

5.10.4 Evacuation Procedures

There is no anticipated hazard potential that would require residential or commercial area evacuation. Any potential evacuation would involve workers in a local work area. Evacuation should be in an upwind direction. Escape routes will be explained to all site workers.

5.10.5 Emergency Contacts

In case of an emergency, the following members of the project team should be notified.

Name	Title	Organization	Telephone
(to be designated)	Project Manager	NYSDEC	
(to be designated)	Field Engineer	NYSDEC	
N. Emandi	Project Manager	D&B	(516) 364-9892
W. Dorsch	Field Operations Manager	D&B	(516) 364-9892

During field activities, in the case of an emergency, the Field Operations Manager and Project Manager should be notified immediately. However, in case of personal injury or illness, no delay should occur in calling for emergency, fire or rescue teams provided above. The Project Manager will contact NYSDEC and the site Health and Safety Officer for review and evaluation of the emergency.

5.10.6 Emergency Treatment

Provisions will be made for having a physician on call on a 24 hour basis. Should site personnel suffer an injury or illness, the resources cited above under emergency procedures will be utilized, if appropriate. If an injury/illness is the result of a chemical exposure, the Project Manager shall promptly initiate the steps necessary to identify the chemical(s). Such information shall be made available to the treating physician and the Health and Safety Officer.

Any injury or illness will require the completion of "Hazardous Waste Incident Report" and "Occupational Illness/Injury Investigation Report." These forms are provided at the end of this section.

Any injury/illness not limited to first aid will require that the Field Operations Manager immediately notify the Project Manager. This will allow the coordination of internal resources to assist the treating physician in rendering appropriate care.

5.11 Medical Surveillance

Due to the low hazard potential for workers at this site, a detailed medical surveillance of each site worker is not anticipated. However, as a precautionary measure, all personnel on-site will have successfully completed a physical examination within last year. This examination is to assure maximum worker health, to establish a baseline health record, and to seek conditions which would predispose the employee to illness from exposure to hazardous materials or from the physical demands of using personal protective equipment. The examination is to include the following:

- Occupational history
- Medical history
- Comprehensive physical
- Pulmonary function test
- Blood profile
- Visual exam
- Complete blood count
- Audiometric test
- Hemoglobin
- Otoscoptic (auditory) exam
- Routine urinalysis
- Tetanus
- Serum cholinesterase
- Stress test
- Liver function
- General neurological test
- Respirator fit test

Medical surveillance of the workers at the site must be performed by a licensed physician with certification in occupational medicine. Records of each person's medical exam will be maintained and evidence of each examination will be provided upon request. The physician must certify that an individual is medically qualified to wear respiratory protective devices, when required, and to perform stated work assignments. Issuance and use of respiratory protection equipment requires prior medical approval.

Depending upon the specific exposure conditions, periodic medical exams will be required. They include examinations after 400 cumulative hours working in contaminated areas where permissible exposure limits are exceeded. Examinations will be required following an acute exposure to any hazardous material. This surveillance includes an updating of the employee's work and medical histories, and occurrences of any accidental exposures previously unreported. The periodic health assessment must include a physical examination. Depending on the chemical, level of potential exposure and route of exposure, this exam may include biochemical or other measurements of body fluids, and an evaluation of pertinent functional systems of the body related to the exposure.

If any potentially hazardous exposures occur, the following information will be included in the employee's medical record:

- Names of hazardous materials to which the employee was exposed.
- Information on the probability, frequency and extent of exposures.
- Any available environmental measurements relating to hazardous materials.

At the end of final work activities at the site, all personnel who were potentially exposed to hazardous levels of chemicals will have a medical examination, as described above, for the preassignment examination. The scope of this examination may vary depending on the time since the employee's last physical exam, exposure to hazards and/or signs or symptoms of exposure.

The Project Manager has overall responsibility for requesting and helping to schedule examinations and will furnish employees, prior to each examination, with available exposure and environmental monitoring data for inclusion in the worker's medical records.

5.12 Reporting Requirements

The Project Manager will assure that the following records are kept:

- o A log of persons trained and the training received
- o Safety inspection reports
- o Accident and incident reports
- o Monitoring reports
- o Documentation on persons receiving medical exams
- o Documentation regarding medical treatment
- o Personnel medical record will be kept by the physician

Safety inspection reports and monitoring reports will be recorded in a bound Field Log Book daily and Daily Field Activity Report, which will be kept on file, together with all other health and safety documentation, after completion of the project. A copy of the Daily Field Activity Report form is contained in the Quality Assurance/Quality Control Plan (Section 4.0).

ACKNOWLEDGEMENT

I have read the attached plan and attachments concerning the health and safety requirements for the Phase II Investigation at the Brookhaven landfill, Town of Brookhaven, New York. I have discussed any questions which I have regarding these materials with the Project Manager or the Health and Safety Officer, and I understand the requirements.

Signed: ______________________________ Date: ______________

Dvirka
and
Bartilucci
CONSULTING ENGINEERS

AIR MONITORING FORM

PROJECT NAME: ______________________ DATE: ______________

PROJECT NUMBER: ____________________ INSTRUMENT: ___________

RECORDED BY: _______________________ CALIBRATION DATE: ______

WEATHER CONDITIONS: ________________ CALIBRATED BY: _________

TIME	LOCATION	WIND SPEED AND DIRECTION	READING	OBSERVATIONS

RECORDING PROCEDURES/REMARKS: ____

Dvirka
and
Bartilucci
CONSULTING ENGINEERS

OCCUPATIONAL ILLNESS/INJURY INVESTIGATION REPORT

EMPLOYEE NAME ______________________________ DATE OF INJURY ____________________

FILL OUT ALL APPLICABLE INFORMATION

1. ACTIVITY IN PROGRESS AT TIME OF ACCIDENT

2. EVENTS - BEGIN WITH INITIATING EVENT AND END WITH NATURE AND EXTENT OF INJURY/DAMAGE.

3. ACCIDENT CAUSES

A. CONDITIONS

C. FACTORS INFLUENCING A OR B

B. ACTIONS

EQUIPMENT/HARDWARE/VEHICLE INVOLVED (AS APPLICABLE)

4. DID EQUIPMENT DESIGN AND DEFECT CONTRIBUTE TO ACCIDENT SEVERITY ☐ NO ☐ YES

5. #1 EQUIPMENT ______________________________ __ __ __ __ __ __ __ __ __ __
Generic (or brand) name and model — Identification Number

#2 EQUIPMENT ______________________________ __ __ __ __ __ __ __ __ __ __
Generic (or brand) name and model — Identification Number

6 CORRECTIVE ACTIONS (IF RISK IS ACCEPTABLE, CORRECTIVE ACTION MAY NOT BE NECESSARY)

A. INITIAL ACTIONS TAKEN

B. ADDITIONAL ACTIONS RECOMMENDED

C. ITEMS IN B TO BE COMPLETED BY ______________________
Implementation Date

7. DID EMPLOYEE LOST TIME? ☐ YES ☐ NO

8. WORK DAYS LOST (___|___|___|___|___|___)

9 WORK DAYS RESTRICTED (___|___|___|___|___|___)

10. DEATH ☐ YES ☐ NO, IF "YES" ENTER DATE (___|___|___|___|___|___)
Month Day Year

11. PERMANENT TRANSFER TO DIFFERENT JOB BECAUSE OF ACCIDENT ☐ YES ☐ NO

TERMINATED BECAUSE OF ACCIDENT? ☐ YES ☐ NO

12. HAS EMPLOYEE RETURNED TO WORK WITH NO FURTHER ANTICIPATED WORK DAYS LOST OR RESTRICTED? ☐ YES ☐ NO

13. WAS SUPERVISOR AWARE THAT THE LOST TIME WAS A RESULT OF WORK-INCURRED INJURY/ILLNESS? ☐ YES ☐ NO

14. WAS CLINIC NOTIFIED OF THE LOST TIME? ☐ YES ☐ NO

15 IF INJURY IS A BACK CASE INCIDENT, HOW DID THE INJURY OCCUR?

A. WITH	LIFTING	☐ YES ☐ NO	PULLING	☐ YES ☐ NO
LOAD	CARRYING	☐ YES ☐ NO	JERKING	☐ YES ☐ NO
	PUSHING	☐ YES ☐ NO	TWISTING	☐ YES ☐ NO

B. BODY MOVEMENT ONLY WITHOUT LOAD ☐ YES ☐ NO

C. PREVIOUS BACK INJURY ☐ YES ☐ NO

16. ANALYSIS (CIRCLE AT LEAST ONE ITEM IN EACH COLUMN)

ACCIDENT DESCRIPTION

1. SLIPS/FALLS
2. CAUGHT IN, ON, OR BETWEEN
3. STRUCK AGAINST OBJECT
4. STRUCK BY OBJECT
5. ELECTRICAL CONTACT
6. NOT OTHERWISE CLASSIFIED

TYPE OF INJURY

1. STRAIN/SPRAIN
2. INHALATION/INGESTION
3. EYE INJURY
4. BRUISE, CUT OR FRACTURE
5. BURN
6. RADIATION EXPOSURE
7. BACK INJURY (SEE NO. 15 ABOVE)
8. NOT OTHERWISE CLASSIFIED

CAUSE

1. UNSAFE CONDITIONS
2. UNSAFE ACT
3. CHANGE IN EQUIPMENT
4. CHANGE IN PROCESS
5. INDETERMINABLE

17. INVESTIGATOR/REPRESENTATIVE ______________________ Date ____________

18. SAFETY COORDINATOR ______________________ Date ____________

19 REVIEWING OFFICIAL ______________________ Date ____________

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Hazardous Waste Incident Report

▶ GENERAL INFORMATION

Facility Name: EPA Permit Number:

Facility Address:

Facility Contact: Title: Phone:

Date of Report: Completed by: Title:

▶ INCIDENT DESCRIPTION

Date of Incident: Time: Location: Type:

Identity of Materials Involved	Quantity

Cause of Incident If Known (use additional sheet if necessary):

Action Taken to Prevent Reoccurrence (use additional sheet if necessary):

▶ PERSONAL INJURIES

No. Individuals Injured: No. Individuals Hospitalized: Fatalities:

Types of injuries sustained:

▶ WASTE RECOVERY

Waste Identity	Quantity	Recovery Method	Disposal Method

Figure 2 — Hazardous waste incident report form.

Section 6

6.0 PROJECT ORGANIZATION AND SCHEDULE

6.1 Overview

This section of the Phase II and Part 360 Hydrogeologic Investigation Work Plan discusses the organization of the overall project, including New York State Department of Environmental Conservation (NYSDEC) management personnel/positions and the various management and technical disciplines of Dvirka and Bartilucci Consulting Engineers and its subcontractors.

Secondly, it identifies the specific professional personnel associated with the sampling program, and discusses each person's affiliation, title and a brief overview of each person's project responsibilities.

Lastly, this section presents an overall schedule of the project, including the details of the sampling program.

6.2 Project Organization (Overall)

For purposes of undertaking all technical aspects of this investigation, the following firms will assist in the completion of the project:

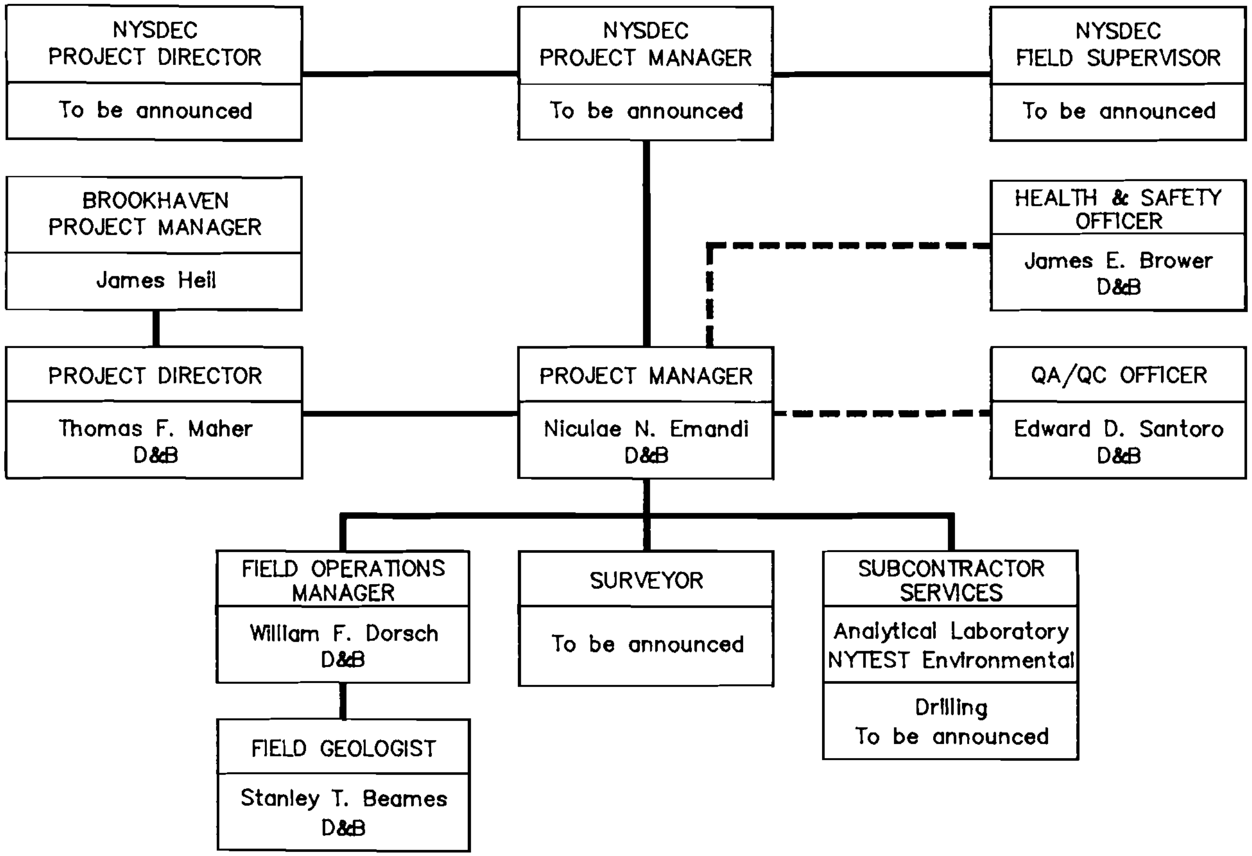
Dvirka and Bartilucci Consulting Engineers (D&B) - D&B will have complete responsibility for the successful completion of all investigation activities and reports.

NYTest Environmental - NYTest Environmental, an approved NYSDEC laboratory, will provide the necessary analytical services.

Drilling Firm - Currently unnamed.

Figure No. 6-1 presents an organizational chart illustrating the relationship among the firms comprising the investigation team. The drilling firm has not been selected as of the time this work plan was prepared.

FUNCTIONAL ORGANIZATION CHART
FOR
TOWN OF BROOKHAVEN – BROOKHAVEN LANDFILL
PHASE II AND PART 360 HYDROGEOLOGIC INVESTIGATION – PROJECT TEAM



Dvirka
and
Bartilucci
CONSULTING ENGINEERS
Syosset, New York

FIGURE NO. 6–1

6.3 Project Organization (Sampling Team)

Figure No. 6-1 presents an organizational chart of the specific personnel and affiliation for the sampling portion of the project. For additional details on the names, affiliations, titles, roles and responsibility of each person on the sampling team, refer to Table No. 6-1.

6.4 Project Schedule

The schedule for the overall project is provided in Figure No. 6-2.

Table No. 6-1

PHASE II AND PART 360 HYDROGEOLOGIC INVESTIGATION PROJECT TEAM BROOKHAVEN LANDFILL

Name	Affiliation	Title	Brief Description of Responsibilities
*	NYSDEC-Region I	Project Director	Overall project director for NYSDEC and assures compliance of project with DEC technical policy.
*	NYSDEC-Region I	Project Manager	Provides day to day guidance to consultant.
*	NYSDEC-Region I	Field Supervisor	Field oversight.
James Heil	Town of Brookhaven	Project Director	Provides administrative oversight for the project on behalf of the Town.
Thomas Maher	D&B	Project Director	Provides administrative oversight for the project on behalf of D&B Consulting Engineers.
Nicolae Emandi	D&B	Project Manager	Manages technical aspects of project for consulting firm.
James Brower	D&B	Health and Safety Officer	Prepares Health and Safety Plan in compliance with NYSDEC/NYSDOH guidance.
Edward Santoro	D&B	QA/QC Officer	Prepares QA/QC Plan for sampling program and oversees implementation of QA/QC in field activities.
William Dorsch	D&B	Field Operations Manager	Responsible for coordinating all field activities, supervises all sampling, and assures Health and Safety, QA/QC Plans are followed.
Stanley Beames	D&B	Field Geologist	Responsible for collection of samples, completing field notes and implementing decontamination procedures.

*Unknown at this time.

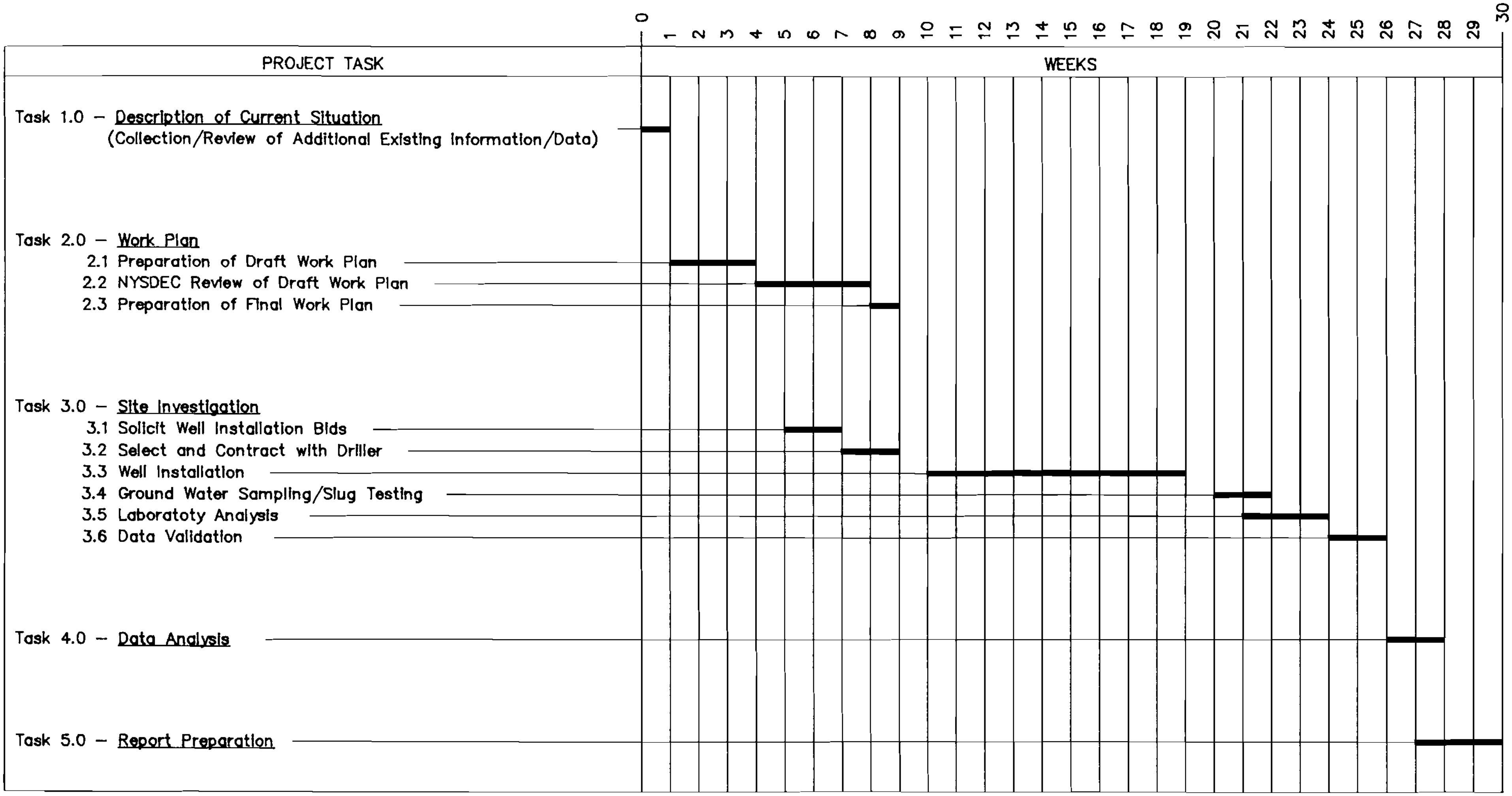
Table No. 6–1 (continued)

PHASE II AND PART 360 HYDROGEOLOGIC INVESTIGATION PROJECT TEAM BROOKHAVEN LANDFILL

Name	Affiliation	Title	Brief Description of Responsibilities
*	*	Surveyor	Responsible for surveying of sampling points and well casing elevations.
*	NYTest Environmental, Inc.	Analytical Laboratory	Assures that laboratory complies with all aspects of NYSDEC, QA/QC procedures.
*	*	Driller	Responsible for completing all phases of assigned well drilling.

*Unknown at this time.

PROJECT SCHEDULE
FOR
TOWN OF BROOKHAVEN – BROOKHAVEN LANDFILL
PHASE II AND PART 360 HYDROGEOLOGIC INVESTIGATION



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Syosset, New York

FIGURE NO. 6–2

Section 7

7.0 REPORTING REQUIREMENTS/FORMAT

7.1 Reporting Requirements

Subsequent to sample and data analysis, a report for the Phase II and Part 360 Hydrogeologic Investigation will be prepared and forwarded to New York State Department of Environmental Conservation (NYSDEC).

The report will outline the purpose and scope of effort, provide a site assessment of the Brookhaven landfill and recalculation of the Hazard Ranking Score, as well as provide a geologic and hydrogeologic characterization of the landfill site and establishment of baseline water and soil quality conditions as part of the Closure Plan and landfill expansion permit application.

7.2 Reporting Format

This report will have a title page and table of contents, and six sections plus an appendix for the raw data.

Following is a brief summary of each section and its intended contents.

Executive Summary - Brief description of the investigation and site assessment.

Introduction and Purpose - A description of the need and goal of the investigation.

Scope of Work - A description of the field program including boring and monitoring well placement and installation, and sampling location selection and procedures (soil, ground water, leachate, surface water and surface water sediment). This will be the final version of the site investigation plan.

Site Assessment - A site history with a description of past disposal activities on the site, notices of regulatory agencies, local changes in ground water quality and past remedial actions; a description of site topography and surface geology, and local land use characteristics; a detailed discussion of site hydrology and geology, and results of the environmental samples obtained as part of the investigation; a site inspection discussion, including QA/QC and Health and Safety Plan application; and an assessment of the environmental conditions of the site in comparison to standards and guidelines. This section will provide analytical calculations, maps, flow nets, cross sections, interpretations and conclusions. It will also include a description of regional geology and topography, surface water and ground water hydrologic features, and sensitive receptors.

Hazard Ranking Score – A final application of the HRS with worksheets that will incorporate all information collected in the investigation of the site.

Recommendations – Recommendations for continued monitoring (frequency, analytes and reporting) as part of the Environmental Monitoring Plan for landfill closure and expansion.

Section 8

8.0 REFERENCES

NYSDEC - Division Technical/Administrative Guidance Memorandum: Phase II Investigation Generic Work Plan - HWR-88-4007 (5-9-1988)

NYSDEC - 6 NYCRR Part 360 Solid Waste Management Facilities - Effective December 31, 1988

US Geological Survey - Ground Water Flow and Solute Transport at a Municipal Landfill on Long Island, New York
Part 1 - Hydrogeology and Water Quality (Report 86-4070) (1988)
Part 2 - Simulation of Ground Water Flow (Report 86-4106) (1988)
Part 3 - Simulation of Solute Transport (Report 86-4207) (1988)

US Geological Survey - Organic Compounds in Ground Water Near a Sanitary Landfill in the Town of Brookhaven, Long Island, New York (Report 85-4218) (1986)

US Geological Survey - Hydrogeology and Chemical Quality of Ground Water Near the Brookhaven Landfill Site, Town of Brookhaven, LI, New York (1985)

EA Science and Technology - Engineering Investigations at Inactive Hazardous Waste Sites - Phase I Investigation Brookhaven Landfill - Horseblock Road Site No. 152041 (1987)

Dvirka and Bartilucci - Town of Brookhaven Scavanger Waste Landfill Leachate Study (September 1981)

Dvirka and Bartilucci - Town of Brookhaven Municipal Landfill Technical Support Document for Modified Consent Order (March 1987)

Dvirka and Bartilucci - Town of Brookhaven Ground Water Assessment Report Brookhaven Landfill (January 1990)

Appendix A

APPENDIX A

SPECIFICATION FOR CONSTRUCTION OF MONITORING WELLS

TECHNICAL PROVISIONS

SECTION

WELL CONSTRUCTION

PART 1- GENERAL

1.01 Scope of Work

A. Furnish all labor, materials, power, equipment and other facilities and incidentals necessary to construct a total of 22 monitoring wells in the area of the Brookhaven Municipal Landfill in the Town of Brookhaven, Horseblock Road, Suffolk County, New York (Drawing No. 1). See Drawing No. 2 for approximate well locations at the site. (Exact well locations will be provided to the Contractor at a later date.)

B. The work also includes the furnishing of all labor, materials, equipment and all other facilities and incidentals, including utility mark outs, necessary to install and develop the wells.

C. In general, the overall well construction procedures shall be as follows:

1. Establishment of decontamination facilities;
2. Equipment, and materials and supplies decontamination, and well set up;
3. Construction and sampling the borehole;
4. Installation of riser pipe and screen;
5. Setting sand pack around the screen and installation of a seal above the screen;
6. Sealing the well riser pipe annulus;
7. Installing a locking vault box and surface seal;
8. Development and completion of the well;

9. Containment of drillings and cuttings, and purge water and development water (if required).

10. Site cleanup, and disposal of clean cuttings and fluids (if required).

1.02 Reference to Standards and Regulations

A. The latest revisions of standards of AWWA and ASTM shall apply as referenced herein.

B. The latest revisions of the New York State Environmental Conservation Law, Article 15.

1.03 Permits and Reports

A. The Contractor shall be responsible for obtaining any permits required for constructing the wells, obtaining potable water for drilling, discharging water from the site, disposing of waste material including clean drillings and cuttings, or clearing the site for work or access.

B. The Contractor shall furnish separate copies of all permits to the Town as the permits are received.

1.04 Description of the Wells

A. Each borehole shall contain one (1) well consisting of a 2-inch stainless steel screen and a 2-inch Schedule 40 PVC riser pipe as shown on Drawing No. 3.

B. The actual depths (and screen settings) for each of the wells shall be determined by the Town based on data obtained in the field. The length of screens shall be 20 feet for the shallow/water table wells and 10 feet for deep/Magothy interface wells, unless otherwise specified in the field by the Town. Tentative depths for the monitoring wells are as follows:

Monitoring Wells

13 shallow/water table wells (approximately 40 feet*)
9 deep/Magothy interface wells (approximately 140 feet*)

*Depth below ground surface

1.05 Description of the Site

A. The approximate locations of the wells in the vicinity of the Brookhaven Municipal Landfill site are shown on Drawing No. 2. Final site selection for the wells will be within the study area shown on Drawing No. 2. Rights of ingress and egress will be provided by the Town to each site. The Contractor shall be responsible for construction of any access that is required in order to move equipment onto the well sites, and provision of water on the well sites including acquisition of permits and any other approvals necessary for obtaining water.

1.06 Qualifications

A. The Contractor responsible for constructing the wells shall employ only competent workmen for the execution of this work, and all such work shall be performed under the direct supervision of an experienced well driller satisfactory to the Town. The Contractor shall have at his immediate disposal, operational equipment rated to do that work required to install monitoring wells.

B. The well driller shall be capable of identifying geologic formations, and developing and testing the wells.

C. The Town may make other investigations deemed necessary to determine the ability of the Contractor to perform the work, and the Contractor shall furnish to the Town all such information and data for this purpose as the Town may request.

D. The Contractor shall furnish satisfactory evidence upon request that all materials to be furnished in performing the work are new and all equipment to be used is in good working order.

E. The Contractor shall complete the work in accordance with applicable portions of the New York State Environmental Conservation Law.

1.07 Submittals

A. Copies of all materials required to establish compliance with the specifications shall be submitted to the Town.

B. During drilling of each well, a daily driller's production report shall be maintained and submitted as requested by the Town. The report shall give a description of the number of feet drilled, number of hours on the job, shutdown due to breakdown, feet of casing set, and other pertinent data requested by the Town.

C. During drilling of each well, formation samples shall be collected and preserved immediately after retrieval in labeled sample jars supplied by the Contractor and approved by the Town. Split spoon samples shall be collected continuously or at depth intervals of every five (5) feet, at every change in formation, or as directed by the Town. Samples shall be clearly and indelibly labeled with the following information:

1. Location of well,
2. Name or number of the well,
3. Depth interval represented by the sample,
4. Date taken,
5. Time taken.

1.08 Handling of Materials

A. All equipment, parts and materials shall be properly protected against damage during a prolonged period at the site. Any equipment, parts and materials damaged, or deemed unacceptable by the Town, shall be removed from the site and replaced with new, like equipment, parts or materials by the Contractor at no additional cost to the Town.

B. If water is used in drilling, the Contractor shall provide a clean portable drilling water storage tank or container for each well. The storage capacity shall be at least 50% greater than the anticipated drilling waste per drill hole.

C. The Contractor shall be responsible for obtaining potable water for drilling and constructing the wells.

D. Well development water and borehole flushing water shall be pumped into DOT approved 55 gallon "ring top" drums located near the well. No water shall be allowed to flow on the site surface, unless approved by the Town.

E. Unless directed otherwise by the Town, the Contractor shall contain all cuttings and drilling water (if used) in a leak proof container/drum located near the well during well construction. No cuttings or water (if used) shall be allowed to flow on the site surface, unless approved by the Town. The Contractor shall supply and contain all spent cuttings and water in DOT-approved 55 gallon "ring top" drums and transport these drums to a location on the Brookhaven landfill site for storage or disposal, if so directed by the Town.

As an option, if the drillings and cuttings meet New York State Department of Environmental Conservation criteria for disposal on-site, the waste materials shall be disposed of in proximity to the well, as directed by the Town.

1.09 Well Acceptance Criteria

A. To be accepted by the Town, a well shall be developed to the point that it is sand and sediment-free, and the parameters of temperature, pH and specific conductance are stable. Sand and sediment-free shall be defined as development water having a turbidity of 50 NTUs (nephelometric turbidity units) or less.

B. In order to ensure that all wells are sufficiently straight, and acceptable to the Town, the Contractor shall pass a 1.66 inch diameter by 36-inch long submersible pump or dummy to the bottom of the 2-inch diameter wells.

C. No payment will be due to the Contractor if he fails to meet those requirements set forth in Sections 1.09A and 1.09B.

1.10 Warranty

A. All equipment supplied under this Section shall be warranteed by the Contractor and equipment manufacturers for a period of one (1) year from date of acceptance by the Town. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period.

B. The wells shall be warranteed to be free from defects in workmanship and materials. If any part of the wells should fail during the warranty period, it shall be replaced and the wells restored to service at no additional expense to the Town.

1.11 Additional Work

A. At the option of the Town, additional work may be authorized. Additional work shall be completed at unit prices not exceeding those of comparable work and materials, as determined by the Town and as specified by the Contractor in his bid price schedule.

1.12 Measurement and Payment

A. Payment for work performed shall be on a basis of unit and lump sum prices bid and actual work performed. The bid items are intended to cover all costs involved in completing the work specified herein. The Contractor shall include all incidental costs into the applicable unit or lump sum prices indicated on the bid sheet.

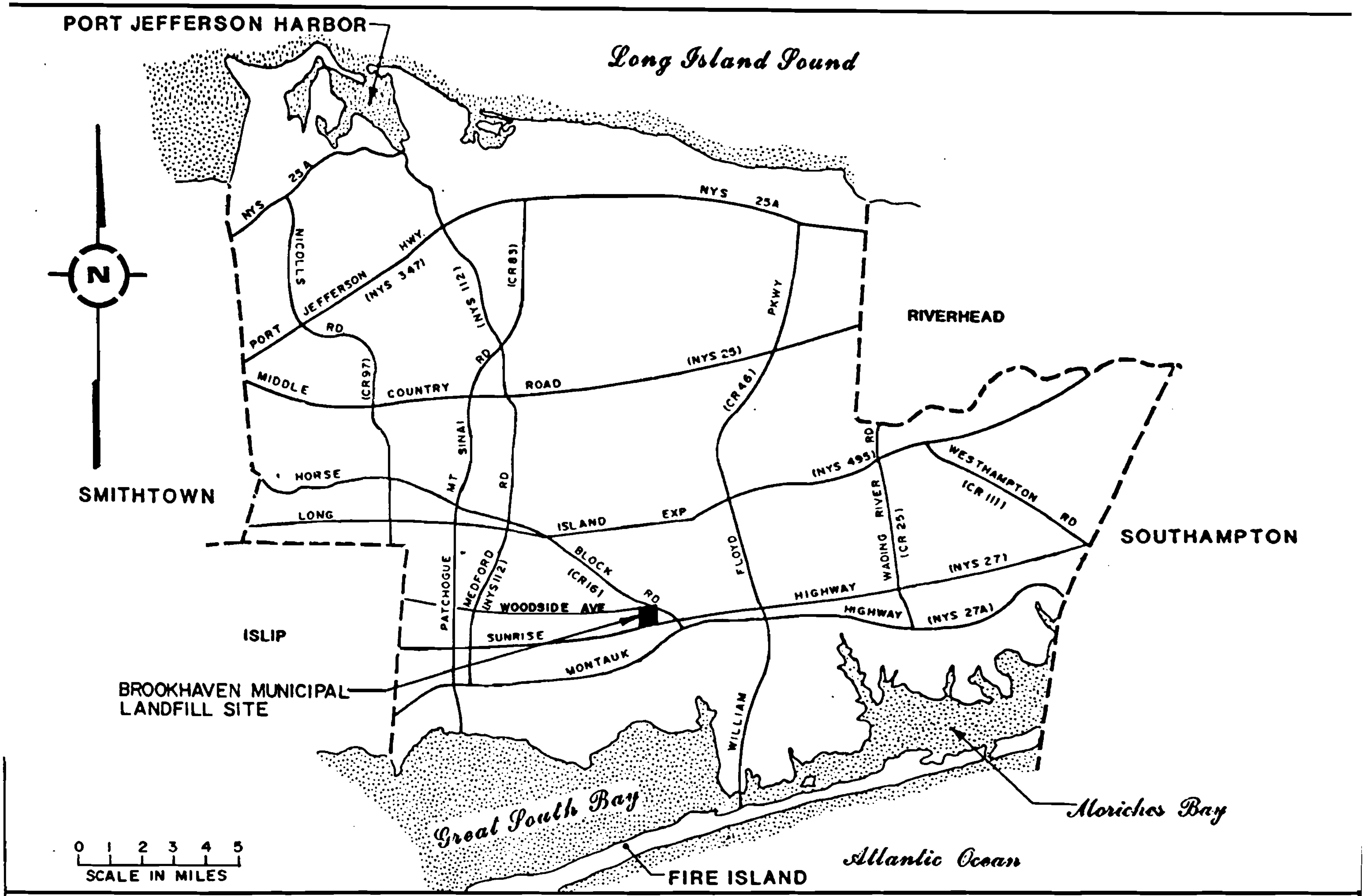
1.13 Contract Drawings

The following figures form a part of this contract:

Drawing No. 1	Location of Brookhaven Municipal Landfill
Drawing No. 2	Proposed Monitoring Well Locations
Drawing No. 3	Plan for Construction of Monitoring Wells

1.13 Contract Drawings (cont'd)

Drawing No. 4	Locking Vault Box for Monitoring Well
Drawing No. 5	Equipment decontamination pad

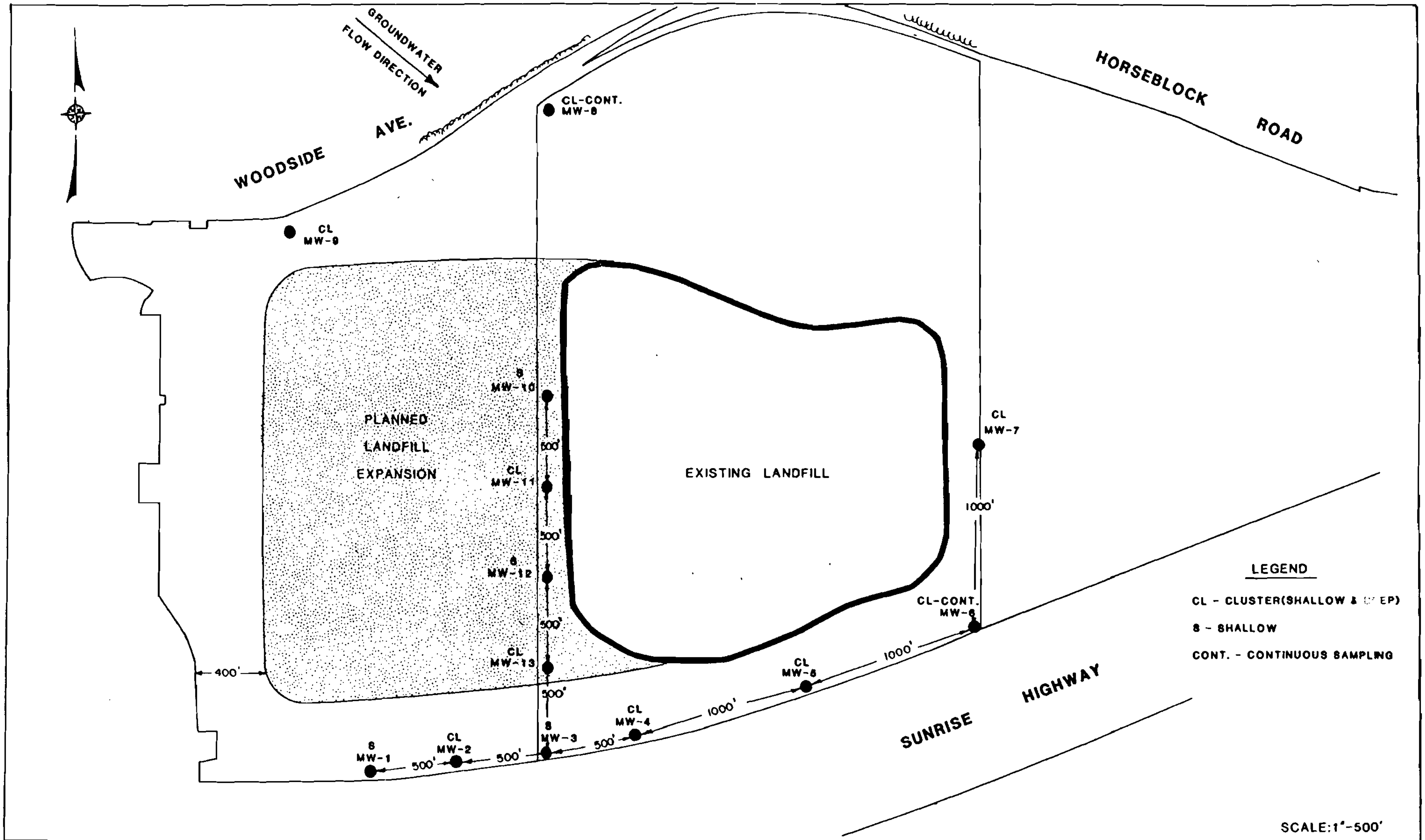


BROOKHAVEN MUNICIPAL LANDFILL SITE

Dvirka and Bartilucci CONSULTING ENGINEERS

LOCATION OF BROOKHAVEN MUNICIPAL LANDFILL

DRAWING NO. 1

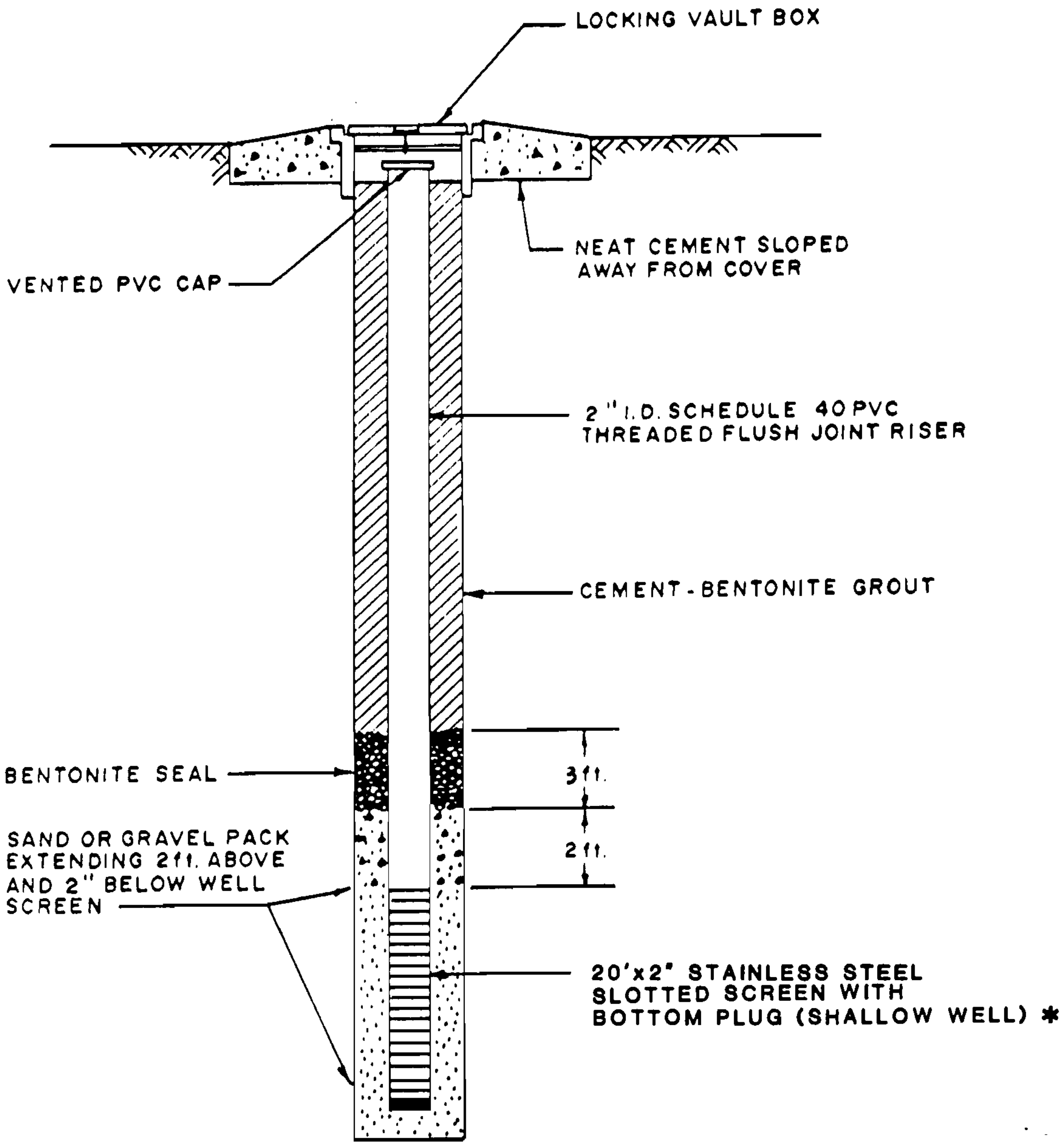


Dvirka and Bartilucci
CONSULTING ENGINEERS

TOWN OF BROOKHAVEN

NEW WELL LOCATIONS

DRAWING NO. 2



* NOTE: 10'x2" STAINLESS STEEL SLOTTED SCREEN WITH BOTTOM PLUG FOR DEEP WELL

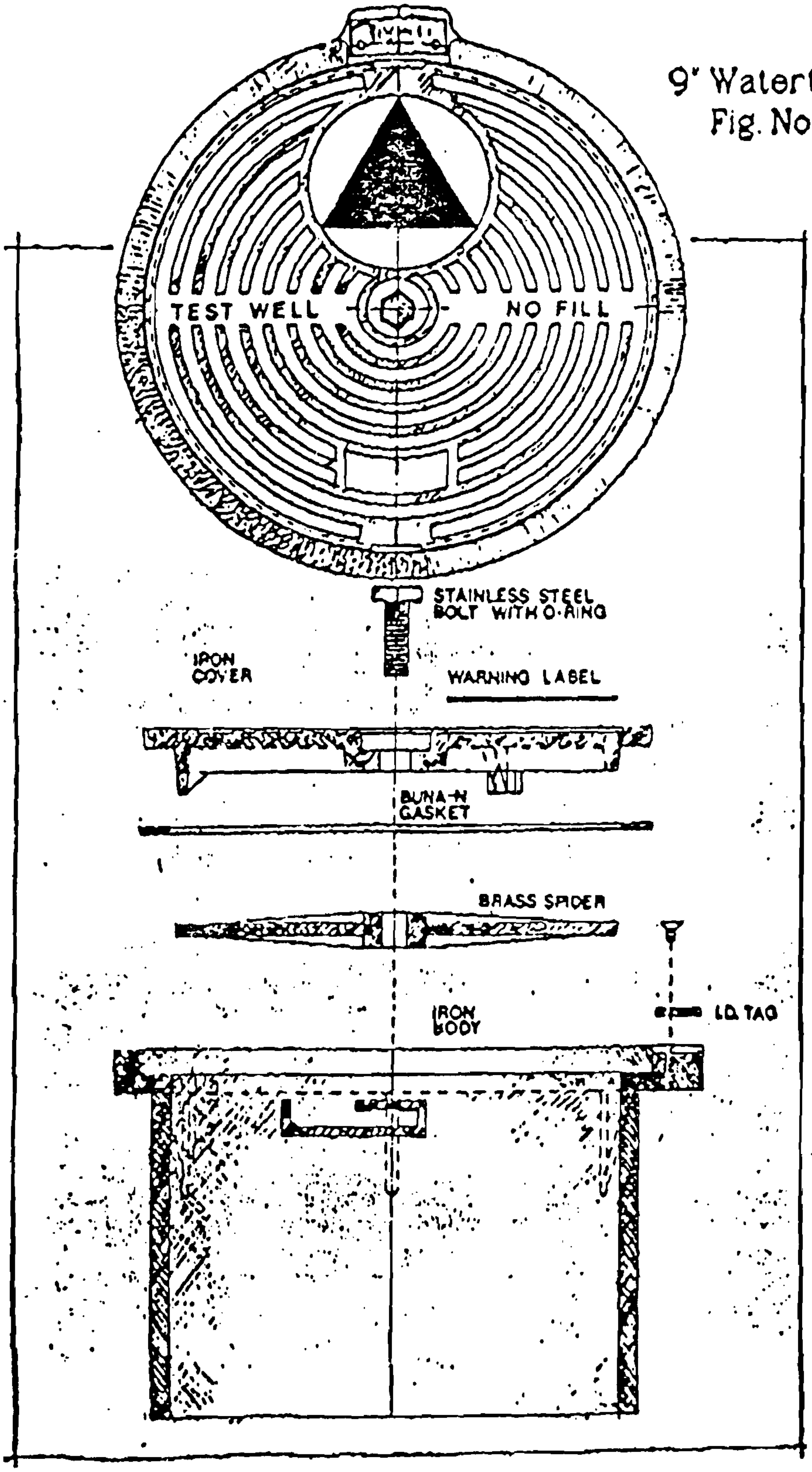
BROOKHAVEN MUNICIPAL LANDFILL SITE

PLAN FOR CONSTRUCTION OF MONITORING WELLS WITH LOCKING VAULT

Dvirka and Bartilucci CONSULTING ENGINEERS

DRAWING NO. 3

A New Product for Monitoring/Observation Wells



9" Watertight Manhole
Fig. No. 519

Description

1. Unit consists of all cast iron body 9" dia. by 7-1/2" deep, cast iron lid, and brass spider (hold-down device).
2. The manhole is designed to be set into a concrete slab. A stainless steel bolt, with a built-in O-ring seal, screws down into the spider drawing the lid with recessed lid gasket tight to the body flange.
3. Spider is removable for full 9" diameter access. Bolt is a standard hex head style.
4. Unit comes complete with bold warning symbol permanently mounted and recessed on lid and brass I.D. tag for stamping well number to rim.

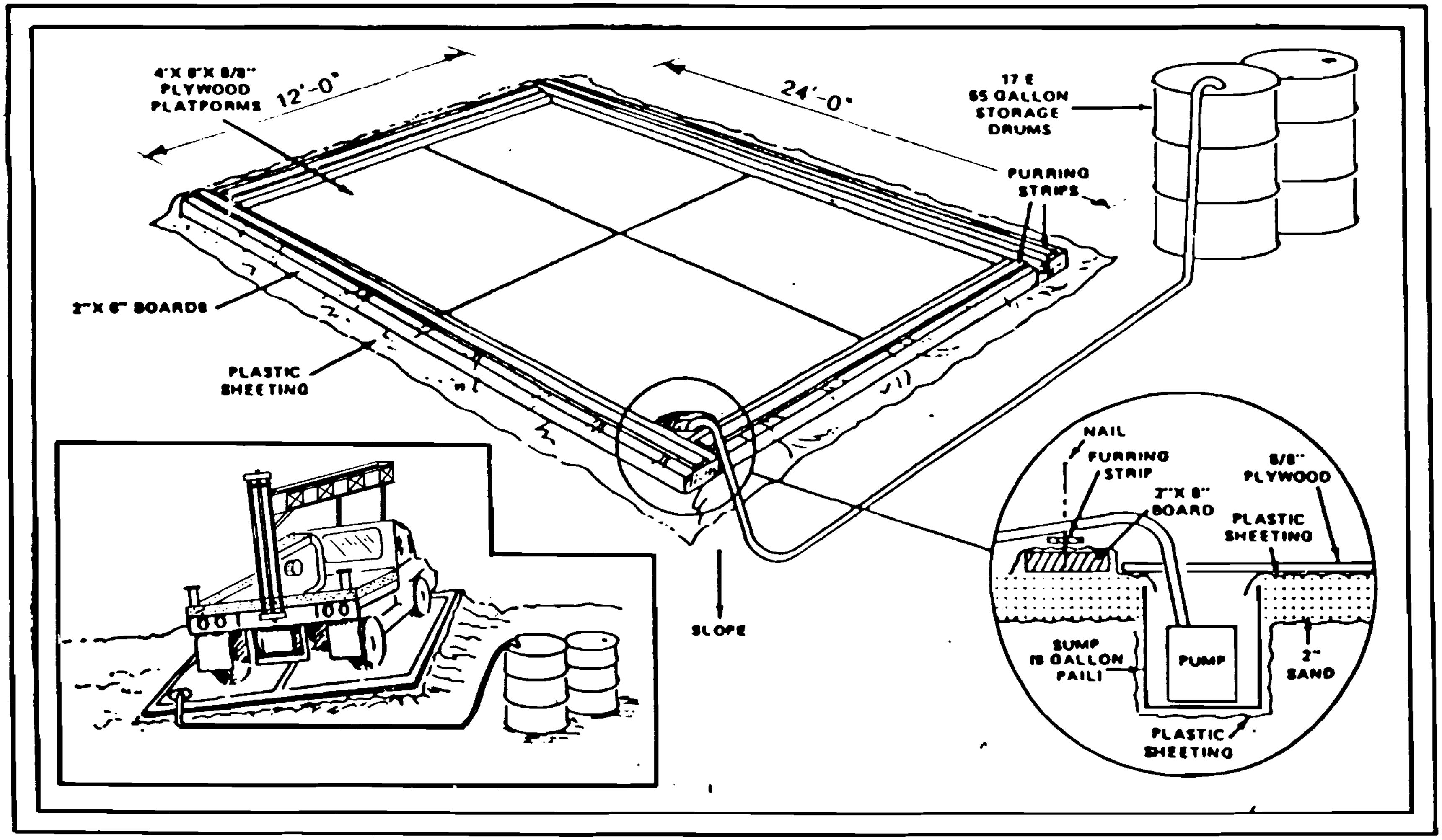
WT.: 32 lbs.

BROOKHAVEN MUNICIPAL LANDFILL SITE

LOCKING VAULT BOX FOR MONITORING WELL

Dvirka and Bartilucci
CONSULTING ENGINEERS

DRAWING NO. 4



PLAN FOR CONSTRUCTION OF THE DECONTAMINATION PAD

Dvirka
and
Bartilucci
CONSULTING ENGINEERS

DRAWING NO. 5

PART 2- PRODUCTS

2.01 Casing

A. The Contractor shall provide all casing together with required couplings, plugs, caps, fittings and other parts necessary to satisfactorily complete the well installation. Casing and appurtenances shall be clean and free of all oil, grease and any other organic contamination. Schedule 40 PVC casing shall be used.

B. If any casing is intended for construction purposes only, it shall be free of contamination and watertight, and of such weight and design as necessary to prevent entrance of sand and to permit its installation and removal to the specified depth and dimension without distortion or rupture.

2.02 Screen

A. Well screens shall be 2-inches nominal diameter as appropriate, new wire wrapped stainless steel Schedule 304, as approved, flush threaded on one end and sealed with a threaded stainless steel plug on the other end. Slot size shall be 0.010-inch or as otherwise recommended by the Contractor and approved by the Town.

The Contractor shall provide all well screens and fittings, and other parts necessary for a complete installation.

B. Well screens shall be as manufactured by Johnson Div./ UOP Inc. or approved equal, providing a "Vee" slot configuration.

C. Screens shall be attached to the casing by screwing the threaded joints together. No glue shall be used to join the screen to the casing.

2.03 Sand Pack

A. Sand shall be employed as a pack material in each monitoring well. The selection of sand for the screen packing shall be determined by the Contractor and approved by the Town.

B. Sand shall be well rounded, washed and sized with a diameter and gradation determined concurrently with the establishment of the well screen slot size to provide compatibility with the native aquifer formation and the selected well screen slot size. Samples of sand proposed by the Contractor for the well installation shall be submitted to the Town for approval.

2.04 Caps and Protective Covers

A. Each well shall have a vented PVC cap, and each well and well casing shall be protected from entry of foreign materials at all times during construction and upon well completion fitted with a lockable vault.

B. Temporary well guard and identifying flagging shall be provided and installed immediately upon well completion and prior to development and removal of the Contractor's well rig from the well site.

2.05 Bentonite Seals

A. The bentonite for bentonite seals and cement/bentonite grout shall be of the Wyoming type manufactured by Sinco, American Colloid Company, Terra-Metric, or an approved equal.

2.06 Health and Safety Equipment

A. The Contractor shall provide for his employees, and any subcontractor, all equipment necessary, including monitoring and personnel protection equipment, to provide adequate safety and health protection. This equipment shall be standby equipment readily available at the site to the employees. The Contractor shall also provide traffic control as necessary.

PART 3- EXECUTION

3.01 Borehole Construction

A. Decontaminate equipment as per Paragraph 3.04.

B. The boreholes shall be drilled by auger, cable tool or spin casing method (or other methods not using mud/drilling fluids other than potable water) as determined by the Contractor and approved by the Town. The work shall include the removal and excavation of pavement, if required.

C. Auger shall be 6-1/4-inch inside diameter (I.D.) and casing used in cable tool or spin casing shall be 6-inch I.D.

D. Geologic borehole sampling shall consist of the collection of split spoon samples collected as directed by the Town as indicated in Part 3.02.

E. The tentative method of drilling is as follows:

a. At each of the well cluster locations, the deepest well (approximately 140 feet) will be drilled first and split spoon sampling will be directed by the Town,

b. Based upon the data gathered, the Town will determine the depth and screen setting for the deep well at that location.

c. At each of the well cluster locations or single well locations, the shallow well (approximately 40 feet) will be drilled to about 15 feet into the zone of saturation and the screen set at that depth.

3.02 Split Spoon Sampling

A. The Contractor shall obtain split spoon samples during drilling operations when directed by the Town.

B. Split spoon samples will be used to obtain information on the type of strata penetrated.

C. The split spoon sampler shall be a 2-inch OD steel cylinder, 1-3/8 inch ID, 24-inches long, split barrel driven vertically into the undisturbed formation at the bottom of the drilled hole.

D. The sampler shall be returned to the surface and core transferred to suitable containers as directed by the Town. Containers for soil samples that will be used to determine the strata penetrated shall be supplied by the Contractor. Containers for samples that will be analyzed for chemical quality will be supplied by the Town. The Contractor is required to have at least four (4) steam cleaned sampling spoons on hand at each well prior to beginning work. After each sampling, the samplers shall be cleaned by the cleaning procedure as described in Part 3.04.

E. Split spoon samples shall be collected continuously in two (2) of the deep/Magothy interface wells and at five (5) foot intervals or significant changes in stratigraphy at the remaining seven (7) deep/Magothy interface wells. It is anticipated that these samples will be obtained between ground surface and 140 feet. Sample recovery of less than 90% will not be acceptable, unless approved by the Town.

3.03 Casing and Screen Installation

A. Casing and screen shall be installed by screwing together the individual pieces and installing them as one unit as directed by the Town. Glue shall not be used to join the screen to the casing, or sections of casing together.

B. Every effort shall be made on the part of the Contractor to assure casing plumbness and centralization within the borehole.

C. Centralizers may be employed by the Contractor as an optional method of assuring centralization and plumbness, with prior approval of the Town.

D. All casings and screens shall be constructed plumb and true to line. If, in the opinion of the Town, a well might be out of plumb, it shall be tested at the Contractor's expense in accordance with Section 1-6.2 and 1-6.3 (AWWA Standards - A100 for Deep Wells).

E. All drilling and well construction methods shall be as approved by the Town.

3.04 Decontamination Procedures

A. All drilling equipment and materials including augers, drill bits, tremie pipe, rods, casings, screens, and sampling equipment shall be high pressure steam cleaned of all foreign matter and void of any external oils and grease prior to use at each well. The Contractor shall demonstrate to the satisfaction of the Town that the temperature of the steam is a minimum of 212°F. All contact equipment including sample pumps and hoses, drill string, water pump and water tank shall be flushed with potable water before each use and as directed during the drilling program. All equipment shall be cleaned to the satisfaction of the Town prior to use. Drill pipe lubrication shall be Crisco grease or equal, and approved by the Town.

B. All equipment shall be stored above ground either on clean racks, pallets or plastic sheeting, with the approval of the Town, and covered with clean plastic sheeting.

C. All down-hole equipment, instruments and tools shall be placed in a specially designated staging area constructed of clean pallets or equal substitutes.

D. All decontamination activities for drilling/well installation/sampling equipment will be performed at the decontamination facility to be provided/constructed by the Contractor.

E. All decontamination equipment and supplies shall be provided by the Contractor.

F. The decontamination facility and all decontamination equipment is subject to approval of the Town.

G. All water used in the drilling operation shall be provided by the Contractor. Acquisition (including cost of water, permits and other approvals), transport and storage of all water will be the responsibility of the Contractor. All water used for drilling and cleaning must be potable and as approved by the Town.

3.05 Sand Pack Installation

A. The sand pack shall be placed in the well by means of a tremie pipe or other approved method to insure that no bridging of the hole occurs and shall extend from the bottom of the borehole to a minimum of two (2) feet above the top of the screen or as otherwise directed by the Town.

3.06 Bentonite Seal

A. A bentonite seal shall be placed in the well by means of a tremie pipe or other approved method to insure that no bridging of the hole occurs and shall extend from the top of the sand pack, to a minimum of three (3) feet above the sand pack, or as otherwise directed by the Town.

3.07 Cement/Bentonite Grout Seal

A. A cement/bentonite grout seal shall be placed above the sand pack and bentonite seal of the well in each borehole. All cement/bentonite grout shall be installed using a tremie pipe or other method approved by the Town.

B. The preparation of cement/bentonite/water in the grout mix shall be 94 pounds/5 pounds/6.5 gallons respectively. Ten (10) percent by volume of hydrated lime (CaO) may be added to facilitate pumping.

C. Bentonite shall be of the Wyoming type manufactured by Sinco, American Colloid Company, Terra-Metric or approved equal.

D. All grout shall be allowed to cure for a minimum of 12 hours or as necessary to provide a proper cure prior to starting the next phase of work.

E. Abandoned boreholes shall be sealed with a cement/bentonite grout. The grout seal shall be installed using a tremie pipe or other method approved by the Town.

3.08 Neat Cement Grout

A. The Contractor shall furnish and place neat cement grout in the annular space between the borehole wall and the surface casing and between the casing and the riser pipe, or as directed by the Town. Work shall include, but not be limited to:

a. opening a clear annular space by circulation of potable water or drilling fluids and removal of any obstructions,

b. mixing and placement of the cement grout in one continuous operation by pumping or tremie.

B. Neat cement grout shall be a mixture of Type II Portland cement confroming to ASTM-C-150 and potable water. The water to cement ratio shall be five (5) to six (6) gallons of water per 94-pound sack of cement. A bentonite additive of 3% to 5%, or other ratio may be specified by the Town. The grout shall be placed by a continuous operation before initial setting of the cement. The grout shall be introduced at the base of the grouting interval to minimize dilution of the grout and bridging of the mixture with upper-formation material. Grout shall be pumped into place. The tremie method may be used only when approved by the Town.

3.09 Vault Box and Locking Cover

A. The Contractor shall furnish and install a vault box with locking cover at wells where so directed by the Town. The elevation at which the vault box and locking cover shall be set will be specified by the Town. In most cases, the specified elevation will be existing grade or slightly above existing grade. Work shall include but not be limited to:

a. excavation of all material and setting of vault box to specified elevation,

b. compaction of soil around box,

c. restoration of area to original conditions,

d. construction of concrete pad at the surface.

B. Concrete for the pad shall be Type II Portland Cement.

C. Vault boxes shall be iron body conforming to AWWA Spec. 500, latest revision and are to be suitable for direct burial. The vault box shall be Heavy Duty Water Line Casting, Pattern Number 4424 with a lock cover as manufactured by Campbell Foundry Company, Harrison, New

Jersey illustrated in Drawing No. 4, or approved equal. Vault boxes shall be installed so that no stress or shock will be transmitted through the box, and shall be set plumb over the well to assure easy access. A total of four (4) lock cover keys shall be provided to the Town. The vault shall permit the draining of water which may enter the box.

D. The concrete pad shall be 2 1/2 feet in diameter.

3.10 Well Development

A. Each well shall be developed by surging, using compressed air (double airline oil filters required), interrupted over-pumping, surge block and bailer, or other methods approved by the Town. Development shall continue until development water from the well measures 50 NTU (nephelometric turbidity units) or less and temperature, pH and specific conductance of the development water is stable at pumping rates of five (5) gallons per minute(gpm), or as directed and until approved by the Town. If the well has not been effectively and satisfactorily developed, the well will not be accepted.

B. All wells shall be tested for development (sand-free condition) and yield by pumping for a minimum of one hour. Pumping shall be at a rate of five (5) gpm or as directed by the Town.

C. All wells shall be developed within 24 hours after completion, unless directed otherwise by the Town.

3.11 Well Abandonment

A. In the event that the Contractor shall fail to install the well to the depth specified or to such lesser depth as directed by the Town, or should the Contractor abandon the well because of loss of tools or for any other cause through the fault of the Contractor, the Contractor shall, if requested and as directed by the Town, plug the well with non-shrink cement/bentonite grout from the bottom of the borehole with a tremie pipe, upwards to ground level in one continuous operation at no additional cost.

3.12 Protection and Site Cleanup

A. At all times during the progress of the work, the Contractor shall use all reasonable precautions to prevent either tampering with the wells or the entrance of foreign material into the wells. The Contractor shall secure the borehole or well at the completion of work each day.

B. Immediately upon completion of a well, the Contractor shall remove all of his equipment, materials and supplies from the site of the work, including decontamination facilities, remove all surplus materials, waste and debris, fill in all holes or excavations, and grade the site to elevations of the surface levels which existed before work started. The site shall be thoroughly cleaned by the Contractor and approved by the Town. Failure to comply with these requirements shall give the Town authority to authorize other contractors or workmen directed by the Town to enter upon the site and complete the cleaning up, grading, etc. The cost of this work shall be deducted from any money due or to become due the Contractor for construction of the wells.

BID SCHEDULE

MONITORING WELL CONSTRUCTION
FOR
BROOKHAVEN MUNICIPAL LANDFILL SITE
BROOKHAVEN, NEW YORK

Contractor's Signature: ______________________________

Title: ____________________ Date: ____________________

Company Name: ______________________________

Company Address: ______________________________

Item Description	Unit	Estimated Quantity	Unit Price* Dollars	Total Item Price Dollars
1. Mobilization, Provision/ Construction of Decon Pad, Set-Up and Demobilization				
a. Site Mobilization	Lump Sum	Once	________	________
b. Provision/Construction of Decon Pad	Lump Sum	Once	________	________
c. Set Up at Each Well**	Each Well	22 Wells	________	________
d. Site Demobilization	Lump Sum	Once	________	________
2. Borehole Drilling				
a. Shallow (0-40 feet)*** (13 wells) (6-1/4" ID auger or 6" ID casing)	Lineal Foot	520 Lineal Feet	________	________

*Unit Price must include all costs for labor, materials, per diem, etc.
**Includes decontamination of equipment, materials and supplies for each well
***Depth below ground surface

Note: Specify drilling method(s) - Shallow: ________________; Deep ________________

Item Description	Unit	Estimated Quantity	Unit Price* Dollars	Total Item Price Dollars
b. Deep (0-140 feet) (9 wells) (6-1/4" ID auger or 6" ID casing)	Lineal Foot	1,260 Lineal Feet	______	______
3. Soil Sampling (split spoon) (including cleaning)				
a. Deep Wells (0-140 feet, every 5 feet for 7 wells and continuously for 2 wells)	Per Soil Sample	336 Soil Samples	______	______
4. Well Installation				
a. 2" Schedule 40 PVC Casing				
1. Shallow (0-20 feet) (13 wells)	Lineal Foot	260 Lineal Feet	______	______
2. Deep (0-130 feet) (9 wells)	Lineal Foot	1,170 Lineal Feet	______	______
5. Screen Installation				
a. 2" Stainless Steel Schedule 304 (20-40 feet) (13 wells)	Lineal Foot	260 Lineal Feet	______	______
b. 2" Stainless Steel Schedule 304 (130-140 feet) (9 wells)	Lineal Foot	90 Lineal Feet	______	______
6. a. 2" Vented PVC well caps (Schedule 40)	Cap	22 Caps	______	______
b. 2" Stainless Steel Bottom Plug (Schedule 304)	Plug	22 Plugs	______	______
7. Sand pack	Bag (100 lbs)	220 Bags	______	______

Item Description	Unit	Estimated Quantity	Unit Price* Dollars	Total Item Price Dollars
8. Bentonite Seal	Bucket (50 lbs)	90 Buckets	________	________
9. Cement/Bentonite Grout	Bag (94 lbs)	2400 Bags	________	________
10. Neat Cement Grout	Bag (94 lbs.)	50 Bags	________	________
11. Well Development (22 wells)	Per Hour	88 Hours	________	________
12. Vault Box and Locking Cover	Per Vault Box and Locking Cover	22 Vault Boxes and Locking Covers	________	________
13. Provide Containment of Drillings and Cuttings	Per 55 Gallon Drum	180 55 Gallon Drums	________	________
14. Provide Containment of Purge and Well Development Water	Per 55 Gallon Drum	170 55 Gallon Drums	________	________
15. Stand-By Time	Hour	40 Hours	________	________

TOTAL AMOUNT OF BID (IN FIGURES) $____________

TOTAL AMOUNT OF BID (IN WORDS)____

Note: Estimated time to complete: ____________days

Bid will be compared on the basis of the TOTAL AMOUNT OF BID. The total Amount of Bid is defined as the sum of the Total Price Bid for each Item.

Estimated quantities where given are approximate and are only for the purpose of evaluating the proposals.

The Town reserves the right to omit or add to the construction of any portion or portions of the work heretofore enumerated or shown on the Drawings.

The Town reserves the right to omit in its entirety any one or more items of this Contract without forfeiture of Contract or claims for loss of anticipated profits or any other claims by the Contractor on account of such ommissions.

Appendix B

APPENDIX B

CALIBRATION SPECIFICATIONS FOR IN-FIELD MONITORING EQUIPMENT

TABLE OF CONTENTS

Instruction

MI
611-132
December 1985

Model OVA 128
CENTURY Organic Vapor Analyzer

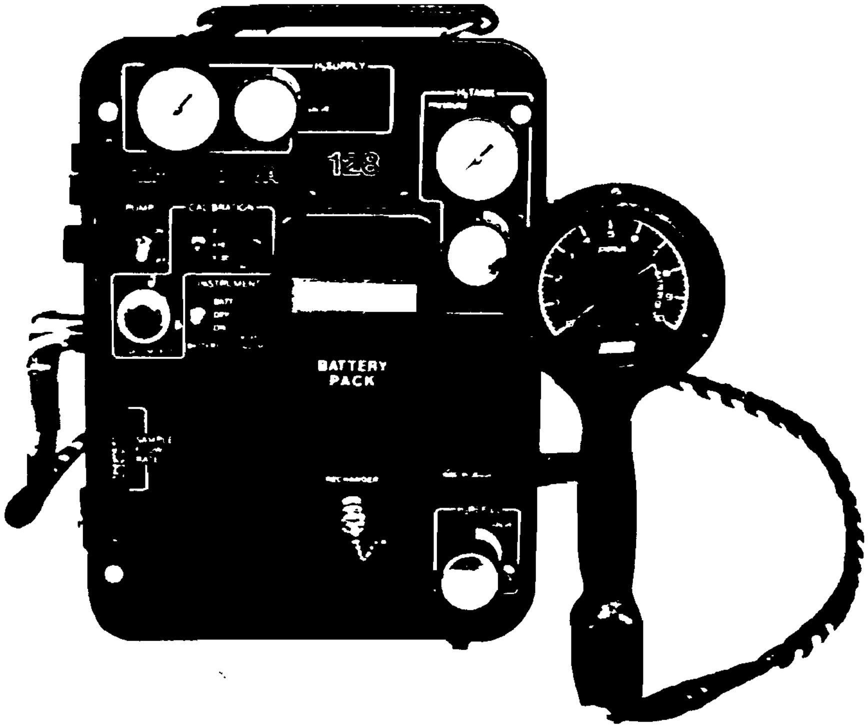


FIGURE 1
PORTABLE ORGANIC VAPOR ANALYZER

FOXBORO®

INTRODUCTION

The Model OVA 128 CENTURY Organic Vapor Analyzer (OVA 128) is manufactured in three configurations. These are:

- Basic Flame Ionization Detector for monitoring total hydrocarbons
- Gas chromatograph supplied with two columns
- Gas chromatograph tri-column for Benzene Analysis.

A battery charger can be ordered for either 120 V ac, 60 Hz or for 220 V ac, 50 Hz. Classifications are:

- FM certified for use in Class I, Groups A, B, C, and D, Division 1 hazardous environments.
- BASEEFA certified intrinsically safe, Ex ib, for IIC, Zone 1, Temperature Class T6. BASEEFA No. 76002/B std. SFA 3007.

Accessories for the OVA 128 are:

- Strip Chart Recorder - either FM or BASEEFA certified.
- Activated Charcoal Filter Assembly - used for zeroing the analyzer in a contaminated environment. Also used with dessicant as a moisture trap.
- Sample Dilutor Assembly for 10:1, 25:1, or 50:1 sample dilution.
- Septum Adapter for direct, online injection with the GC.
- Portable Isothermal Pack (PIP) for temperature control of GC columns.

The OVA 128 is a sensitive instrument designed to measure trace quantities of organic materials in air. It is essentially a flame ionization detector such as utilized in laboratory gas chromatographs and has similar analytical capabilities. The flame ionization detector is an almost universal detector for organic compounds with the sensitivity to measure in the parts per million range (V/V) in the presence of atmospheric moisture, nitrogen oxides, carbon monoxide, and carbon dioxide.

The instrument has broad application since it has a chemically resistant air sampling system and can be readily calibrated to measure almost all organic vapors. It has a single linearly scaled readout from 0 ppm to 10 ppm with a X1, X10, and X100 range switch. This range expansion feature provides accurate readings across a wide concentration range with either 10, 100 or 1000 ppm full scale deflection. Designed for use as a portable survey instrument, it can also be readily adapted to fixed remote monitoring or mobile installations. It is ideal for the determination of many organic air pollutants and for monitoring the air in potentially contaminated areas.

The OVA 128 is certified by Factory Mutual Research Corporation (FM) for use in Class I, Groups A, B, C, & D, Division I hazardous locations. Similar foreign certifications have been obtained, including BASEEFA. This requirement is especially significant in industries where volatile flammable petroleum or chemical products are manufactured or used and for instruments which are used in portable surveying or for analyzing concentrations of gases and vapors. Such instruments must be incapable, under normal or abnormal conditions, of causing ignition of hazardous mixtures in the air. In order to maintain the certified safety, it is important that the precautions outlined in this manual be practiced and that no modifications be made to these instruments.

It is highly recommended that the entire manual be read before operating the instrument. It is essential that all portions relating to safety of operation and maintenance be thoroughly understood.

Reference Literature

MI 611-101	Operation of Tri-Column GC Option
MI 611-102	Operation of Dilutor Kit
MI 611-105	Operation of Portable Isothermal Pack

GENERAL DESCRIPTION

The OVA 128 Analyzer is designed to detect and measure hazardous organic vapors and gases found in most industries. It has broad application since it has a chemically resistant sampling system and can be calibrated to almost all organic vapors. It can provide accurate indication of gas concentration in one of three ranges: 0 to 10 ppm; 0 to 100 ppm; or 0 to 1000 ppm. While designed as a lightweight portable instrument, it can be permanently installed to monitor a fixed point.

The instrument utilizes the principle of hydrogen flame ionization for detection and measurement of organic vapors. The instrument measures organic vapor concentration by producing a response to an unknown sample, which can be related to a gas of known composition to which the instrument has previously been calibrated. During normal survey mode operation, a continuous sample is drawn into the probe and transmitted to the detector chamber by an internal pumping system.

The sample stream is metered and passed through particle filters before reaching the detector chamber. Inside the detector chamber, the sample is exposed to a hydrogen flame which ionizes the organic vapors. When most organic vapors burn, they leave positively charged carbon-containing ions. An electric field drives the ions to a collecting electrode. As the positive ions are collected, a current corresponding to the collection rate is generated. This current is measured with a linear electrometer preamplifier which has an output signal proportional to the ionization current. A signal conditioning amplifier is used to amplify the signal from the preamp and to condition it for subsequent meter or external recorder display. The display is an integral part of the Probe/Readout Assembly and has 270° scale deflection.

In general, the hydrogen flame ionization detector is more sensitive for hydrocarbons than any other class of organic compounds. The response of the OVA varies from compound to compound, but gives repeatable results with all types of hydrocarbons; i.e., saturated hydrocarbons (alkanes), unsaturated hydrocarbons (alkenes and alkynes) and aromatic hydrocarbons.

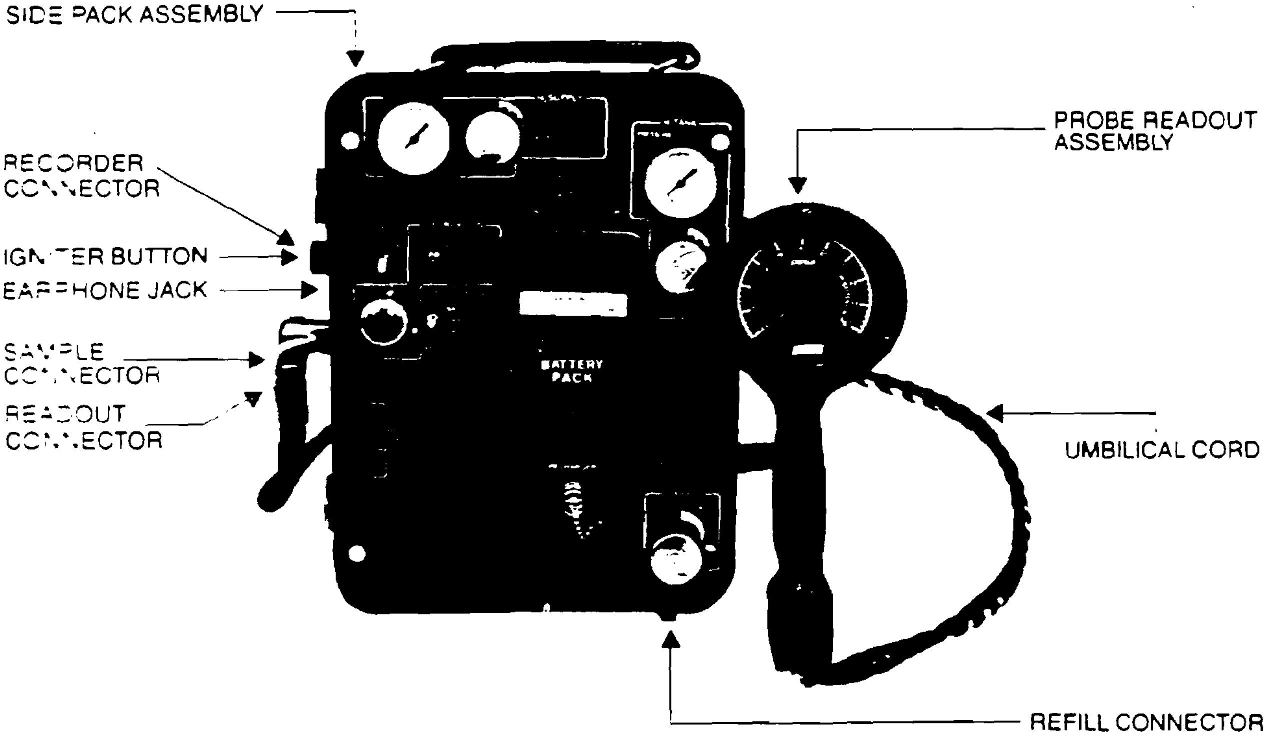


FIGURE 2
PORTABLE ORGANIC VAPOR ANALYZER
Model OVA 128

Typical response of various hydrocarbons, relative to methane is as follows:*

Compound	Relative Response (percent)
Methane	100 (reference)
Hexane	70
Propane	64
N-butane	61
N-pentane	100
Ethylene	85
Acetylene	200
Benzene	150
Toluene	120
Ethane	90

Compounds containing oxygen, such as alcohols, ethers, aldehydes, carbolic acid and esters give a lower response than that observed for hydrocarbons. This is particularly noticeable with compounds having a high ratio of oxygen to carbon such as the lower members of each series which have one, two or three carbons. With compounds containing higher numbers of carbons, the effect is diminished to such an extent that the response is similar to that of the corresponding hydrocarbons.

Nitrogen-containing compounds (i.e., amines, amides, and nitriles) respond in a manner similar to that observed for oxygenated materials. Halogenated compounds also show a lower relative response as compared with hydrocarbons. Materials containing no hydrogen, such as carbon tetrachloride, give the lowest response; the presence of hydrogen in the compounds results in higher relative responses. Thus, $CHCl_3$ gives a much higher response than does CCl_4. As in the other cases, when the carbon to halogen ratio is 5:1 or greater, the response will be similar to that observed for simple hydrocarbons.

The OVA has negligible response to carbon monoxide and carbon dioxide which, due to their structure, do not produce appreciable ions in the detector flame. Thus, other organic materials may be analyzed in the presence of CO and CO_2.

Applications

(1) Measurement of most toxic organic vapors present in industry for compliance with Occupational Safety and Health Administration (OSHA) requirements.

(2) Evaluation and monitoring applications in the air pollution field.

(3) Source identification and measurement for fugitive emissions (leaks) as defined by EPA.

(4) Forensic science applications.

(5) Controlling and monitoring atmospheres in manufacturing and packaging operations.

(6) Leak detection related to volatile fuel handling equipment.

(7) Monitoring the background level of organic vapors at hazardous waste sites.

(8) Quality control procedures geared to leak checking, pressurized system checks, combustion efficiency checks, etc.

Major Features

The basic instrument consists of two major assemblies, the Probe/Readout Assembly and the Side Pack Assembly (See Figure 2). The recorder is optional on all models, but is normally used with all instruments which incorporate the GC Option. The output meter and alarm level adjustments are incorporated in the Probe/Readout Assembly.

The Side Pack Assembly contains the remaining operating controls and indicators, electronic circuitry, detector chamber, hydrogen fuel supply, and electrical power supply.

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*NOTE: Each OVA detector will have slightly different responses for organic vapors relative to methane. The user should determine responses for his individual instrument. The typical response of various compounds relative to methane is as follows:

KETONES	
Acetone	60
Methyl ethyl ketone	80
Methyl isobutyl ketone	100
ALCOHOLS	
Methyl alcohol	15
Ethyl	25
Isopropyl	65
HALOGEN COMPOUNDS	
Carbon tetrachloride	10
Chloroform	65
Trichloroethylene	70
Vinyl chloride	35

Other major features are: linear scale readout, approximately two second response time and portable operating time of 8 hours for fuel supply and battery pack. A battery test feature allows charge condition to be read on the meter. Hydrogen flame-out is signified by an audible alarm plus a visual indication on the meter. The instrument contains a frequency modulated detection alarm which can be preset to sound at a desired concentration level. The frequency of the detection alarm varies as a function of detected level giving an audible indication of organic vapor concentration. An earphone is provided to allow the operator to hear the alarm in noisy areas or to avoid disturbing workers.

During use, the Side Pack Assembly can be carried by the operator on either his left or right side or as a back pack. The Probe/Readout Assembly can be detached from the Side Pack Assembly and disassembled for transport and storage.

Standard Accessories

A variety of sampling fixtures can be used. In addition, small diameter tubing can be used for remote sampling or electrically insulated flexible extensions can be used for places that are difficult to reach.

Telescoping Probe

Probe length can be increased or decreased over a 22 to 30 inch range to suit the individual user. A knurled locking nut is used to lock the probe at the desired length. The probe is attached to the Readout Assembly. When appropriate, the probe is replaced with a Close Area Sampler, which is supplied as a standard accessory.

Sampling Accessories

Part Number	Description
510125-1	Close area sampler - Connects directly to the readout assembly.
510035-1	Telescoping wand - Adjustable length -accommodates the probe listed below.
510126-1	Tubular area sampler - Used with the telescoping wand.

Particulate Filters

The primary filter of porous stainless steel is located behind the sample inlet connector (see Side Pack Assembly drawing). In addition, a replaceable porous metal filter is installed in the "close area" sampler.

Carrying Case

An instrument carrying case is provided to transport, ship and store the disassembled Probe/Readout Assembly, the Side Pack Assembly and other equipment.

Specifications

READOUT: 0 to 10, 0 to 100, 0 to 1000 ppm (linear)
SAMPLE FLOW RATE: 1 1/2 to 2 1/2 litre per minute at 22°C, 760 mm, using close area sampler
RESPONSE TIME: Approximately 2 seconds for 90% of final reading.
PRIMARY ELECTRICAL POWER: 12 volt (nominal) battery pack.
FUEL SUPPLY: Approximately 75 mL volume tank of pure hydrogen, maximum pressure 2400 psig, fillable in case.
HYDROGEN FLOW RATE: Factory set 12.5 ±0.5 mL/min (minus GC option) 11.0 ±0.5 mL/min (GC models)
PORTABLE OPERATING TIME: Minimum 8 hours with battery fully charged, hydrogen pressure at 1800 psig.
PHYSICAL DIMENSIONS: 9" x 12" x 5" (229 mm x 305 mm x 127 mm) Sidepack only.
WEIGHT: 12 pounds (5.5 kg) (sidepack and hand-held probe assembly)
DETECTION ALARM: Audible alarm plus meter indication. User preset to desired level.
FLAME-OUT ALARM: Audible alarm plus meter indication (needle drops off scale in negative direction).
BATTERY TEST: Battery charge condition indicated on readout meter. Upon activation of momentary contact switch, a meter reading above the indicator line means that there is 4 hours minimum service life remaining (at 22°C).
FILTERS: In-line sintered metal filters will remove particles larger than 10 microns.
OPERATING TEMPERATURE RANGE: 10°C to 40°C.
MINIMUM AMBIENT TEMPERATURE: 15°C for Flame Ignition (coldstart).
ACCURACY: Based on the use of a calibration gas for each range:

Calibration Temp. °C	Operating Temp. °C	Accuracy in % of Individual Full Scale		
		X1	X10	X100
20 to 25	20 to 25	±20	±10	±10
20 to 25	10 to 40	±20	±20	±20

RELATIVE HUMIDITY: 5% to 95%, Effect on accuracy: ±20% of individual full scale
RECORDER OUTPUT: 0 to 5 volts
MINIMUM DETECTABLE LIMIT (METHANE): 0.2 ppm
STANDARD ACCESSORIES:
1. Instrument carrying and storage case
2. Hydrogen fuel filling hose assembly
3. Battery charger
4. Earphone
5. Various sampling fixtures
6. Maintenance tool kit
7. Operators manual (2 each)
8. Padded leather carrying straps

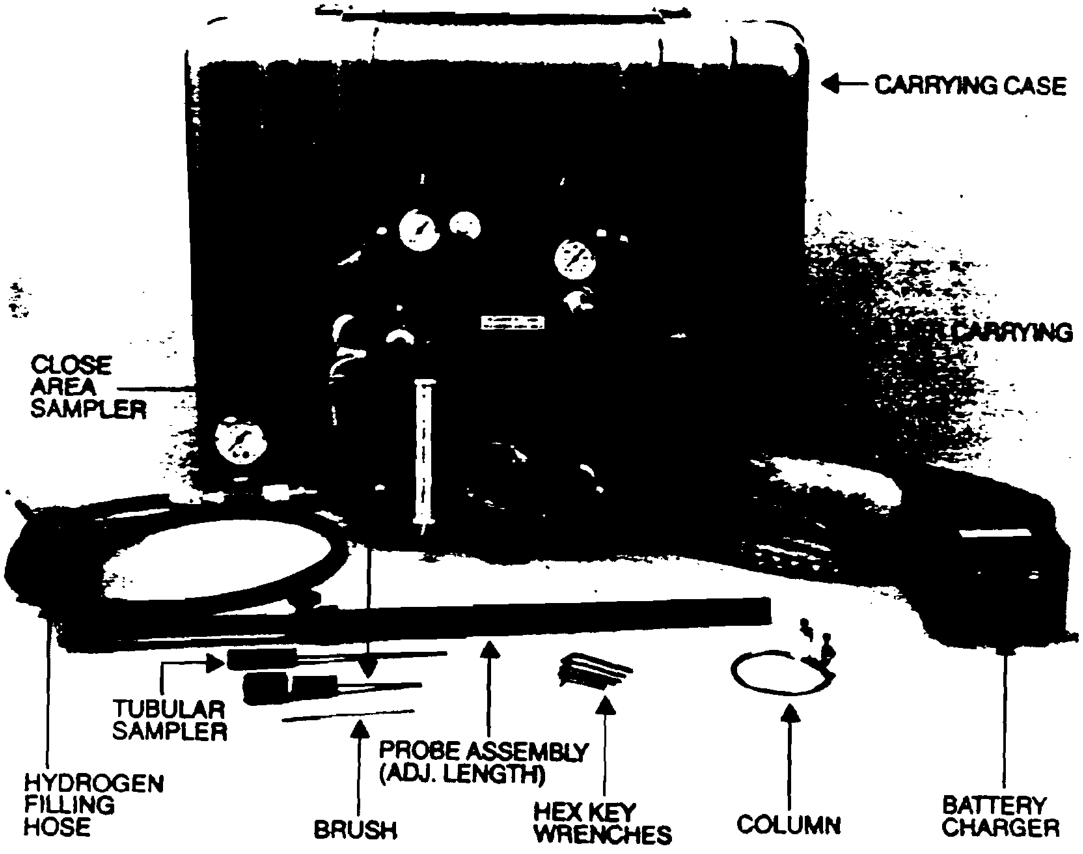


FIGURE 3
OVA-128 ANALYZER COMPONENTS
(Gas Chromatograph Model Shown)

OPERATING PROCEDURES

Controls and Indicators

Sidepack Assembly

1) INSTR/BATT Test Switch* - Three position toggle switch controls all instrument electrical power except the pump and alarm power. It also permits display of the battery charge condition on the readout meter.

2) PUMP (ON/OFF) Switch* - Toggle switch controls power to the internal pump and audio alarms.

3) Igniter Switch - Momentary push button switch connects power to the igniter coil in the detector chamber and simultaneously disconnects power to pump.

4) CALIBRATE Switch (range selector) -Selects the desired range: X1 (0 to 10 ppm); X10 (0 to 100 ppm); X100 (0 to 1000 ppm).

5) CALIBRATE ADJUST (zero) Knob -Potentiometer used to "zero" the instrument.

6) GAS SELECT KNOB (span control) - Ten-turn dial readout potentiometer sets the gain of the instrument (commonly referred to as span control).

7) Recorder Connector - Five-pin connector used to connect the instrument to an external recorder with the following pin connections:

   Pin E - + 12 V dc
   Pin H - Ground
   Pin B - Signal 0 to 5 V dc

8) Charger Connector - BNC connector used to connect the battery pack to the battery charger.

9) HYDROGEN TANK VALVE - Valve used to supply or close off the fuel supply from the hydrogen tank.

10) HYDROGEN TANK PRESSURE Indicator - High pressure gauge measures pressure in the hydrogen fuel tank which is an indication of fuel supply.

11) HYDROGEN SUPPLY VALVE - Valve used to supply or close off hydrogen fuel to the detector chamber.

12) HYDROGEN SUPPLY PRESSURE Indicator - Low pressure gauge used to monitor hydrogen pressure at the capillary restrictor.

13) SAMPLE FLOW RATE Indicator - Indicator to monitor the sample flow rate.

14) REFILL CONNECTION - ¼ in AN fitting to connect the hydrogen refill hose to the instrument.

15) REFILL VALVE - Valve to open one end of the instrument fuel tank for refilling with hydrogen.

16) EARPHONE JACK - Used to connect the earphone; speaker is disabled when earphone is used.

17) VOLUME Knob - Potentiometer adjusts the volume of the internal speaker and earphone.

18) Readout and Sample Connectors - Used to connect the sample hose and umbilical cord from the Probe/Readout to the Side Pack.

Controls and Indicators

Probe/Readout Assembly

1) Meter - Linear scaled 270° meter displays the output signal level in ppm.

2) Alarm Level Adjust Knob - Potentiometer (located on the back of the Readout Assembly) is used to set the concentration level at which the audible alarm is actuated.

*Special Switch - switch handle must be pulled to change position. This prevents accidental movement.

Startup Procedure

a) Connect the Probe/Readout Assembly to the Sidepack Assembly by attaching the sample line and electronic jack to the Sidepack.

b) Select the desired sample probe (close area sampler or telescoping probe) and connect the probe handle. Before tightening the knurled nut, check that the probe accessory is firmly seated against the flat seals in the probe handle and in the tip of the telescoping probe.

c) Move the Instr/Batt Switch to the test position. The meter needle should move to a point beyond the white line, indicating that the integral battery has more than 4 hours of operating life before recharging is necessary.

d) Move the Instr/Batt Switch to the "ON" position and allow a 5 minute warm-up.

e) Turn the Pump Switch on.

f) Use the Calibrate Adjust knob to set the meter needle to the level desired for activating the audible alarm. If this alarm level is other than zero, the Calibrate Switch must be set to the appropriate range.

g) Turn the Volume Knob fully clockwise.

h) Using the Alarm Level Adjust knob, turn the knob until the audible alarm is activated.

i) Move the Calibrate Switch to X1 and adjust the meter reading to zero using the Calibrate Adjust (zero knob).

j) Open the hydrogen Tank Valve 1 or 2 turns and observe the reading on the Hydrogen Tank Pressure Indicator. (Approximately 150 psi of pressure is required for each hour of operation).

k) Open the Hydrogen Supply Valve 1 or 2 turns and observe the reading on the Hydrogen Supply Pressure Indicator. The reading should be between 8 and 12 psi.

Note: With GC instrument, a column or jumper must be installed.

l) After approximately one minute, depress the Igniter Button until the hydrogen flame lights. The meter needle will travel upscale and begin to read "Total Organic Vapors". Caution: Do not depress igniter for more than 6 seconds. If flame does not ignite, wait one minute and try again.

m) The instrument is ready for use. NOTE: If the ambient background organic vapors are "zeroed out" using the Calibrate Adjust knob, the meter needle may move offscale in the negative direction when the OVA is moved to a location with lower background. If the OVA is to be used in the 0 to 10 ppm range, it should be "zeroed" in an area with very low background. A charcoal filter (Part No. 510095-1) can be used to generate the clean background sample.

Operating Procedures

The following procedure describes operation of the OVA in the "Survey Mode" to detect total organic vapors.

a) Set the CALIBRATE Switch to the desired range. Survey the areas of interest while observing the meter and/or listening for the audible alarm indication. For ease of operation, carry the Side Pack Assembly positioned on the side opposite the hand which holds the Probe/Readout Assembly. For broad surveys outdoors, the pickup fixture should be positioned several feet above ground level. When making quantitative readings or pinpointing, the pickup fixture should be positioned at the point of interest.

b) When organic vapors are detected, the meter pointer will move upscale and the audible alarm will sound when the setpoint is exceeded. The frequency of the alarm will increase as the detection level increases.

If the flame-out alarm is actuated, check that the pump is running, then press the igniter button. Under normal conditions, flame-out results from sampling a gas mixture that is above the lower explosve level which causes the hydrogen flame to extinguish. If this is the case, reignition is all that is required to resume monitoring. Another possible cause for flame-out is restriction of the sample flow line which would not allow sufficient air into the chamber to support combustion. The normal cause for such restriction is a clogged particle filter.

It should be noted that the chamber exhaust port is on the bottom of the case and blocking this port with the hand will cause fluctuations and/or flame-out.

Shut Down Procedure

The following procedure should be followed for shut down of the equipment:

A. Close HYDROGEN TANK VALVE
B. Close HYDROGEN SUPPLY VALVE
C. Move INSTR Switch to OFF
D. Wait 5 seconds and move PUMP Switch to OFF. INSTRUMENT IS NOW IN A SHUT DOWN CONFIGURATION.

Fuel Refilling

NOTE: Use PREPURIFIED or ZERO grade hydrogen (certified total hydrocarbons as methane <0.5 ppm recommended).

a) The instrument and the charger should be completely shut down during hydrogen tank refilling operations. Refilling should be done in a ventilated area. THERE SHOULD BE NO POTENTIAL IGNITERS OR FLAME IN THE AREA.

b) If you are making the first filling on the instrument or if the filling hose has been allowed to fill with air, the filling hose should be purged with hydrogen prior to filling the instrument tank. This purging is not required for subsequent fillings.

c) The filling hose assembly should be left attached to the hydrogen supply tank when possible. Ensure that the FILL/BLEED Valve on the instrument end of the hose is in the OFF position. Connect the hose to the refill connection on the Side Pack Assembly.

d) Open the hydrogen supply bottle valve slightly. Open the REFILL VALVE and the HYDROGEN TANK VALVE on the instrument panel and place the FILL/BLEED Valve on the filling hose assembly in the FILL position. The pressure in the instrument tank will be indicated on the HYDROGEN TANK PRESSURE Indicator.

e) After the instrument fuel tank is filled, close the REFILL VALVE on the panel, the FILL/BLEED Valve on the filling hose assembly and the hydrogen supply bottle valve.

f) The hydrogen trapped in the hose should now be bled off to atmospheric pressure. CAUTION should be used in this operation as described in Step (g) below, since the hose will contain a significant amount of hydrogen at high pressure.

g) The hose is bled by turning the FILL/BLEED Valve on the filling hose assembly to the BLEED position. After the hose is bled down to atmospheric pressure, the FILL/BLEED Valve should be turned to the FILL position to allow the hydrogen trapped in the connection fittings to go into the hose assembly. Then, again, turn the FILL/BLEED Valve to the BLEED position and exhaust the trapped hydrogen. Then turn the FILL/BLEED Valve to OFF to keep the hydrogen at one atmosphere in the hose so that at the time of the next filling there will be no air trapped in the filling line.

h) Close the HYDROGEN TANK VALVE.

i) With the HYDROGEN TANK VALVE and the HYDROGEN SUPPLY VALVE closed, a small amount of HYDROGEN at high pressure will be present in the regulators and plumbing. As a leak check, observe the HYDROGEN TANK PRESSURE Indicator while the remainder of the system is shut down and ensure that the pressure reading does not decrease rapidly (more than 350 psi/h) which would indicate a significant leak in the supply system.

Battery Charging

WARNING: Never charge in a hazardous environment.

a) Plug charger connector into mating connector on battery cover and insert ac plug into 115 V ac wall outlet.

b) Move the battery charger switch to the ON position. The lamp above the switch button should illuminate.

c) Battery charge condition is indicated by the meter on the front panel of the charger; meter will deflect to the left when charging. When fully charged, the pointer will be in line with "charged" marker above the scale.

d) Approximately one hour of charging time is required for each hour of operation. However, an overnight charge is recommended. The charger can be left on indefinitely without damaging the batteries. When finished, move the battery charger switch to OFF and disconnect from the Side Pack Assembly.

THE FOLLOWING ARE SPECIAL INSTRUCTIONS FOR RECHARGING BATTERIES WHICH HAVE BEEN COMPLETELY DISCHARGED.

It has been established that the above battery charging procedures may not be effective when the operator has allowed the battery to COMPLETELY discharge.

When this happens and the above procedures fail to charge the battery, perform the following additional steps:

e) Remove the battery from the instrument case.

f) Connect to any variable dc power supply.

g) Apply 40 volts at ½ ampere maximum.

h) Observe the power supply meter. As soon as the battery begins to draw current, gradually reduce the power maintaining ½ A maximum until the meter reads approximately 15 volts.

NOTE: The time required to reach the 15 volt reading will depend on degree of discharge.

i) Repeat steps (a), (b), (c), and (d) above to complete the charging cycle.

SUMMARY OF OPERATING PROCEDURES

Start Up

a) Check battery condition by moving the INSTR Switch to the BATT position.

b) Move INSTR Switch to ON and allow five (5) minutes to warm-up.

c) Use the Calibrate Adjust knob to set the meter needle to the level desired for activating the audible alarm. If this alarm level is other than zero, the Calibrate Switch must be set to the appropriate range.

d) Turn the Volume Knob fully clockwise.

e) Using the Alarm Level Adjust knob, turn the knob until the audible alarm is activated.

f) Set CALIBRATE Switch to X1 position, use CALIBRATE Knob and set meter to read 0.

g) Move PUMP Switch to ON position, then place instrument panel in vertical position and check SAMPLE FLOW RATE indication. The normal range is 1.5 to 2.5 units. If less, check filters.

h) Open the HYDROGEN TANK VALVE and the HYDROGEN SUPPLY VALVE. Wait one minute for hydrogen to purge the system.

i) Depress Igniter Button until burner lights. Do not depress Igniter Button for more than six seconds. (If burner does not ignite, let hydgrogen flow for one minute and again attempt ignition.)

j) Use CALIBRATE Knob to "zero" out ambient background. For maximum sensitivity below 10 ppm, set CALIBRATE Switch to X1 and readjust zero on meter. To avoid false flame-out alarm indication, set meter to 1 ppm with CALIBRATE Knob and make differential readings from there.

Shut Down

a) Close the HYDROGEN SUPPLY VALVE

b) Close the HYDROGEN TANK VALVE

c) Move the INSTR Switch and PUMP Switch to OFF

d) Instrument is now in shut down configuration

CALIBRATION

Recalibration to Various Organic Vapors

The OVA 128 is capable of responding to nearly all organic compounds. At the time of manufacture, the analyzer is calibrated to mixtures of methane in air. For precise analysis it is necessary to recalibrate with the specific compound of interest. The GAS SELECT control is used to set the electronic gain for a particular compound.

The instrument is recalibrated using a mixture of a specific vapor in air, with known concentration. After the instrument is in operation and the normal background is zeroed, draw a sample of the calibration gas into the instrument. The GAS SELECT Knob on the panel is then used to set the readout meter indication to correspond to the concentration of the calibation gas mixture.

The instrument has now been calibrated to the vapor mixture being used. After this adjustment, the setting on the "digidial" should be recorded for that particular organic vapor compound. This exercise can be performed for a large variety of compounds, thereby generating a "library" which can be used for future reference without need for additional calibration standards.

To read a particular compound, the GAS SELECT control is turned to the predetermined setting for the compound. Calibration on any one range automatically calibrates the other two ranges.

Using Empirical Data

Relative response data can be used to estimate the concentration of a vapor without need to recalibrate the analyzer. With the instrument calibrated to methane, obtain the concentration reading for a calibration sample of the test vapor. The response factor (R) in percent, for that vapor is:

$$R = \frac{\text{Actual Concentration}}{\text{Measured Concentration}}$$

To determine the concentration of an unknown sample of that vapor, multiply the measured concentration by R.

Calibration Standards

Commercial Standards

Commercially available standard samples offer the most convenience and are recommended for the most precise analyses. Always remember to obtain the desired vapor in an air background. Samples should be drawn from the cylinder into a collapsed sample bag, then drawn from the bag by the instrument to prevent a pressure or vacuum at the sample inlet.

Preparation of Standards

The following procedure is for generating calibration standards as an alternative to using commercial mixtures.

Obtain a five (5) gallon glass bottle and determine its volume by measuring the volume of water needed to fill it (use of a 1000 mL graduated cylinder is convenient). Another approach is to weigh the empty bottle, fill it with water and weigh again. The difference between the two values is the weight of water. By multiplying the weight of water in pounds by 0.455, obtain the volume of the bottle in liters. Empty the water and allow the bottle to dry. Place a one-foot piece of Teflon tubing in the flask to aid in mixing the vapors uniformly with the air. The volume of such a bottle should be about 20 liters, which is 20,000 mL. If the volume were 20,000 mL, then a 2 mL sample of a gas would be equivalent to 200 mL per 2 million mL or 100 ppm (V/V). Use of a gas tight Syringe, readable in 0.01 mL, allows the preparation of mixtures in the 1-2 ppm range, which are sufficient for the quantitative estimation of concentrations. A plastic stopper is loosely fitted to the tip of the bottle. The needle of the syringe is placed inside the jug neck and the stopper squeezed against the needle to decrease leakage during sample introduction. Inject the sample into the bottle and withdraw the needle without removing the stopper. Tighten the stopper and shake the bottle for a few minutes with sufficient vigor that the plastic tubing in the bottle moves around to ensure good mixture of the vapors with the air.

Calculations

$$\text{Injection} = \frac{\text{Volume Concentration X Molecular Weight X System Volume}}{\text{Density X Molar Volume at STP*}}$$

$$= \frac{(C)\ (MW)\ (V)}{(D)\ (V)}$$

Using the Ideal Gas Law, PV=RT, the molar volume of any gas at STP (25°C and 1 atm) is:

$$V = \frac{RT}{P} = \frac{\text{Universal Gas Constant x Temperature}}{\text{Pressure}}$$

$$= \frac{\left[(0.08206\ \frac{\text{litre atm}}{\text{mol K}})\right]\ (298.15\ K)}{1\ \text{atm}}$$

$$= (24.47\ L)\ (\text{mol}^{-1})$$

Therefore, the injection volume necessary to prepare 1 liter of a 100 ppm sample of hexane would be:

$$\text{Injection Volume} = \frac{(100\ \text{ppm})\ [(86.18\ g)\ (\text{mol}^{-1})]\ (1\ \text{liter})}{[(0.659\ g)\ (\text{mL}^{-1})]\ [(24.47\ L)\ (\text{mol}^{-1})]\ [(1000\ \text{mL})\ (l^{-1})]}$$

$$= 0.534\ \mu L$$

* STP - Standard Temperature and Pressure

Primary Calibration for Methane

Internal electronic adjustments are provided to calibrate and align the circuits. After initial factory calibration, it should not be necessary to repeat the calibration unless the analyzer undergoes repairs which affect calibration. If the OVA 128 will be extensively used for analysis of a sample other than methane, recalibration of the electronics (after resetting the GAS SELECT CONTROL) may result in better accuracy. See Recalibration to Various Organic Vapors above.

Primary calibration of this instrument is accomplished at the factory using methane-in-air, sample gases.

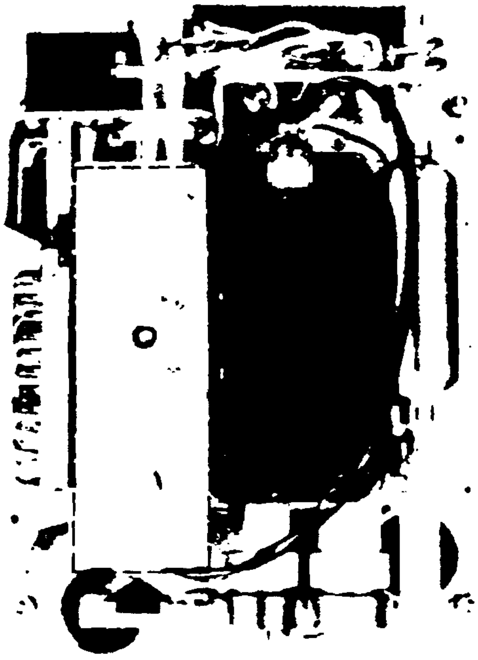


FIGURE 4
LOCATION OF ELECTRONIC ADJUSTMENTS

Calibration Using Known Samples for Each Range *(Refer to Figure 4)*

The accuracy stated under Specifications is obtained when the instrument is calibrated with known concentrations for each range. Prepare separate samples of methane-in-air in these concentration ranges: 7 to 10 ppm, 90 to 100 ppm, and 900 to 1000 ppm. Calibrate the instrument as follows:

a) Place the instrument in normal operation and allow a minimum of 15 minutes for warm-up and stabilization.

b) Set the GAS SELECT control to 300.

c) Set the CALIBRATE Switch to X1.

d) Set the CALIBRATE ADJUST (Zero) Knob so that the meter reads zero.

e) Check that the meter reads zero on the X10 and X100 ranges.

f) Set the CALIBRATE Switch to X1 and introduce the sample with known concentration in the 7 to 10 ppm range.

g) Adjust R31 so that the meter reading corresponds to the sample concentration.

h) Set the CALIBRATE Switch to X10 and introduce the sample with known concentration in the 90 to 100 ppm range.

i) Adjust R32 so that the meter reading corresponds to the sample concentration.

j) Set the CALIBRATE Switch to X100 and introduce the sample with known concentration in the 900 to 1000 ppm range.

k) Adjust R33 so that the meter reading corresponds to the sample concentration.

l) The instrument is now calibrated for methane and ready for service.

Calibration Using a Single Sample Calibration *(Refer to Figure 4)*

Calibration may be accomplished using a single known sample of methane in air in the range of 90 to 100 ppm. This may not provide the accuracy stated under specifications but is adequate for field survey work.

a) Place instrument in normal operation with CALIBRATE Switch set to X10 and GAS SELECT control set to 300.

b) Use the CALIBRATE ADJUST (zero Knob to adjust the meter reading to zero.

c) Introduce a methane sample of a known concentration (between 90 and 100 ppm not to exceed 100 ppm) and adjust trimpot R-32 so the meter reading corresponds to the known sample.

d) This sets the instrument gain for methane with the panel mounted gain adjustment (GAS SELECT) set at a reference number of 300.

e) Turn off HYDROGEN SUPPLY VALVE to put out flame.

f) Leave CALIBRATE Switch on X10 position and use CALIBRATE ADJUST (zero) Knob to adjust meter reading to 4 ppm.

g) Place CALIBRATE Switch in X1 position and using trimpot R-31 adjust meter reading to 4 ppm.

h) Move CALIBRATE Switch to X10 position again. Use CALIBRATE ADJUST (zero) Knob to adjust meter to a reading of 40 ppm.

i) Move CALIBRATE Switch to X100 position and use trimpot R-33 to adjust meter reading to 40 ppm.

j) Move CALIBRATE ADJUST (zero) Knob to adjust meter reading to zero.

k) Unit is now balanced from range to range, calibrated to methane, and ready to be placed in normal service.

SAFETY PRECAUTIONS

The OVA 128 has been tested and certified by Factory Mutual Research Corporation (FM) as safe for use in Class I, Division 1, Groups A, B, C and D hazardous atmospheres. Similar foreign certifications have been obtained, including BASEEFA. Special restrictions must be strictly adhered to, to ensure the certification is not invalidated by actions of operating or service personnel.

All flame ionization hydrocarbon detectors are potentially hazardous since they use hydrogen or hydrogen mixtures in the detector cell. Mixtures of hydrogen and air are flammable over a wide range of concentrations whether an inert gas such as nitrogen is present or not. Therefore, the recommended precautions and procedures should be followed for maximum safety. Safety considerations were a major factor in the design of the Organic Vapor Analyzer (OVA).

All connections are of the permanent type as opposed to quick disconnect. To protect against external ignition of flammable gas mixtures, the flame detection chamber has porous metal flame arrestors on the sample input and the exhaust ports as well as on the hydrogen inlet connector. The standard battery pack and other circuits are internally current limited to an intrinsically safe level.

No Modifications Permissible

It is imperative that operation and service procedures described in this manual be carefully followed in order to maintain the intrinsic safety which is built into the OVA. NO MODIFICATION TO THIS INSTRUMENT IS PERMISSIBLE. Therefore, component replacement must be accomplished with approved parts.

Electrical Protection

The 12 V battery power supply circuit is current limited to an instrinsically safe level. Fuses are not utilized and all current limiting resistors and other components which are critical to the safety certification are encapsulated to prevent inadvertent replacement with components of the wrong value or specification. Under no circumstances should the encapsulation be removed.

Fuel Supply System

The OVA fuel tank has a volume of approximately 75 cm which, when filled to the maximum rated pressure of 2300 psig, holds approximately 5/8 ft of gas. The fuel used in the OVA should be PREPURIFIED or ZERO grade hydrogen (certified total hydrocarbons as methane <.5 ppm recommended.)

Hydrogen gas gains heat when expanding and, therefore, should not be rapidly released from a high pressure tank to a low pressure environment. Flow restrictors are incorporated in the hydrogen refill fitting and hydrogen is restricted on the output side of the tank by the low flow rate control system. In addition, a special flow restrictor is incorporated in the FILL/BLEED valve of the hydrogen filling hose assembly. These precautions limit the flow rate of the hydrogen to prevent ignition due to self-heat from expansion.

Precautions should be taken during hydrogen filling or hydrogen emptying operations to ensure that there are no sources of ignition in the immediate area. Since the instrument tank at 2300 psig holds only 5/8 ft of hydrogen, the total quantity, if released to the atmosphere, would be quickly diluted to a non-flammable level. There is, however, the possibility of generating flammable mixtures in the immediate vicinity of the instrument during filling or emptying operations if normal care is not exercised.

Detector Chamber

The input and output ports of the flame ionization chamber have sintered metal flame arrestors. The chamber is ruggedly constructed of Teflon such that even if highly explosive mixtures of hydrogen and air are inadvertently created in the chamber and ignited, the chamber would NOT rupture.

MAINTENANCE

This section describes the routine maintenance schedule and provides procedures for trouble-shooting an instrument malfunction.

CAUTION: Maintenance personnel should be thoroughly familiar with instrument operation before performing maintenance. It is essential that all portions of this manual relating to safety of operation, servicing and maintenance, be thoroughly understood. There should be no potential igniters or flame in the area when filling, emptying or purging the hydrogen system and the instrument should be turned off.

Extreme care should be exercised to ensure that required parts replacement is accomplished with the parts specified by Foxboro. NO MODIFICATIONS ARE PERMITTED. DISASSEMBLE INSTRUMENT ONLY IN A NON-HAZARDOUS ATMOSHPHERE.

Routine Maintenance *(Refer to Figure 5)*

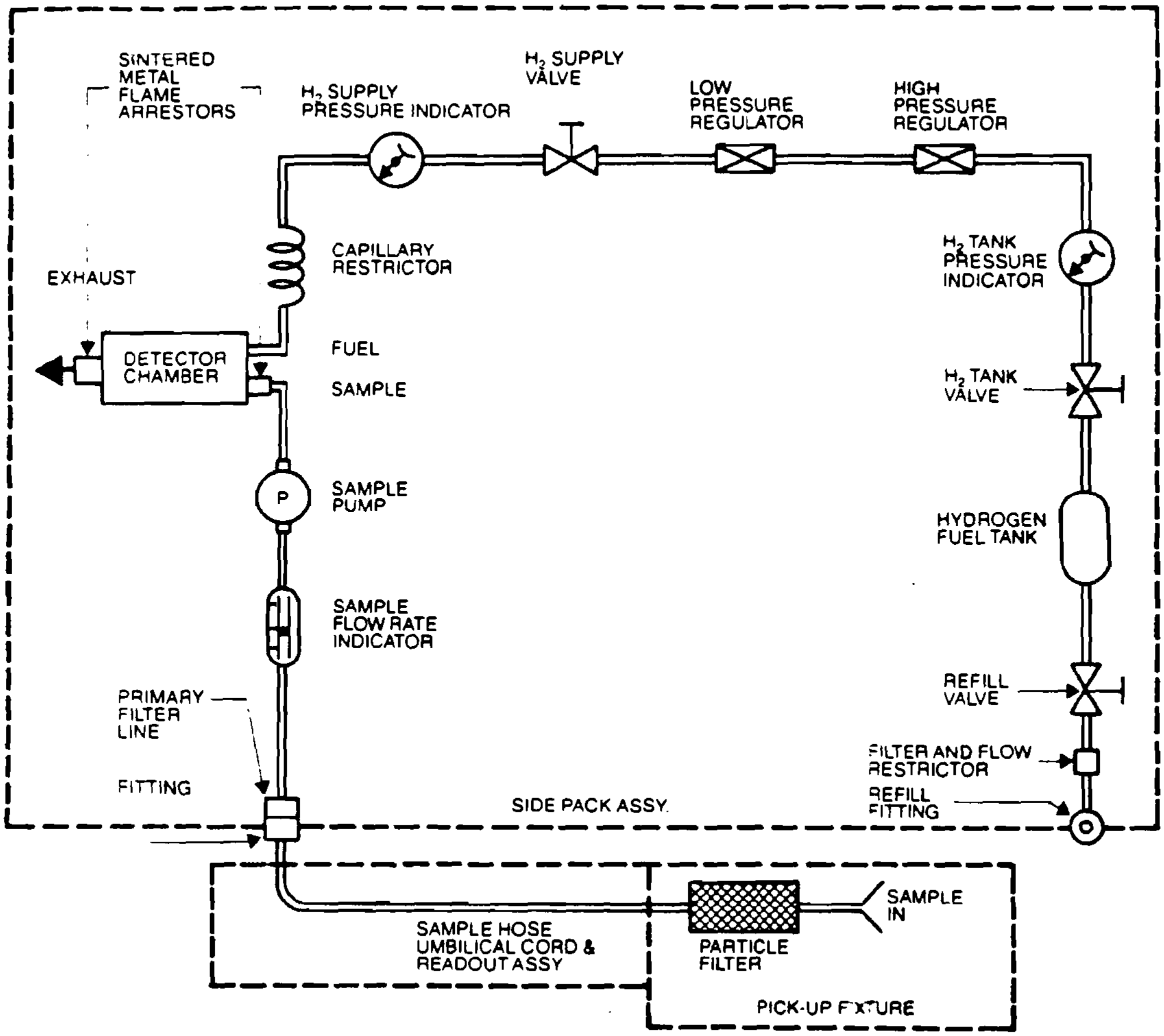


FIGURE 5
BLOCK DIAGRAM - GAS HANDLING SYSTEM

Primary Filter

This filter is located behind the sample inlet connector (Fitting Assembly) on the Side Pack Assembly and is removed for cleaning by using a 7/16 inch thin wall socket to unscrew the Fitting Assembly. The filter cup, "O" ring and loading spring will then come out. The porous stainless filter cup can be cleaned by blowing out or washing in solvent. If a solvent is used, care should be taken to ensure that all solvent is removed by blowing out or heating the filter. Reassemble in reverse order ensuring that the "O" ring seal on the Fitting Assembly is intact.

Secondary Filter

A particle filter is located in each pick-up fixture. One of these filters must be in the sample line whenever the instrument is in use. The OVA 128 uses a porous metal filter which can be replaced or cleaned.

Mixer/Burner Assembly Filter

A porous metal particle filter is incorporated in the Mixer/Burner Assembly which screws into the Preamp Assembly. This filter is used as the sample mixer and inlet flame arrestor in the chamber. The filter should not become contaminated under normal conditions but can be cleaned or the assembly replaced if necessary.

Access to this filter or output surface does not require removing the instrument from the case. For access, remove the safety cover using a hex key wrench (supplied) then unscrew the exhaust port. The Filter Assembly can now be seen on the side of the chamber (Preamp Assembly) and can be cleaned with a small wire brush.

Exhaust Flame Arrestor

A porous metal flame arrestor is located in the exhaust port of the detector chamber (Preamp Assembly). It acts as a particle filter on the chamber output and restricts foreign matter from entering the chamber. This filter may be cleaned by removing the exhaust port. For access, see Mixer/Burner section above. Note that the filter is captive to the exhaust port. Clean the filter with a solvent or detergent and ensure that it is dry and completely baked out at 120°F before reinstalling.

Sampling Fixtures

Sampling fixtures should be periodically cleaned with an air hose and/or detergent water to eliminate foreign particle matter.

If a solvent is used, the fixture should be subsequently cleaned with detergent and baked out at 120°F to eliminate residual hydrocarbons from the solvent.

Hydrogen Tank Supply & Refill Valves

After some time, the Teflon washers under each valve packing nut can "cold flow" (move with pressure) and allow hydrogen to leak. Leakage can be determined by using Leak-Tec, Snoop or a soap solution around the valve stems. This leakage can usually be stopped by tightening the compression nut (adapter) as outlined below.

a) Unscrew the packing nut with a 7/16 inch wrench
b) Unscrew the valve
c) Replace the compression rings

This compression is against soft material and only a small amount of force is necessary to sufficiently compress the Teflon washers. If, after tightening, leakage still occurs, it would be advisable to replace the two Teflon washers, as follows:

a) Drain hydrogen system slowly and to the extent necessary to work on the leaking valve(s). Observe safety precautions. There should be no potential igniters in the area.

b) Remove all three (3) knob screws and knobs.

c) Remove the compression nut on the valve that is not sealing properly. Remove the stem by unscrewing it from the valve body. Observe the sandwich of metal and Teflon washers and note their order.

d) Visually check the Kel-F™ seat on the stem for cracks or foreign material. Wipe clean, if necessary, with a lint free cloth (no solvents or oils) and replace if damaged.

e) Remove the washers and replace the Teflon washers (the factory procedure is a light wipe of HYDROCARBON FREE silicone grease).

f) Replace the stem assembly in the valve body and tighten lightly.

g) Push the washers down into the compression area in the same order as noted upon removal. Replace the compression nut and tighten snuggly.

h) Close the low pressure valve and fill the tank assembly. Check valves for leaks. Tighten again, if necessary, and reassemble the unit.

Air Sampling System Maintenance

A potential problem associated with the OVA instrument is that leaks can develop in the air sample pumping system. These leaks can result in dilution or loss of sample, causing low reading of vapor concentration and slow response.

The OVA is equipped with a flow gauge that provides a method to check for air leaks. Assemble the pickup probe selected for use to the readout assembly and then position the sidepack vertically so the flow gauge may be observed. Cover the end of the pickup probe with your finger and observe that the ball in the flow gauge goes to the bottom, indicating no air flow (if ball has slight chatter while on bottom, this is acceptable). Cover the center of the chamber exhaust port with your thumb and again observe the ball going to the bottom. Another simple check is to expose the pickup probe to cigarette smoke or a light vapor (butane) and observe that the meter responds in approximately 2.0 seconds. It should be noted that slow meter response may also indicate a restriction in the air sampling system.

Failure of the ball to go to the bottom when the inlet is blocked indicates a leak in the system between the probe and the pump inlet or the inlet check valve. To isolate the problem, remove parts, one at a time, and again block off the air inlet. Remove the pickup probe(s) and cover the air inlet at the Readout Assembly. If the ball goes to the bottom, check that the "readout to probe" seal washer is in place and replace the probes, holding them back against this seal while tightening the nut. Recheck, and if leakage is still present, it is probably in the probe (pickup fixture), which should be repaired or replaced.

If leakage is indicated as being past the readout handle when the connection to the sidepack is tight, disconnect the sample line at the fitting on the sidepack and cover this inlet with your finger. If the flow gauge ball goes to the bottom, the problem should be a leak in the umbilical cord/Readout Assembly, which should be investigated and repaired. There is also the possibility of a leaking check valve in the pump which would not show up on this test. If the leakage is not found in the umbilical cord, it is most likely in the pump check valve. The pump should be replaced.

If the ball does not go to the bottom, the leak will be either in the flow gauge or it's connecting tubing. Visually check that the tubing is connected and if so, the flow gauge should be repaired or replaced. Check the "O" ring installation in the sample inlet connector (Fitting Assembly).

As an alternate approach, leaks on the inlet side of the pump can be detected by using alcohol on a "Q" Tip and lightly swabbing the connections one at a time or by directing organic vapor or smoke at the potential leakage points and observing the meter response or audible alarm.

Leaks (beyond the pump) are easier to locate, as any of the commercially available leak detection solutions can be used. Cover the exhaust port, which will place the exhaust system under pressure, and check each connection, one at a time. Replace the Teflon tubing or retape the threaded connections with Teflon joint tape. Check the igniter and Mixer/Burner Assembly where they screw into the detector, the high voltage terminal screw on the side of the Mixer/Burner and exhaust port itself. If after these checks, the flow gauge ball still will not go to the bottom with the exhaust blocked, the problem is likely a leaking exhaust check valve in the pump, which should be repaired or replaced.

Contaminating Control

On occasion, the background reading may be relatively high under normal ambient conditions. Ambient background readings will vary somewhat depending on the geographical location where the instrument is being used. However, the background reading normally should be in the range of 3 to 5 ppm as methane. The acceptable background reading consists of 1 to 1½ ppm of methane which is present in the normal air environment. In addition to the measurement of a normal methane background, there will normally be 2 to 4 ppm of equivalent methane background caused by acceptable levels of contamination in the hydrogen fuel and/or hydrogen fuel handling system resulting in a total equivalent methane reading of 3 to 5 ppm in clean air.

If the background reading goes above 5 ppm to 6 or 7 ppm, this is normally still acceptable since any measurement is additive to that background reading, i.e., 2 ppm on top of 5 or 2 ppm on top of 7 provides the same differential reading, however, the lower background is obviously desirable.

The background reading is zeroed out or nulled - even though in reality the background still exists. The background reading is measured by zeroing the meter with the flame out and noting the meter indication after the flame is on.

The cause for a high background reading is usually associated with contamination in the hydrogen fuel system. This will, of course, cause a background reading since this is the function of the basic detector "to measure contamination entering the detector chamber". In addition, contamination present in the hydrogen will many times leave a small unobservable deposit on the burner face which can continue to generate a background reading when the detector is in operation and the burner assembly is heated.

Another possible cause of contamination is the Mixer/Burner Assembly when the contamination is trapped in the porous bronze sample filter. This is not a common problem and usually only happens when an unusually high level of contaminant is drawn into the assembly. Another possible cause of high background reading is contamination in the air sample line to the detector. This is uncommon but can be the source of the problem.

NOTE: An OVA that has the Chromatograph Option can have high background caused by saturation or contamination of the activated charcoal filter, which is in the line during chromatograph analysis, or of the column which is in the hydrogen line at all times.

Analysis and Correction

Prior to analyzing the problem, the OVA should be checked for proper electronic operation. It should be ensured that the instrument is calibrated to methane as referenced.

If, after checking that the OVA is properly calibrated, the background is still higher than normal for ambient conditions, the following procedure should be followed to isolate the cause of the problem:

a) Let the OVA run for a period of time (15 to 30 minutes) and see if the background level decreases as a function of time. The background could go down as a result of clearing line contamination which is removable simply by the normal flow of air through the sample line.

b) Take a reading in a known, relatively clean air environment. Normally, outside air environment is clean enough to assess by comparison whether the background reading is internal to the instrument or is present in the location where the instrument is being used.

c) If the OVA has the Gas Chromatograph Option, depress the sample inject valve, so that the activated charcoal is in the line, and observe whether the background reading goes down and stays steady after elution of the air peak. The reading should always go down or stay the same but never increase when the sample valve is depressed, since the charcoal filter will remove trace elements of organic vapors in the air sample heavier than C_2. If another activated charcoal filter is available, this may be attached to the end of the probe to scrub the air so that a clean air sample is supplied to the detector. The external activated charcoal filter can be used on any instrument, with or without chromatograph, for providing a clean air sample to assess background level.

d) If the background cannot be reduced by any of the previous steps, remove the safety cover and the exhaust port of the detector chamber (on the bottom of the case) and clean the cavity and the electrode using the small wire brush supplied with the analyzer. This will remove any small quantities of contamination which could be the source of the background vapor. After cleaning, replace the exhaust port and safety cover and reignite the OVA. If detector contamination was the cause, the problem should be immediately resolved and the ambient back ground will drop to an acceptable level.

e) If the high background is still present, the various parts of the sample flow line such as pickup probes, umbilical cord to the instrument, etc., should be investigated by the process of elimination to see if the contamination can be isolated.

Serious contamination in the air sample line is very uncommon, however, if very large doses of low vapor pressure compounds are sampled, there is a possibility of residual contamination. This would eventually clear itself out but may take a considerable period of time. A typical cause for high background from the sample line is a contaminated Mixer/Burner Assembly. If heavy contamination of the Mixer/Burner is indicated, replace the Mixer/Burner Assembly.

f) In the event of contamination in the pump or other internal parts of the sample flow lines which cannot be removed, the sample flow components have to be disassembled and cleaned. This is normally a factory operation, however, components such as the pump can be replaced in the field along with any contaminated tubing.

g) High background readings on OVA's which include the Gas Chromatograph Option can be caused by other sources of contamination. If the charcoal filter mounted on the instrument panel is saturated, contaminated air would be supplied to the detector and raise the ambient level background. To check for this, refill the cartridge with fresh charcoal, Foxboro P/N CSC004. This would determine if the charcoal was the source of the background reading. It is also possible that a high background reading could be due to contamination in the column. This could be caused by compounds slowly eluting from a column which has become contaminated. The easiest way to check for column contamination is to replace the column with a clean column or a short empty piece of column tubing and see if the high background reading drops.

h) If the above steps do not correct the high background, the cause will normally be contamination in the hydrogen fuel system.

Contamination in the hydrogen fuel system is usually the direct result of contaminated hydrogen gas or contamination introduced during the filling operation. Filling hose contamination can be caused by storing the hose in a contaminated area.

To remove contamination, the fuel system should be purged with hydrogen. Effective purging is accomplished by disconnecting the capillary tube fitting to the manifold block which has the low pressure gauge (Hydrogen Supply Pressure Gauge and Hydrogen Supply Valve). This disconnects the capillary tubing from the hydrogen line so that hydrogen may be purged at a reasonable rate from the tank assembly through the regulators, gauges and valves. After disconnecting the capillary, the hydrogen tank can be filled in the normal manner. The tank valve and hydrogen supply valve can then be opened which will bleed the hydrogen from the tank through the hydrogen fuel system, purging contamination which is in vapor form. There is the possibility that contamination has been introduced into the hydrogen fuel system which is not readily purged by the hydrogen gas, but this is unlikely. After purging with clean hydrogen two or three times, the capillary tube should be reconnected and the background again checked. Five or ten minutes should be allowed before assessing the background reading, since contaminated hydrogen can be trapped in the capillary tube.

If another clean instrument is available, the fuel system from the clean instrument can be connected to the contaminated instrument to verify whether the problem is associated with the hydrogen fuel supply system. The interconnection should be made to the capillary tube of the contaminated instrument.

Troubleshooting

Table 1 presents a summary of field troubleshooting procedures. If necessary, the instrument can be easily removed from the case by unlocking the four (4) ¼ turn fasteners on the panel face and removing the refill cap. The battery pack is removed by taking out the four (4) screws on the panel and disconnecting the power connector.

Factory Maintenance

To ensure continuous trouble-free operation, a periodic factory maintenance, overhaul, and recalibration is recommended. The recommended schedule is every six to nine months. This maintenance program includes replacement of plastic seals and parts as required, pump overhaul, motor check, sample line cleaning, hydrogen leak check, recalibration, and detailed examination of the unit for any other required maintenance and repair.

Recommended Spare Parts

Item	Description	Part Number	Recommended Quantity
1	Igniter	510461-1	2
2	Pump Assembly	510223-6	1
3	Cup, Filter (3/8 inch OD, ss)	510318-1 (5/pkg.)	1
4	Mixer/Burner Assembly	510513-1	1
5	Wafer, Teflon, H_2 Valve	510160-1 (10/pkg.)	1
6	Washer, Brass, H_2 Valve	510160-2 (10/pkg.)	1
7	Exhaust Port Assembly	510530-1	1
8	Battery Pack Assembly	510542-1	1
9	Sample Line Assembly	510316-1	1
10	Particle Filters	510116-1	1

TABLE 1

PROBLEM	TROUBLE SHOOTING PROCEDURE	REMEDY
1) Low sample flow rate on flow indicator. Nominally 2 units on flow gauge. (See also 6 below)	a) Check primary filter in sidepack and particle filters in the pickup assembly.	Replace or clean filter if clogged.
	b) Determine assembly containing restriction by process of elimination, i.e., remove probe, remove Readout Assembly, remove primary filter, etc.	Investigate the assembly containing this restriction to determine cause of blockage. Clean or replace as required.
	c) If the restriction is in the Side Pack Assembly, further isolate by disconnecting the sample flow tubing at various points, i.e., pump output chamber, etc. NOTE: The inherent restrictions due to length of sample line, flame arrestors, etc., must be taken into account when troubleshooting.	If in the detector chamber, remove and clean or replace porous metal flame arrestors. If pump is found to be the problem, remove and clean or replace.
2) Hydrogen flame will not light. (See also 6 below)	a) Check sample flow rate (see 1 above)	If sample flow rate is low, follow procedure 1 above.
	b) Check igniter by removing the chamber exhaust port and observing the glow when the IGNITE BUTTON is depressed.	If igniter does not light up, replace the plug. If igniter still does not light, check the battery and wiring.
	c) Check for rated Hydrogen Supply Pressure. (Listed on calibration plate on pump bracket).	If low, remove battery pack and adjust to proper level by turning the allen wrench adjustment on the low pressure regulator cap.
	d) Check hydrogen flow rate by observing the psi decrease in pressure on the Hydrogen Tank Pressure gauge. The correct flow rate will cause about 130 psi decrease in pressure per hour. (Approximately 12 cm^3/min at detector).	The most likely cause for hydrogen flow restriction would be a blocked or partially blocked capillary tube. If flow rate is marginally low, attempt to compensate by increasing the Hydrogen Supply Pressure by one-half or one psi. If flow rate cannot be compensated for, replace capillary tubing.
	e) Check all hydrogen plumbing joints for leaks using soap bubble solution. Also, shut off all valves and note pressure decay on hydrogen tank gauge. It should be less than 350 psi per hour.	Repair leaking joint.

TABLE 1

PROBLEM	TROUBLE SHOOTING PROCEDURE	REMEDY
	f) Check to see if hydrogen supply system is frozen up by taking unit into a warm area.	If there is moisture in the hydrogen supply system and the unit must be operated in subfreezing temperatures, purge the hydrogen system with dry nitrogen and ensure the hydrogen gas used is dry.
	g) Remove exhaust port and check for contamination.	If the chamber is dirty, clean with ethyl alcohol and dry by running pump for approximately 15 minutes. If hydrogen fuel jet is misaligned, ensure the porous metal flame arrestor is properly seated.
	h) Check spacing between collecting electrode and burner tip. Spacing should be 0.1 to 0.15 inches.	Adjust by screwing Mixer/Burner Assembly in or out. This spacing problem should only occur after assembling a Mixer/Burner Assembly to a Preamp Assembly.
3) Hydrogen flame lights but will not stay lighted.	a) Follow procedures 2(a), (c), (d), (e), (g) and (h) above. Also refer to 5 below.	
4) Flame-out alarm will not go on when hydrogen flame is out.	a) Check instrument calibration setting and GAS SELECT control setting.	Readjust as required to proper setting. Note that the flame-out alarm is actuated when the meter reading goes below zero.
	b) Remove exhaust port and check for leakage current path in chamber (probably moisture or dirt in chamber).	Clean contamination and/or moisture from the chamber using a swab and alcohol, dry chamber by running pump for approximately 15 minutes.
	c) If above procedures do not resolve the problem, the probable cause is a malfunction in the preamp or power board assemblies.	Return preamp chamber or power board assembly to the factory for repair.
	d) Check that volume control knob is turned up.	Adjust for desired volume.

TABLE 1

PROBLEM	TROUBLE SHOOTING PROCEDURE	REMEDY
5) False flame-out alarm.	a) Flame-out alarm is actuated when signal goes below electronic zero (with flame on). This can be due to inaccurate initial setting, drift, or a decrease in ambient concentration. Verify if this is the problem by zeroing meter with flame out and reigniting.	When using the X1 range adjust meter to 1 ppm, rather than zero, be sure instrument has been zeroed to "lowest expected ambient background level".
6) Slow response, i.e., time to obtain response after sample is applied to input is too long.	a) Check to ensure that probe is firmly seated on the rubber seal in the readout assembly.	Reseat by holding the probe firmly against the rubber seat and then lock in position with the knurled locking nut.
	b) Check sample flow rate per procedure 1 above.	See 1 above.
7 Slow recovery time, i.e., too long a time for the reading to get back to ambient after exposure to a high concentration or organic vapor.	a) This problem is normally caused by contamination in the sample input line. This requires pumping for a long period to get the system clean of vapors. Charcoal in the lines would be the worst type of contamination. Isolate through the process of elimination. (See 1(b)).	Clean or replace contaminated sample line or assembly as required.
	b) Check flame chamber for contamination.	Clean as required.
8) Ambient background reading in clean environment is too high.	a) A false ambient background reading can be caused by hydrocarbons in the hydrogen fuel supply system. Place finger over sample probe tube restricting sample flow and if meter indication does not go down signficantly the contamination is probably in the hydrogen fuel.	Use a higher grade of hydrocarbon free hydrogen. Check for contaminated fittings on filling hose assembly.
	b) A false ambient background reading can also be caused by a residue of sample building up on the face of the sample inlet filter. If the test in 8(a) above produces a large drop in reading, this is usually the cause.	Remove the exhaust port (it is not necessary to remove instrument from case). Use the small wire brush from the tool kit or a knife blade and lightly scrub surface of sample inlet filler.

TABLE 1

PROBLEM	TROUBLE SHOOTING PROCEDURE	REMEDY
	c) A false ambient background reading can also be caused by hydrocarbon contamination in the sample input system. The most likely cause would be a contaminant absorbed or condensed in the sample line. NOTE: It should be emphasized that running the instrument tends to keep down the buildup of background vapors. Therefore, run the unit whenever possible and store it with the carrying case open in clean air.	Clean and/or replace the sample input lines. Normally the false reading will clear up with sufficient running.
9) Pump will not run.	a) Check that there is no short circuit in wiring.	If no short circuit, pump motor is defective.
10) No power to electronics but pump runs.	a) Short circuit in electronics.	There is a short in the electronics assembly. Return OVA to factory or authorized repair facility.
11) No power to pump or electronics	a) Place battery on charger and see if power is then available. Recharge in a non-hazardous area only.	If power is available, battery pack is dead or open. Recharge battery pack. If still defective, replace battery pack.

GAS CHROMATOGRAPH (GC) OPTION

The Model OVA 128 CENTURY Organic Vapor Analyzer provides efficient and accurate indication of total organic compound concentrations on a continuous sampling basis. However, in areas where mixtures of organic vapors are present, it often becomes necessary to determine the relative concentration of the components and/or to make quantitative analysis of specific compounds.

To provide this capability, a gas chromatograph (GC) option is available. See Figure 6 for the location of the major components and controls associated with the GC option. When the GC option is used, the capability of the OVA includes both qualitative and on-the-spot quantitative analysis of specific components present in the ambient environment. The Recorder, which is used with the GC option, is described separately.

This section is applicable only to an OVA with the optional gas chromatograph system.

Modes of Operation

The OVA with GC option has two modes of operation. The first mode is the measurement of total organic vapors in the same manner as described for the basic OVA instrument. This mode is referred to as the "Survey Mode". The OVA is in the "Survey Mode" of operation whenever the Sample Inject Valve is in the "out" position.

The second mode of operation is called the "GC Mode". The OVA is in this mode of operation any time a sample has been injected into the GC system and the sample is being transported through the GC column. This section provides a brief description of how a gas chromatograph (GC) operates and specifically, how the model OVA 128 performs the required operations. A comprehensive discussion of gas chromatography theory, column selection, and data analysis is beyond the scope of this manual.

The OVA with GC option can be utilized for many types of analysis in the outdoor or indoor ambient environment or for specific laboratory type analysis. The OVA was not designed to compete with the research or process gas chromatograph but to compliment these instruments or eliminate their need in field applications.

This manual is intended to provide the operator with information to operate and maintain the OVA. Foxboro publishes Application/Technical Notes to assist the operators in applying the instrument to field monitoring situations.

All flame ionization detector (FID) gas chromatographs require certain elements for their operation. These elements include three flow regulated gas supplies as follows: 1) A carrier gas to transport the sample through the column; 2) Hydrogen gas for operation of the FID; 3) A clean air supply to support combustion to the FID. In addition, a method for injecting a known volume of sample air (aliquot) to be analyzed is required.

In standard gas chromatographs these three (3) flow regulated gases are individually supplied from pressurized cylinders equipped with regulators and flow control apparatus. The Model 128 GC system differs in that the hydrogen fuel for the FID is also used as the carrier gas. The clean air supply is simply the normal air sample pumped to the FID. During the GC analysis, this air is scrubbed in a charcoal filter to provide the clean air supply. The end result is that no additional gas supplies are required to add the GC option to the basic OVA instrument.

A valving arrangement is incorporated to provide a method for transferring a fixed volume of air into the GC system for analysis. The sample air injected into the GC column is the same sample being analyzed by the OVA for total organic vapor concentration. Therefore, the instrument provides the unique capability to observe the total organic vapor concentration of the sample prior to injecting it into the GC system. This operating feature is invaluable in field work where the environment is continually changing and where valuable GC analysis time must be expended only on the sample of concern.

OVA Columns

Columns are available in 4, 8, 12, 24, 36 and 48 inch lengths as standard offerings with any of the column packings listed below. Longer lengths are available in 12-inch increments on a non-standard basis. To order a column simply use the general part number for a column which is 510454 followed by a dash (-), the Foxboro packing material designation, a second dash and the desired length in inches. A sample column designation is 510454-G-24. This would represent a 24 inch column with 10% OV 101 on chromosorb W, HP 60/80 mesh. If a specific application arises which calls for a column material not listed below, please contact Foxboro. We will be happy to check on its availability.

Foxboro Designation	Material
A	20% Dioctyl Phthalate on Chromosorb-P, AW 60/80 Mesh
C	Chromosorb 101, 60/80 Mesh
D	20% Ucon 50 HB 280 on Chromosorb-P, AW 60/80 Mesh
E	20% Carbowax 400 on Chromosorb-P, AW 60/80 Mesh
F	5/1.75% Diethylhexyl Sebecate/Bentone 34 on Chomosorb W, AW 60/80 Mesh
G	10% OV-101 on Chromosorb W, HP 60/80 Mesh
T	10% 1,2,3-Tris (2-cyanoethoxy) Propane on Chromosorb P, AW 60/80 Mesh
B	3% Diisodecyl Phthalate on Chromosorb W, AW 60/80 Mesh
PT	Poropak T, 60/80 Mesh
Q	Poropak Q, 60/80 Mesh
H	20% Carbowax 20M on Chromosorb P, AW 60/80 Mesh
J	n-Octane on Porasil C, 80/100 Mesh
N	Porapak N, 60/80 Mesh

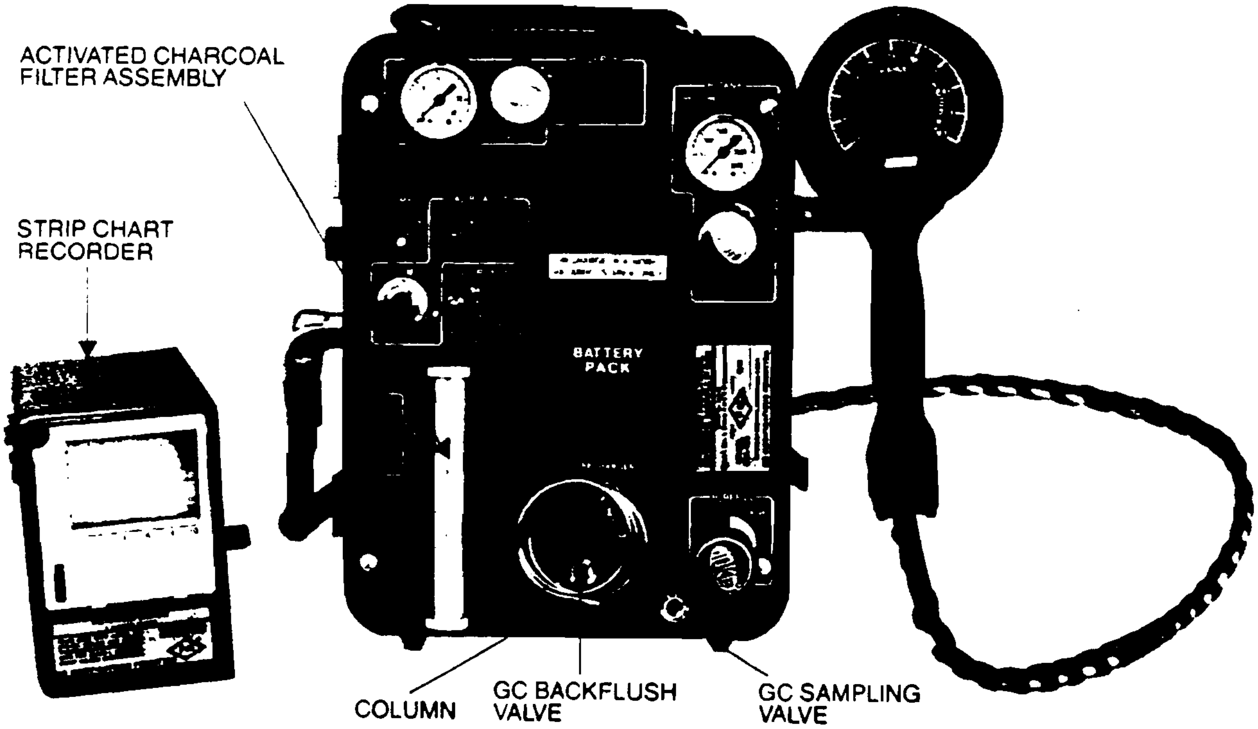


FIGURE 6
ADDITIONAL CONTROLS & COMPONENTS - GC OPTION

Sample Flow

Figure 7 is a flow diagram illustrating the flow paths of the hydrogen fuel, sample air supply, and GC injected sample aliquot.

Two push-pull valves are used in the GC system; the Sample Inject Valve and the Backflush Valve.

Block D illustrates the flow paths with the Sample Inject Valve in the "out" position. With this valve in the "out" position, the OVA functions in its normal manner as a total organic vapor analyzer.

Block C illustrates the flow paths after the Sample Inject Valve is moved to the "in" position to initiate the GC Mode.

The hydrogen flow path is now through the sample loop which enables hydrogen to sweep the air sample from the loop and carry it through the GC column.

Also note that the sample air going to the FID chamber is now routed through the activated charcoal filter where essentially all organic vapor contamination is removed from the air. The activated charcoal filter will effectively absorb most organic vapors with the exception of methane and ethane. The functions of the Sample Inject Valve are, therefore, to transfer a fixed volume sample of the air being monitored into the hydrogen stream and to reroute the sample air supply through a filter (scrubber).

The Backflush Valve has no prepositioning requirement to function. It can be in either the "in" or "out" position at the time a sample is injected into the GC system for analysis. The Backflush Valve simply reverses the direction of the hydrogen flow through the GC column.

Regardless of the operating mode, hydrogen always flows through the column to the FID detector and the sample air supply always flows to the FID detector to provide oxygen for the hydrogen flame.

The recommended hydrogen flow rate is 12 cm /min for proper FID operation and as a standard flow rate for generating GC reference/calibration data. This hydrogen flow rate is adjusted by varying the Hydrogen Supply Pressure, which is the hydrogen pressure at the input of the flow control capillary tube of the OVA. The pressure is changed by adjusting the set screw in the bonnet of the low pressure regulator, accessible by removing the battery pack from the instrument panel. To monitor the hydrogen flow rate, connect a bubble flowmeter to an end of the GC column which has been disconnected from the panel fitting and move the Backflush Valve so that hydrogen is flowing out of the column. Primary hydrogen flow control is accomplished by the capillary tube of the OVA. However, the flow restriction of a GC column will also affect the hydrogen rate and the effect will vary with column length, type of packing and packing methods. The nominal Hydrogen Supply Pressure is around 10 psig and the pressure drop across a typical 24 inch long column packed with 60/80 mesh material is approximately 1 to 1.5 psig. Normally, when the hydrogen flow rate is set at 12 cm^3/min with a standard 24 inch long column, no adjustment needs to be made when using columns from four (4) inches to four (4) feet long. Longer columns may require hydrogen flow adjustment for proper operation. Adjustment would be required if and when precisely controlled analysis was being conducted or when the hydrogen flow was too low to keep the flame burning.

The sample air flow rate is not adjustable and is nominally 1.0 liter/minute. This flow rate should remain relatively constant. A sample flow gauge is provided on the OVA panel to monitor the sample flow rate. (Note: Panel gauge is not calibrated in L/min). When the Sample Inject Valve is in the "in" position, there may be a slight increase or decrease in sample air flow rate (0 to 15%). This change will normally not affect operation of the instrument as long as the flow rate is consistent from analysis to analysis. Basically, if the flow rate is consistent between calibration and end usage, there will be suitable precision in the measurements.

GC Analysis

1) SAMPLE INJECTION

When the Sample Injection Valve is depressed, the air in the sample loop is injected into the hydrogen stream which transports the sample through the column for separation of its components and to the flame chamber for analysis. This small volume of injected sample is qualitatively analyzed based on the retention time of the individual components of that sample while passing through the column. Quantitative analysis can then be accomplished by peak height or peak area analysis methods.

2) THE COLUMN

The column consists of tubing packed with a material which physically interacts with organic vapors and retards the passage of the vapors through the column. Since the packing material has a different attraction for each organic substance, each component in a mixture of gases will be slowed down to a different extent.

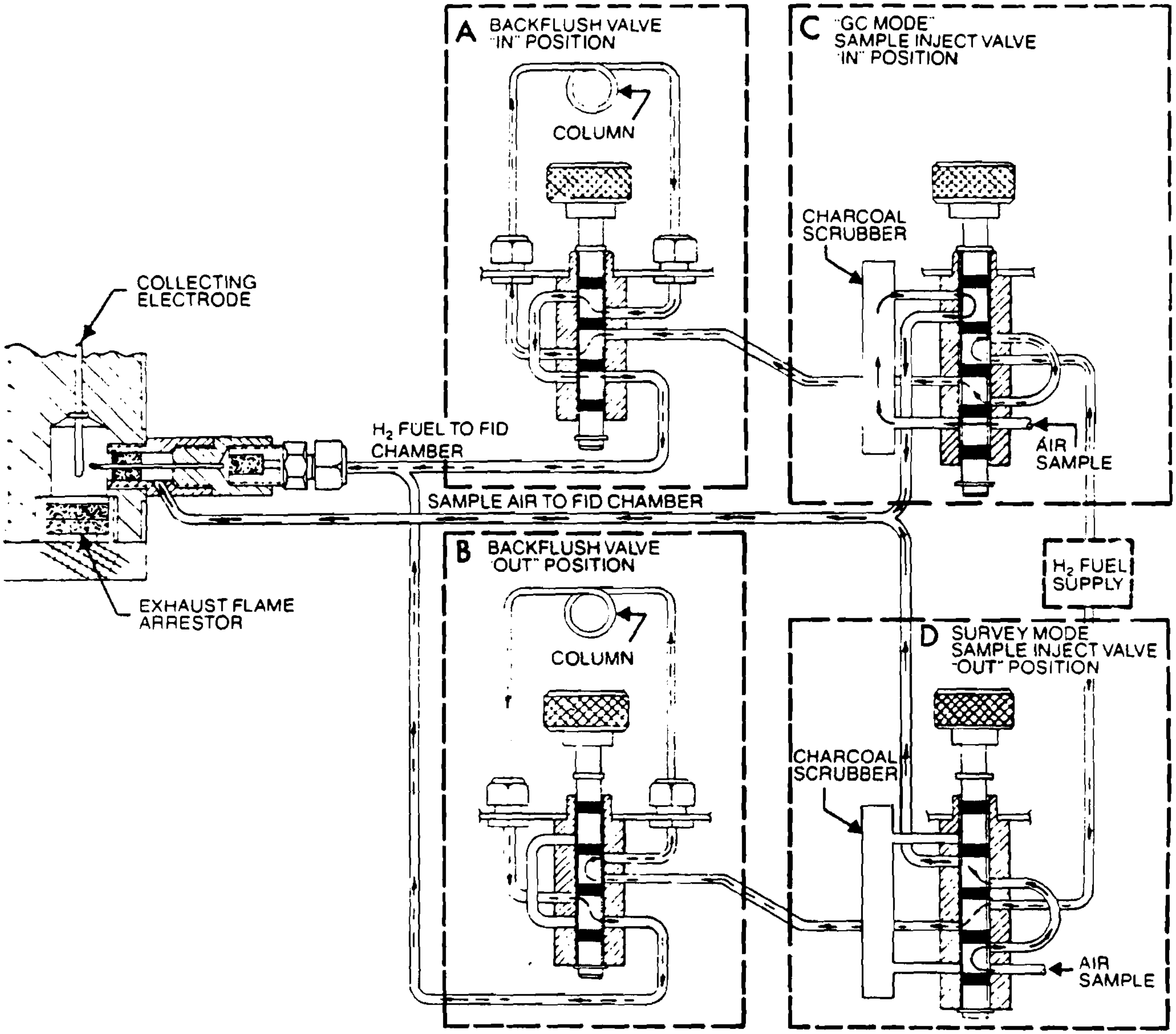


FIGURE 7
FLOW DIAGRAM - GC OPTION

The net effect is that each component elutes from the column at a different time. The components are then fed to the detector which gives a response to the meter or to an external strip chart recorder.

A portable isothermal pack (PIP) can be used for temperature control and/or isothermal analysis. This is described further under PIP kit option.

3) QUALITATIVE ANALYSIS

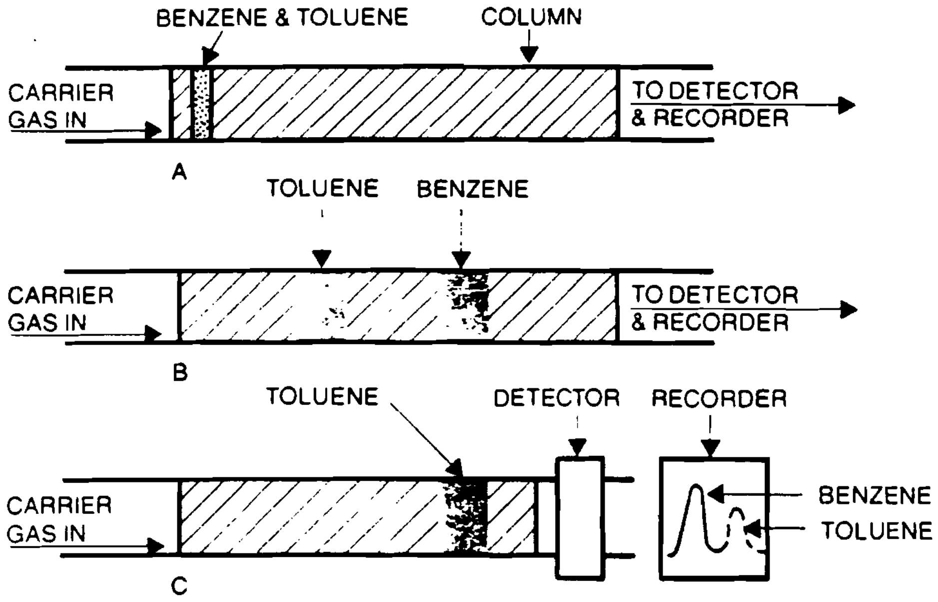
As each organic substance has a unique interaction with the column packing material, the time that the substance is retained on the column is also unique and thus characteristic of that particular substance. The "retention time" (RT) is primarily dependent on the type of packing material, the length of the column, the flow rate of the gas carrying the mixture through the column and the temperature range of the system.

When these variables are controlled, the retention times can be used to identify each of the components in a mixture. Because of these variables, it is usually necessary to establish retention times for each instrument by making a test with the pure substances of interest or to refer to established time data charts prepared in advance for that specific instrument. In those cases where retention times of the components are too close together for a good analysis, an adjustment in one or more of the operating variables will effect a sufficient difference in retention times to enable meaningful analysis.

4) QUANTITATIVE ANALYSIS

The detector response to any organic component is proportional to the quantity of material passing through the detector at a given time. For an eluted component, a plot of concentration vs. time forms a bell-shaped curve.

When using a strip chart recorder, the curve drawn on the paper is triangularly shaped and the area under the peak is related to the amount of substance being analyzed.



PICTORIAL SEPARATION OF BENZENE AND TOLUENE – "A" AT BEGINNING OF SEPARATION; "B" DURING SEPARATION; "C" BENZENE HAS ALREADY PASSED THE DETECTOR AND IS RECORDED. TOLUENE (DOTTED LINES) WILL APPEAR ON RECORDER AS IT PASSES THE DETECTOR.

FIGURE 8
TYPICAL COLUMN SEPARATION SEQUENCE

5) BACKFLUSH

The column Backflush Valve is provided to reverse the flow of the carrier gas (hydrogen) through the column. It is necessary that the column be backflushed after each individual analysis except under certain special conditions. The primary purpose of the backflush function is to clear the column of heavy compounds (with long retention times) which would contaminate the column and cause interferences to future GC analysis. The Backflush Valve has no prepositioning requirement; it is reversed from either position it was in during GC analysis. The Backflush Valve should be actuated immediately after the peak of the last compound of interest elutes. Figure 8 illustrates the function of the Backflush Valve.

In the GC system, the backflush is "to the detector". This is possible because the carrier gas and detector fuel are the same, i.e., hydrogen. It provides a convenient means of quantifying the total compounds in the backflush by simply recording the peak that elutes during the backflush operation. For field instruments, this quantitative backflush information is valuable since it provides a direct means of observing the condition of the column and seeing when the column is clean and the detector response has returned to baseline. The time required for the backflush is usually 1.2 to 1.5 times the GC analysis time.

6) SURVEY TO GC MODE

There is an inherent advantage to integrating the GC system to the basic total Organic Vapor Analyser (OVA). The OVA provides a direct reading of total organic vapors in the air being sampled, which gives the operator information about the sample being injected into the GC system. This information can be used to predict and verify the peaks that result during the GC analysis, including the backflush peak.

This feature eliminates expending valuable GC analysis time where there is no contamination of concern (comparable to taking noise measurements in quiet corners). It also enables the operator to select the most appropriate location to conduct an analysis, normally the area of highest concentration.

GC MODE OPERATING PROCEDURES

The gas chromatographic analysis mode (GC Mode) of operation can be initiated at any time during a survey by simply depressing the Sample Inject Valve. After completion of the analysis and backflush operations, the Sample Inject Valve is pulled out and the survey continued or another sample injected. Note that when the Sample Inject Valve is in the survey mode (out position) the OVA operates in the same manner as an OVA which does not incorporate the GC option.

Controls/Indicators

Refer to Figure 6.

1) Sample Inject Valve - This two (2) position valve (shown schematically in Figure 7) is used to select either Survey Mode (valve out) or GC Mode (valve in).

2) Backflush Valve - This two (2) position valve (shown schematically in Figure 7) is used to reverse the flow of hydrogen through the column to:

    a) Backflush the column for cleaning.

    b) Quantitatively measure total compounds after a selected point. Example: Separation of methane from non-methane hydrocarbons to read total non-methane hydrocarbon level.

3) Column - Separates components of a gas mixture so that each component of the mixture elutes from the column at a different time.

4) Activated Charcoal Filter Assembly - This assembly functions only in the GC Mode (Sample Inject Valve "in") as shown schematically in Figure 7). It removes organic compounds (except methane and ethane) by absorption from the sample air supply.

Turn on Procedure

Place the Sample Inject Valve in the "out" position and put the OVA instrument in operation per "Operating Procedures" for the survey mode. NOTE: Leave the hydrogen fuel and pump "on" for three (3) to four (4) minutes before attempting ignition to allow time for hydrogen purging of the column.

Survey Mode

When using the OVA in the Survey Mode, ensure that the Sample Inject Valve remains in the full "out" position and that the Backflush Valve is either full "in" or full "out". Note that when changing from the GC Mode to the Survey Mode, the OVA output reading will continue to change until all compounds have been eluted from the GC column. Therefore, under normal field conditions, the GC column should be backflushed for clearing, which takes approximately 1.2 to 1.5 times the forward analysis time. The backflush peak may be observed returning to baseline, after which the Sample Inject Valve may be moved to the Survey Mode (out) position.

When the compound(s) being analyzed are known to be the only compound(s) present in the air sample, backflushing may be omitted.

GC Mode Operation

In normal GC analysis, a strip chart recorder is used to record the output concentration from the OVA as a function of time. This record, called a chromatogram, is utilized for interpretation of the GC data.

a) OPERATION

    1) Turn on recorder and push Sample Inject Valve "in" with a fast, positive motion. This starts the GC analysis which is automatic up to the point of backflushing. NOTE: Rapid and positive motion should be used when moving either the Sample Inject or Backflush Valves. On occasion, the flame in the FID detector may go out, which would be indicated by a sharp and continued drop of the concentration level. If this occurs, reignite the flame and continue the analysis. NOTE: A negative "air" peak typically occurs shortly after sample injection and should not be confused with flame-out.

    2) The negative air peak and various positive compound peaks indicated on the OVA readout meter and the strip chart recorder represent the chromatogram.

3) After the predetermined time for the analysis has elapsed (normally immediately after the peak of the last compound of concern), rapidly move the Backflush Valve to its alternate position (in or out). Leave the instrument in this condition until the backflush peak returns to baseline, then pull the Sample Inject Valve to the "out" position. If no backflush peak appears, pull the Sample Inject Valve out after being in the backflush condition for a period at least twice as long as the analysis time. The OVA is now in the Survey Mode and ready for survey or injection of another sample into the GC system.

b) INTERPRETATION OF RESULTS

The OVA 128 with GC option is intended for applications where there are a limited number of compounds of interest and the compounds are normally known. Under these conditions, the operator must know the retention time and peak height characteristics of the compounds under specific operating conditions. To calibrate the OVA in the GC Mode, determine, by test, the retention time and peak area (using peak height analysis) for the compounds of concern. These tests should be conducted on the column to be utilized and over the concentration and temperature range of concern. When representative characteristic data is available, such as in the Application/Technical Notes, a spot calibration check is normally all that is required.

It should be noted that under normal field conditions, the vapor concentrations vary continually as a function of time, location, and conditions. Field measurements for industrial hygene work are normally associated with a threshhold level around a preestablished concentration. Surveys for locating fugitive emission sources present a continually varying situation. Under these conditions, it is desirable to have a simple method of interpreting the GC data for on-the-spot analysis and decision making. High precision is normally not a requirement for these type analyses since the environment is continually changing. The methods presented in this section are designed to provide a means for typical field analysis. When the OVA is used under laboratory conditions, standard laboratory methodology may be used for greater precision.

Technical Discussion

The chromatogram is a chart recorder trace of the organic vapor concentration from the Organic Vapor Analyzer (OVA) as a function of time. A typical chromatogram is illustrated in Figure 9 and is a series of triangular shaped peaks originating from and returning to a fixed baseline. Qualitative interpretation of a chromatogram involves identifying a peak by analyzing the time it took for the peak to appear after initial injection [referred to as retention time (RT)] and comparing this RT to reference data. Quantitative interpretation involves analyzing the area under the peak and relating this area to calibration data of peak area versus concentration for that specific compound under the conditions present during the GC analysis.

It can be seen that interpretation of a chromatogram requires the use of calibration reference data. GC reference data is always generated empirically, i.e., through tests. Foxboro Application/Technical Notes may be used as a reference for selecting columns and interpreting chromatograms. However, simple tests must be conducted to obtain the required reference data.

a) QUALITATIVE ANALYSIS

Under a given set of operating conditions the retention time is characteristic of that particular substance and can be used to identify specific compounds. It will be necessary to calibrate retention times by making tests with the pure compounds of interest.

The retention time (RT) is defined as that period of time from injection until the time of maximum detector response for each substance. Retention time is measured from the time of sample injection to the time the apex of the triangle shaped curve is obtained on the strip chart recorder. (See Figure 9). The strip chart recorder operates on a clock mechanism such that the distance along the baseline is proportional to time. While retention times are characteristic for each compound, it is possible that two materials could have the same retention times. Thus, if there is any question as to the identity of the vapor, it may be necessary to verify identification by retention times on different columns.

Use of a longer column will increase the retention times of those components it is capable of separating. The time between peaks will also be increased. This is especially useful if a component comes through too fast or if desired peaks are so close that they overlap.

b) COLUMN SELECTION

Two columns are supplied with the instrument. These are general purpose columns which are useful in a wide variety of applications. If they do not achieve separations for a particular application, it may be necessary to select other packing materials or longer columns. Foxboro will assist in this selection or prepare a custom column if necessary.

If columns are made by the user or purchased from other sources, ensure that the packing density does not create too large a pressure drop. A large pressure drop can result in flame-out problems.

c) TEMPERATURE EFFECT ON RETENTION TIME

An increase in temperature will decrease column retention time (RT) and vice versa. Normally retention time (RT), as a function of temperature, changes linearly over the range of 0 to 40°C. For complex qualitative analysis, a calibration plot of RT versus temperature will be required. In typical usage, such as inside a factory, the effect of temperature can be compensated for during chromatogram interpretation. A single component tracer compound can be sampled at any time to provide a "key" for other compound identification.

d) CARRIER GAS FLOW RATE AFFECT ON RETENTION TIME

An increase in carrier gas flow rate will decrease retention time. For reproducible data, the carrier gas (hydrogen) flow rate must be recorded in association with a chromatogram. Primary control of the hydrogen flow rate is accomplished in the OVA by regulating the hydrogen pressure across a capillary tube. The hydrogen flow rate is also affected by the restriction of the GC column but most columns have a limited effect. The hydrogen flow rate is factory set at 12 cm /minute with a typical 24 inch column.

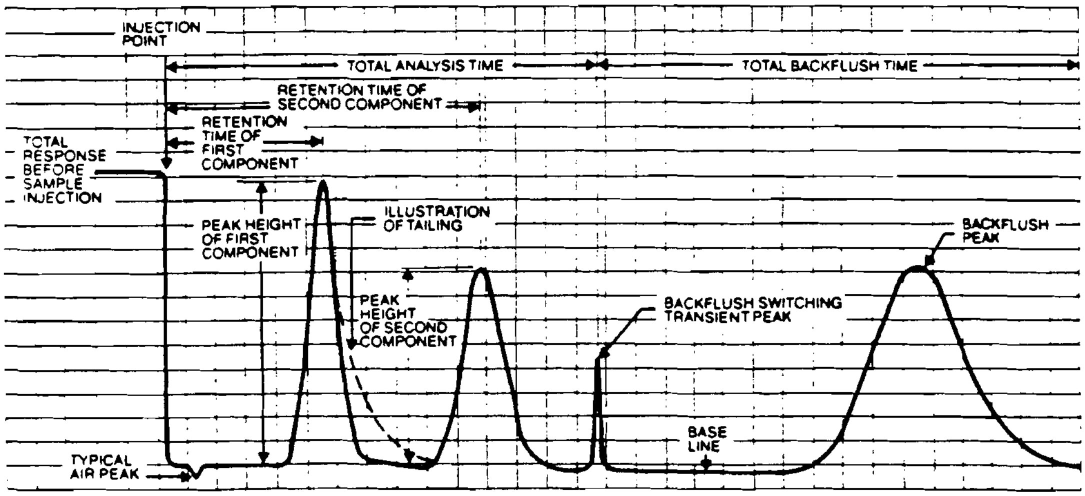


FIGURE 9
TYPICAL CHROMATOGRAM

e) QUANTITATIVE ANALYSIS

In general, the more triangularly symmetrical the peak, the better the peak height analysis capability. However, many GC peaks have "tailing" as illustrated in Figure 9. Peak height calibration is an acceptable method for quantitative analysis as long as the area under the tail is small compared with the total peak area. If severe tailing occurs, empirical calibration data generated through tests may be required to plot the peak height versus the concentration curve.

Only peak height analysis will be discussed in this manual. The method involves injecting a known concentration of the compound and recording the peak height under the test conditions. Peak height characteristics can be established for various columns and various temperatures. Normally, both retention time and peak height characteristics will be measured.

When peak area measurements are desired, the areas mav be measured using an integrator on the OVA output signal. Other manual methods may also be used, such as counting squares, weighing curves or simple triangulation. When the GC peaks have good symmentry, triangulation (area equals 1/2 base x height) is a convenient method.

Calibration Data

When conducting tests to obtain GC calibration data, the following information should be recorded.

a) Column - description and serial number as applicable.
b) Temperature - column temperature, normally room ambient.
c) Chart speed - distance/unit time.
d) Carrier flow rate - hydrogen flow rate through the column (cm /min).
e) Sample concentration - ppm for each compound,
f) Sample volume - OVA by serial number or typically 0.25 cm for standard value.
g) Recorder scaling - ppm per unit deflection.
h) Range - range of OVA being used, i.e. X1, X10, X100.
i) OVA serial number.

To obtain a calibration point, inject a known concentration sample into the GC system and record the resulting chromatogram peak. The retention time for the peak may be scaled from the record or timed with a stop watch. The peak height may be scaled from the record or the OVA readout meter may be observed during the elution of the peak. Figure 10B presents the format of a chart which may be used to record calibration data. Experience has indicated that the peak height response of a compound is linear within the concentration range of 0 to 160 ppm. Therefore, a single calibration point, preferable around the concentration of concern, is normally all that is required to plot peak height response in ppm as a function of compound concentration. Data for other compounds on the same column may also be plotted along with their associated retention times, percent relative response in the total organic Survey Mode, TLV, etc. It is recommended that copies of the actual chromatograms be kept with the charts for observing the peak shapes, peak interferences, etc. It should be noted that a chromatogram can be utilized like a fingerprint for compound identification or peak height and shape comparison. Transparent overlays are an aid in chromatogram analysis.

When temperature variations are anticipated, data should be taken at several points and recorded on the chart as a new curve or as a relative change as a function of temperature as illustrated in Figure 10B.

Preparing and using the calibration chart is very straightforward. As an example, once the elution sequence of a group of compounds is determined, a mixture of 100 ppm of each can be prepared and run on the GC for chart data. The retention time of each compound and the peak height of each can be read directly from the chromatogram and the data put on the chart. If temperature data is to be taken, additional chromatograms may be run with the same sample and the RT and peak height as a function of temperature.

When complex mixtures such as gasoline are analyzed, it may be desirable to keep the record of the backflush peak for future reference and peak area comparison. It is also recommended that the total organic vapor concentration reading on the OVA be recorded for each calibration sample used. This reading is used for arriving at relative response numbers and as a check on sample preparation precision.

Routine Maintenance

a) COLUMN

Any column can be contaminated with compounds having long retention times. This will result in high background readings. This condition can be checked by installing a new column or a blank column (tubing only). If this reduces the background reading, the contaminated column should be baked at 100°C (212°F) for three (3) to four (4) hours in a drying oven while passing nitrogen through the column. Higher temperatures may permanently damage the column packing.

When installing any column, avoid touching the ends, as this may cause contamination. Also, ensure that the fittings are tight to avoid hydrogen leakage.

IMPORTANT: The following simple test may be run to determine whether the GC column is contaminated. While in a clean ambient air background, place the Sample Inject Valve in the "in" (GC Mode) position. Observe the background reading on the meter or recorder. After one (1) to two (2) minutes, change the position of the Backflush Valve and again observe the background reading. If the background reading went down and then started to increase in one to two minutes, the column is probably contaminated and needs to be cleaned. Note that if hydrogen flows into one end of the column for a period of time, the contamination is pushed into the column.

Then when the hydrogen flow is reversed, the exhaust end of the column will be clean until the contamination is again pushed through. Remember that to clean a column the purge gas must be run through the column in one direction until all contamination is removed. NOTE: Contaminated columns can be avoided by backflushing the column after every analysis.

b) CHARCOAL FILTER ASSEMBLY

After repeated use, the Charcoal Filter Assembly will become saturated. Periodically, the operator should check the effectiveness of the activated charcoal.

This can easily be done by operating the unit with the Sample Injection Valve "in" and passing the probe near a concentrated sample of the compound being analyzed. The readout should remain nearly steady (should not rise more than 0 to 2 parts per million (ppm)). If rise is more than 2 ppm, replace the old charcoal with new activated charcoal. Care should be taken to completely fill the tube to prevent a path for sample to bypass the charcoal. The life of the charcoal depends on the time (length) of exposure and the concentration level during that exposure. When changing charcoal, be sure that any fine charcoal dust is removed from the assembly.

Another test of the charcoal filter is to note the background reading with the Sample Inject Valve "out" and then note the reading with the valve "in". The level should never be higher when the valve is in the "in" position and the charcoal filter is in the air line. If the reading with the valve in the "in" position is higher, the charcoal filter is probably contaminated and acting like a contamination emitter.

Trouble Shooting

Table 2 presents recommended field trouble shooting procedures which are associated with the GC system. These procedures are in addition to those found in the basic OVA section of the manual.

TABLE 2

PROBLEM	TROUBLE SHOOTING PROCEDURE	REMEDY
1) Low sample flow rate on flow indicator.	a) Check Teflon tubing in valve assembly for kinks, etc.	Straighten or replace teflon tubing.
	b) Check flow rate with valve in down position.	Check for over restriction of charcoal filter.
2) Hydrogen flame will not light.	a) Check column connections on top of unit to make sure they are tight.	Tighten fittings.
	b) Check column for sharp bends or kinks. (Hydrogen flows through this column at all times and a sharp bend will compact packing too tightly for proper hydrogen flow).	Replace column.
	c) Check charcoal filter fittings to make sure they are tight.	Tighten fittings.
	d) Check hydrogen flow rate from the column.	Adjust hydrogen pressure to obtain 12 cm^3/min flow rate.
	e) Check that the Inject and Backflush Valves are both completely in or out. A partially activated valve will block the hydrogen and air flow paths.	Ensure both valves are either completely in or out.
	f) If a new column was installed prior to problem identification, check for proper hydrogen flow rate through the column (should be approximately 12 cm /min).	Increase hydrogen pressure to obtain proper hydrogen flow rate or if column is excessively restrictive, replace or repack the column.
3 Ambient background reading in clean environment is too high.	a) Check for contamination in charcoal filter assembly. This can be detected if ambient reading increases when going in to the chromatographic mode.	Replace activated charcoal in charcoal filter assembly.
	b) Check for contamination in column.	Replace or clean column.
	c) Check for contamination in column valve assembly.	Remove valve stems and wipe with clean lint-free cloth. Heat valve assembly during operation to vaporize and remove contaminants.
4) Flame-out when operating either valve.	a) Ensure valves are being operated with a quick, positive motion.	Operate valve with a positive motion.

TABLE 2

PROBLEM	TROUBLE SHOOTING PROCEDURE	REMEDY
	b) Either hydrogen or air may be leaking around one or more of the valve quad rings. Assess by tests and "O" ring inspection.	Remove stems and lightly coat with silicone grease, only on contact surface of the "O" ring. Wipe off excess (do not remove quad rings).
	c) Damaged or worn quad rings causing leak.	Replace quad rings and grease as above.
5) Excessive peak tailing	a) Change or clean GC; see if problem disappears.	Ensure columns are clean prior to use. If one of the same type of column tails are worse than others, repack the column or discard.
	b) Inspect GC valves for excessive silicone grease or contamination.	Excessive lubricant or foreign matter in the valve assembly can cause excessive tailing. Clean valve assemblies and lightly relubricate as required. Lubricant should be put only on the outside contact surface of the "O" ring. Do not get grease into the "O" ring grooves.

Recommended Spares

The following spare parts and supplies are recommended to support the GC system and recorder. These are an addition to the spare parts list for the basic OVA described in the "OVA MAINTENANCE" section.

ITEM DESCRIPTION	PART NO.
1) Quad Rings	510496-1 (10/pkg.)
2) Tubing, .148 in ID .020 wall	12942
3) Tubing, Teflon .120 in ID .030 wall	12941
4) Activated Charcoal	CSC-004
5) "O" Ring for Charcoal Scrubber	U0118CE
6) Chart Paper (linear)	CSC-008 (6/rls/pkg)

ACCESSORIES

Recorder Accessory

A portable Strip Chart Recorder is available for use with the OVA (reference Figure 11). The recorder is powered from the OVA battery pack and the output can be scaled to match the OVA readout meter, thereby providing a permanent record for subsequent analysis or reference. P/N 510445-4 is FM certified intrinsically safe. P/N 510445-6 is BASEEFA certified.

The recorder can be used with the OVA to provide a long term monitoring profile of total hydrocarbon or can be used with the Gas Chromatograph Option to provide a chromatogram.

Features

The recorder prints dry (no ink) on pressure sensitive chart paper. The recorder is equipped with two gain ranges and an electronic zero adjustment. The HIGH gain position is normally used to provide a means of scale expansion.

Controls and Connections

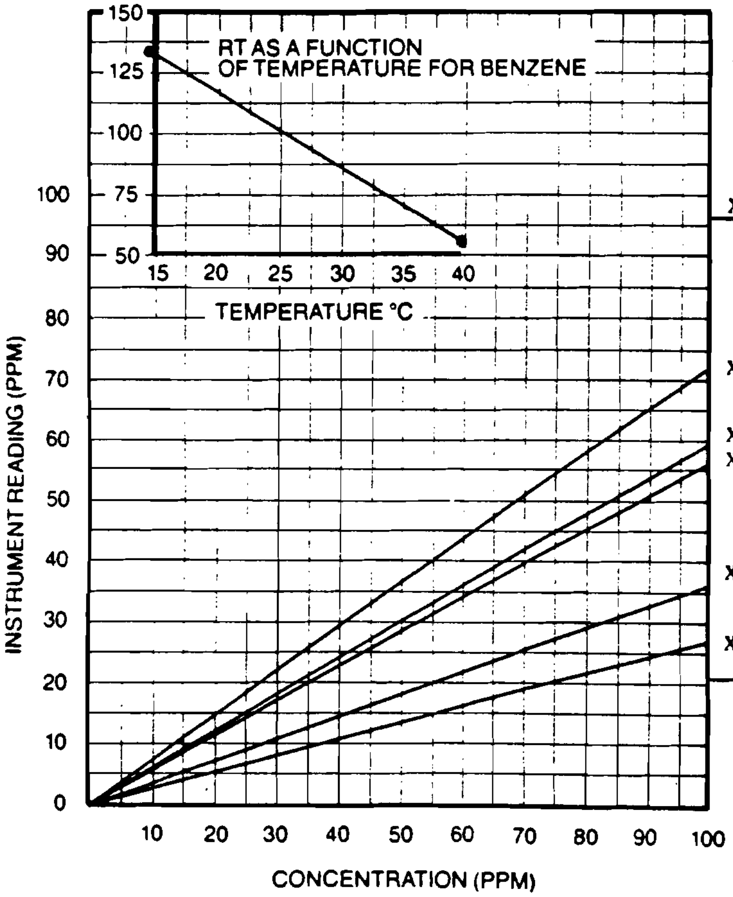
Described below are the functions of recorder controls and connectors.

1) HIGH-LOW Switch - This switch, located on the right hand side of the recorder, provides 2 ranges. The LOW range is set for the same full scale reading as the OVA readout meter. The HIGH range can be set to give an increased sensitivity to the recorder without effecting the OVA calibration.

2) ZERO ADJUST Knob - This potentiometer, located on the right hand side of the recorder, permits "nulling" of the background reading on the recorder without affecting the calibration of the OVA displayed on the OVA readout. In the full clockwise position, the recorder will display the same reading as the OVA meter. Counterclockwise rotation will reduce the reading on the recorder.

3) POWER CONNECTOR - This 126 series, 5 pin connector provides power and signal to the recorder, as follows:

PIN	FUNCTION
B	Input Signal
E	pos. 12VDC input
H	Ground

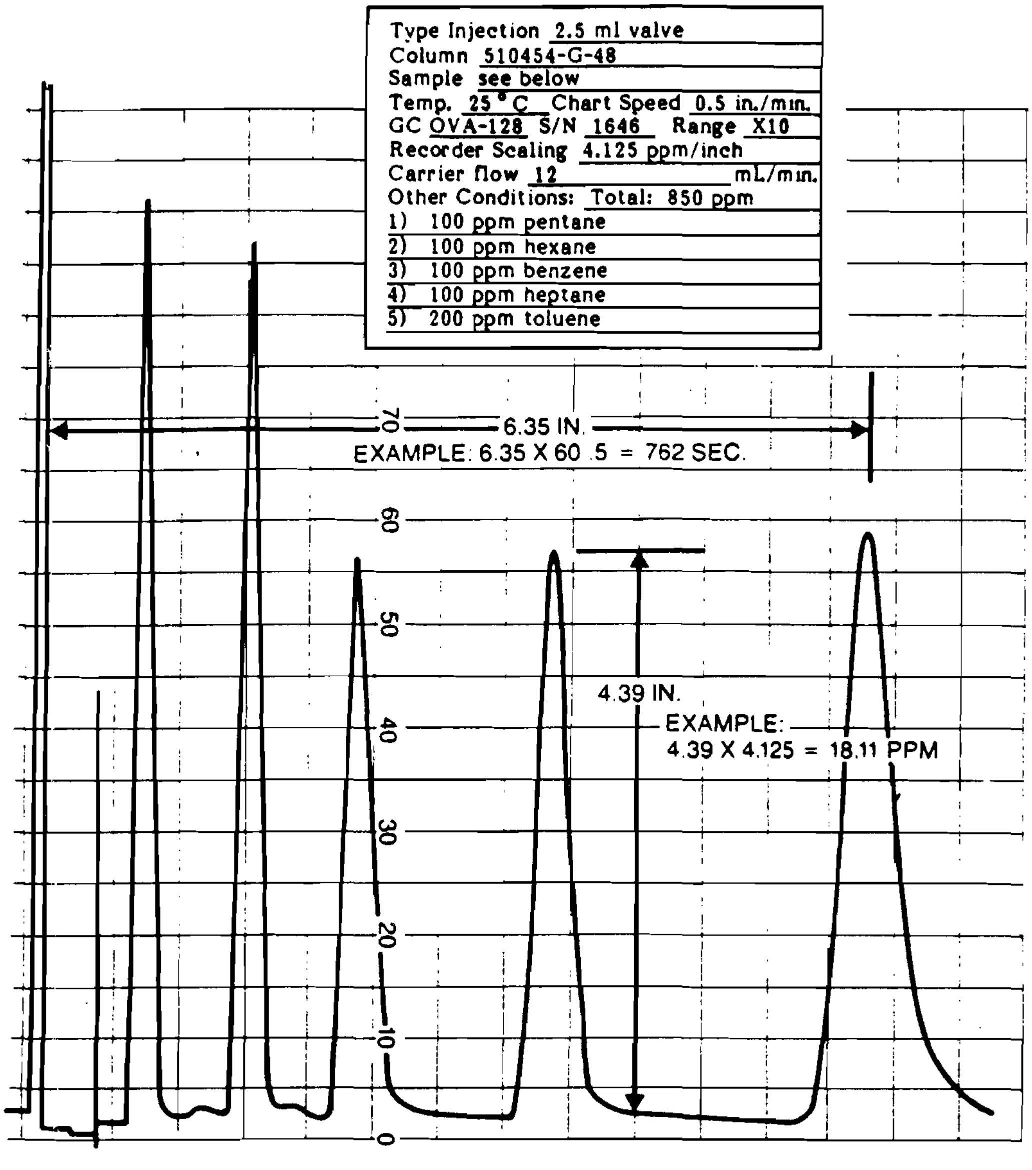


Column G-48 Chromatograph OVA-128
Temperature 25°C Carrier Flow 12 mL/sec.
Injection: Volume 2.5 mL Type valve

X	Compound	R.R (%)	RT (sec)	TLV (ppm)
X4	Heptane	80	471	400
X2	Pentane	100	90	1000
X2	Hexane	90	198	100
X2	Benzene	150	291	1
X3	Toluene	120	762	200

NOTE:
1. Concentration used for test is 100 ppm or as indicated.
2. X = Concentration multiplier

FIGURE 10A
CALIBRATION CHART



Type Injection 2.5 ml valve
Column 510454-G-48
Sample see below
Temp. 25°C Chart Speed 0.5 in./min.
GC OVA-128 S/N 1646 Range X10
Recorder Scaling 4.125 ppm/inch
Carrier flow 12 mL/min.
Other Conditions: Total: 850 ppm
1) 100 ppm pentane
2) 100 ppm hexane
3) 100 ppm benzene
4) 100 ppm heptane
5) 200 ppm toluene

FIGURE 10B
CHROMATOGRAM

Calibration

Electronic and mechanical adjustments, other than the operational adjustments on the side panel, are provided to calibrate and align the recorder. (See Figure 11).

MECHANICAL ZERO ADJUSTMENT

A) Snap out the front panel nameplate using a small blade screwdriver in the left hand slot) for access to mechanical zero adjust screw, place HIGH-LOW Switch in OFF position.

B) Unscrew knurled fastener at top of front panel to open recorder. Pull down plastic chassis latch on right side to release sticker bar tension on paper and adjust mechanical zero as required. Replace nameplate, chassis latch and resecure front panel.

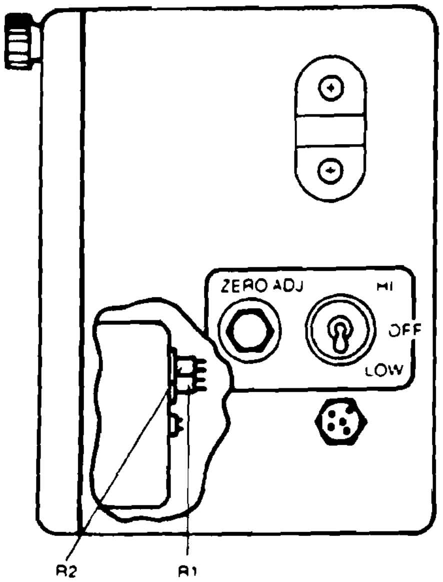


FIGURE 11
RECORDER CONTROLS AND ADJUSTMENTS

GAIN ADJUSTMENT

Separate adjustments are provided for the HIGH and LOW ranges on the recorder. (Refer to Figure 11 for location).

a) Connect recorder to OVA and adjust OVA for full scale reading on readout (about 5 VDC).
b) Loosen knurled fastener on upper left of the front panel and pull front panel down.
c) Place HIGH-LOW Switch in LOW and adjust R1 until recorder prints full scale.
d) Place HIGH-LOW Switch in HIGH and adjust OVA to read the desired full scale with front panel CALIBRATE ADJUST Knob, typically half scale on the readout. Adjust R2 until recorder reads full scale. NOTE: Full scale adjustment of the recorder for 1/2 scale on the OVA gives a gain increase of two (2) in the height of the peak on the chromatograms. This is the factory set point for the HIGH gain range; however, other points can be set as desired with a gain of three being the maximum obtainable without amplifier loading.

Maintenance and Routine Operations

Refer to the manufacturer's (Gulton) manual on the recorder which is enclosed with each recorder when shipped.

Changing Chart Speeds

The recorder is equipped with a 16 RPM motor which gives a writing speed of four (4) strikes per second. The chart advance speed is determined by the gear train assembly number used. The inches per hour for each gear train is given in the table on page 9 of the Gulton recorder manual. Refer to the bottom line of the chart adjacent to drive motor 16 and note for example that a number 1 gear train has a chart speed of 8"/hour.

a) To change the paper speed, open the recorder, remove gear box spring (on left side), move gear box in direction of arrow on its case and lift out from top. Do not force out from bottom. Insert new gear, bottom first, slide into position against arrow direction. Replace gear box spring.

Activated Charcoal Filter Accessory

The Activated Charcoal Filter Assembly is an accessory which can be installed on the OVA Readout Assembly or attached at the end of the telescoping probe. The filter is typically filled with activated charcoal which acts as an absorbent and effectively filters out organic vapors other than methane or ethane.

A screw cap on the probe end is removed for refilling the filter with activated charcoal or other filtering media.

Applications of the filter include:

1) Obtaining a clean air sample for zero baseline check and adjustment.

2) Running "blank" chromatograms to assess instrument contamination.

3) Rapid screening of methane and non-methane organic vapors.

4) Selective screening for natural gas surveys.

5) As a moisture filter when filled with a desiccant such as silica gel.

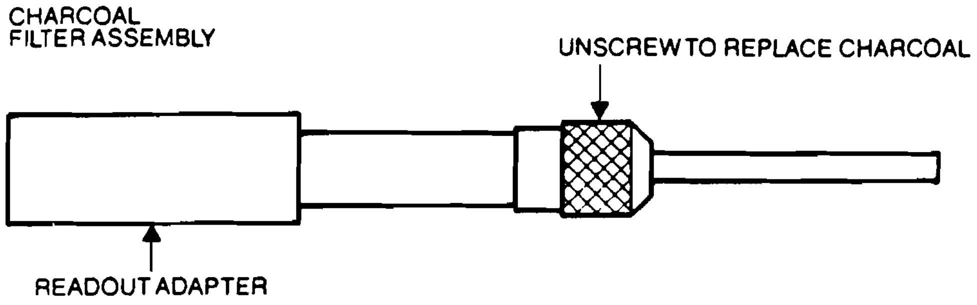


FIGURE 12
ACTIVATED CHARCOAL FILTER ASSEMBLY

A press fit adapter on the back of the filter assembly is removed when installing the unit on the telescoping probe. When replacing the cap end after refilling, one wrap of ¼ inch teflon tape should be used to seal the threads.

The life of the filter will depend on the time in use and the concentrations of the compounds being filtered. Under typical industrial air monitoring conditions, the filter will last for many days of continuous sampling. See Figure 12.

Sample Dilutor Accessory

An adjustable sample dilutor assembly, P/N 511745-1 is an accessory. The dilutor is supplied with a 10:1 dilution orifice as standard. Orifices for 25:1, P/N 511770-2, and 50:1, P/N 511770-3, dilution are also available.

In operation, the dilutor is attached to the end of the telescoping probe or connected by external tubing to the input fitting of the OVA side pack. Dilution of the air being monitored is accomplished by stream splitting through the use of a needle valve on the sample input. An activated charcoal scrubber is inserted in the main air supply line to the OVA and scrubs the air of organic vapors. It also creates a slight vacuum at its output side of the scrubber and the vacuum at this point draws the sample air through the needle valve where it mixes with the main air supply going to the OVA detector.

The dilution valve provides a means of sampling vapor levels above the lower explosive level (LEL) and in oxygen deficient atmospheres. These conditions can occur in normal leak or source survey as the operator gets close to the leak or vapor source or in monitoring various manufacturing or material handling processes. Approximately 14% oxygen is required to sustain operation of the FID in the OVA.

Setting Dilution Rate

Prepare a sample in a bag at a high level, typically 1,000 to 5,000 ppm. Any suitable gas can be used, such as butane from a cigarette lighter; however, a compound similar to those to be measured provides greater accuracy. The actual concentration of the gas does not have to be known, since the dilution rate is simply a relative level.

Obtain an OVA reading on the vapor sample with the dilution valve removed. Then install the valve, loosen the jam nut and turn the needle valve until the meter reading corresponds to the original reading divided by the dilution factor desired. Retighten the jam nut.

It should be noted that when the dilution valve is used for natural gas leak survey and pinpointing, the charcoal filter will not remove the methane from the dilution air supply. Care should be taken so that natural gas is not allowed to enter the main air inlet. (See Figure 13.)

OVA Septum Adapter Accessory

A Septum Adapter, P/N 510645-1, is available for direct on-line sample injection to the GC column inlet. The Septum Adapter mounts directly on the OVA front panel and sample injections from .025 to 2.5 cm may be made using a gas tight syringe.

This provides a range of sensitivity of approximately 10% to 1000% of the OVA standard valve, which has a sample loop volume of approximately 0.25 cm . Syringe injection can cause flame-out, however, the OVA may be reignited after the injection is made. The air in the sample must elute from the column before reignition. The time for the air peak to elute is a function of the column length and the volume of the sample injected. For example, a 1 cm sample into a 12" column will require approximately 5 seconds; and, a 2.5 cm sample into a 48" column will require approximately 20 seconds.

The Septum Adapter also provides a means whereby samples from oxygen deficient atmospheres or process streams can be injected directly into the chromatograph. Headspace analysis may also be accomplished using the Septum Adapter and a syringe.

OVA Portable Isothermal Pack (PIP) Accessory

A column can separate an exceptionally wide variety of components if the separations are made at different temperature ranges. In addition, peak heights and retention times can vary with column temperature. The PIP option was developed to control column temperature, without affecting the analyzer's intrinsic safety specifications and without compromising the analyzer's portability.

When the Septum Adapter is installed on the OVA, the normal GC sample valve may still be used alternatively with the syringe injection. In addition to variable sample size and sensitivity, syringe injections will normally provide greater symmetry and reduce tailing of chromatogram peaks as compared with the standard valve injection.

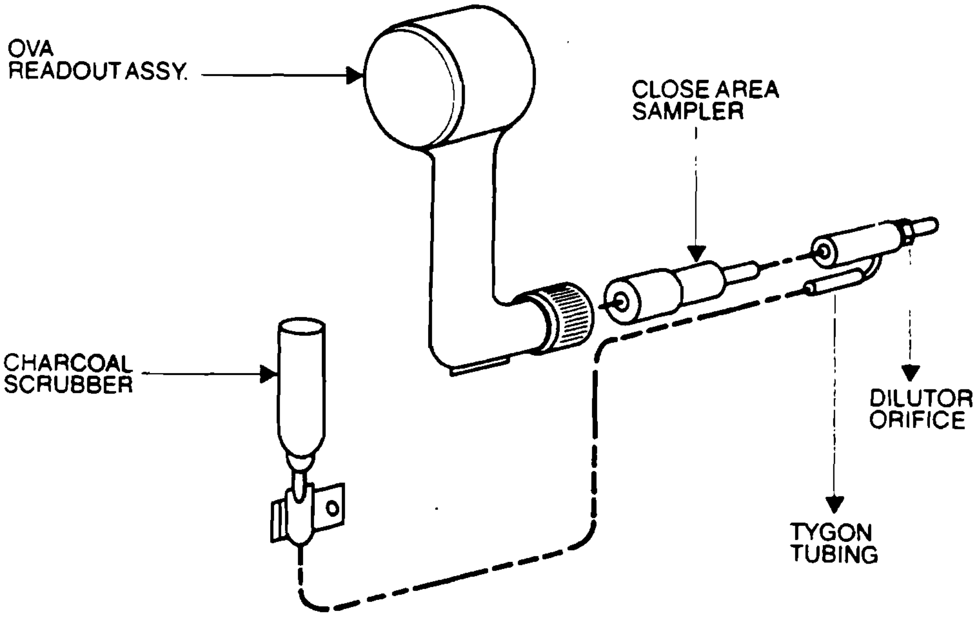


FIGURE 13
OVA SAMPLE DILUTOR

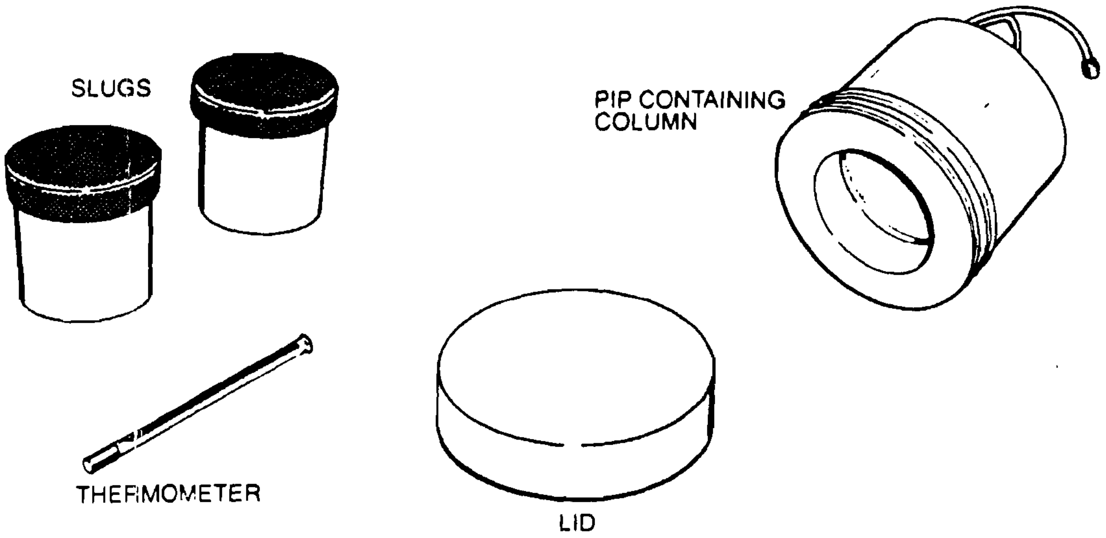


FIGURE 14
PORTABLE ISOTHERMAL PACK

PIP Components & Spare Parts

511800-1	PIP Kit
511805-1	PIP Assembly (specify column length and packing material)
511810-1	40°C Slug (phase-change material)
511830-1	Seeder for 40°C Slug
511815-1	Aluminum Slug
511820-1	Empty Bottles (package of six)
511825-1	Insulating Cover
511826-1	Thermometer

PIP columns can be prepared with any standard column packing material. A temperature control slug is inserted into the PIP slug cavity which has exterior foam insulation. For field operation in extreme ambient temperatures, an additional sheepskin jacket can be installed. The period of temperature control depends upon the temperature difference between ambient and the slug. For a 0°C ice pack and ambient temperature of 27°C, a control period of approximately 10 hours is typical. Additional information on the PIP system will be found in Foxboro document TI611-105.

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Snoop is a trademark of The Nupro Company.

Kel-F is a trademark of M.W. Kellog Company.

Chromosorb is a trademark of Johns-Manville.

Carbowax is a trademark of Union Carbide Corporation.

Poropak is a trademark of Waters Associates.

Porasil is a trademark of Waters Associates.

USER'S MANUAL

TIPI

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PHOTOVAC
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In US call toll free:
1-800-387-5700

Version 2.0 SEPTEMBER 1986

600422-06

IMPORTANT NOTICE

Please Read Carefully

Your TIP* AIR ANALYZER is powered by rechargeable Nickel-Cadmium (NiCd) batteries. NiCd batteries are reliable and dependable, but must be given proper care in order to provide optimum long life performance. The following information must be observed in order to ensure satisfactory operation.

The batteries in your TIP* have been charged at the factory, but in order to assure satisfactory performance on your initial use of the instrument you should charge the batteries as described in Section 5.2 of the manual.

NiCd batteries will develop a "memory" if they are not run through complete discharge/full recharge cycles on a regular basis.

This means, for example, that if you use your TIP* for only 1/2 hour each time before recharging, the batteries will develop a "memory" for this duty cycle and will be unable to deliver adequate power for longer duty cycles.

In order to avoid this condition you should, on a regular basis, run your TIP* until the LOBAT message appears, then fully recharge for 16 hours as described in the manual. The instrument must be turned off in order to re-charge the batteries. You cannot recharge the batteries if the unit is turned on.

The warranty does not cover replacement of batteries which have developed a "memory" and which are unable to deliver a full duty cycle as a result of improper cycling or charging.

**TIP is a trademark of Photovac Incorporated*

PHOTOVAC
incorporated

Unit 2, 134 Doncaster Avenue, Thornhill, Ontario, Canada, L3T 1L3
Telephone (416) 881-8225
Telex 06-964634

YOUR TA103 (390008)

CALIBRATION KIT INCLUDES :

ITEM#	PART#	QUANTITY	DESCRIPTION
PART A: 1	600628	1	Gas bag
2	600083-06	1	1" Tygon tube
3	600083-07	1	6" Tygon tube
4	600645-01	1	Poly tee
5	600646-01	1	Duckbill valve
PART B: 6	600649	1	Regulator
7	600647	1	Swagelok elbow
8	600403	1	Teflon tape
PART C: 9	TA312 (600648)	1	Gas bottle

NOTE: Items 1 through 5 are pre assembled for your convenience.

Items 6 through 8 are pre assembled for your convenience;

WARNING

THIS EQUIPMENT GENERATES, USES AND CAN RADIATE RADIO FREQUENCY ENERGY AND IF NOT INSTALLED AND USED IN ACCORDANCE WITH THE INSTRUCTIONS MANUAL, MAY CAUSE INTERFERENCE TO RADIO COMMUNICATIONS. IT HAS BEEN TESTED AND FOUND TO COMPLY WITH THE LIMITS FOR CLASS A COMPUTING DEVICE PURSUANT TO SUBPART J OF PART 15 OF FCC RULES, WHICH ARE DESIGNED TO PROVIDE REASONABLE PROTECTION AGAINST SUCH INTERFERENCE WHEN OPERATED IN A COMMERCIAL ENVIRONMENT. OPERATION OF THIS EQUIPMENT IN A RESIDENTIAL AREA IS LIKELY TO CAUSE INTERFERENCE IN WHICH CASE THE USER AT HIS OWN EXPENSE WILL BE REQUIRED TO TAKE WHATEVER MEASURES MAY BE REQUIRED TO CORRECT THE INTERFERENCE.

CONTENTS

1.1 HOW TO USE THIS MANUAL

This manual describes the Photovac TIP I Air Analyzer and gives instructions on its operation and maintenance. It isn't necessary for all users to read this entire manual to operate TIP I properly, but one or both How to Use TIP I sections must be read and absorbed.

To assist in understanding the instructions, tutorials are included in these sections explaining what to expect from TIP I when the instructions are followed. Tutorials are numerically referenced to instructions.

For a better understanding of TIP I and its capabilities, please read Section 2 - General Information .

If you wish to use TIP I as a high sensitivity gas and vapor detector and you do not need a numerical concentration reading, then turn to Section 3 - How to Use TIP I - Qualitative. Used this way, TIP I will respond to concentrations as low as 10 parts per billion, and is suited to leak detection, chemical spill boundary detection, and initial waste site investigation.

To use TIP I to its fullest and obtain numerical concentration readings, also read Section 4 - How to Use TIP I-Direct Reading . Here calibration and the use of the TIP Span Kit are described in detail.

All users should read Section 5 - Maintenance to keep TIP I in top operating shape.

If you are using TIP I together with a Photovac headset or external battery pack, or with an external power supply or chart recorder or data logger, read Section 6 - Connecting External Devices to TIP I .

Should TIP I not function as expected, turn to Section 7 - Service Information .

The Appendices of Section 8 contain reference material for your interest.

1.2 WHEN YOU FIRST RECEIVE TIP I

1. Carefully unpack TIP I and examine for any physical damage which may have occurred in transit. Inform PHOTOVAC at once if TIP I is damaged.

2. Unpack and examine the battery charger. Set the voltage switch to correspond to the AC voltage in your area.

3. Unscrew the dust cover from the rear receptacle of TIP I and connect the battery charger. Turn the knurled collar on the charger plug clockwise to lock it on to the receptacle.

4. Plug the charger into the AC mains. Allow TIP I to charge for 16 hours.

5. Unplug the charger from the AC mains, remove charger plug from TIP I, and replace TIP I rear receptacle dust cover.

2.1 GENERAL INFORMATION

TIP I is an analytical instrument which has been designed to sense certain important impurities in air and other gases. the name TIP* stands for "Total Ionizables Present"; this implies that the instrument senses any chemical in the air (or other gas matrix) which is "ionizable". Obviously, virtually any chemical can be ionized, and this includes the normal air gases such as oxygen, nitrogen, etc. In the case of TIP I* "ionizable" actually means photoionizable; we must begin by defining this.

TIP I* contains a miniature lamp which emits very short wave length unltraviolet (UV) radiation. the energy of this radiation is enough to bring about "photoionization" if it strikes the molecules of certain chemicals. Whether or not photoionization takes place depends upon a factor called the "Ionization Potential" (IP) of the molecule in question. Ionization Potential is normally measured in energy units known as Electron Volts (eV).

Most of the light permanent gases (such as the air gases, hydrogen, helium, etc.) have ionization potentials at 12 eV or more. On the other hand, a huge number of organic chemicals which enter the air as gases or vapors, have ionization potentials below 10.5 eV. Included amongst this latter group are the vast majority of those compounds which we describe as "Pollutants".

The ultraviolet lamp used in TIP I* has an energy of about 10.6eV.

Let us now assume that we have an air sample which is "polluted" with a great number of gases and vapors (perhaps it could have been taken from the vicinity of a gas station at a busy time of day). If this air sample is exposed to radiation from the UV lamp in TIP I*, the air gases (and water vapor) will not be photoionized but the pollutants will and a whole range of ions of all shapes and sizes will be formed. We have thus used a carefully selected lamp energy to "pick out" the pollutants and ignore the clean air; this is the essence of the principle used in TIP I*.

TIP I* uses a small pump which continuously draws air into a tiny ionization chamber which is also flooded with UV light. Inside this chamber are two electrodes; an electric voltage is applied across these electrodes and one of them is connected to a very sensitive current measuring circuit (electrometer). When ions are formed, and these will have both positive and negative charges, the negative ions will travel to the positive electrode and the positive ions to the negative electrode. This will result in an electric current which is measured by the electrometer and can than be used in a number of ways to express the "Total Ionizables Present".

It is important to realize that TIP I* does not distinguish between different pollutants; the signal produced represents a composite of all different ionizable pollutants. Where the "pollutant burden" in a given sample of air becomes high, TIP I* will register this fact. The correct implication to be drawn is that there is a potentially serious situation which requires further investigation using more specific detection equipment (such as Photovac's 10S gas chromatograph).

In many cases, a factory will have only one chemical in use in a particular area and this will be by far the major pollutant in the air. Here, TIP I* can be calibrated for this specific compound and can register a precise reading of the level in a very direct and useful manner.

A further instance where TIP I* can give specific quantification would be in the case of an accidental spill of a certain chemical where, again, this chemical would predominate.

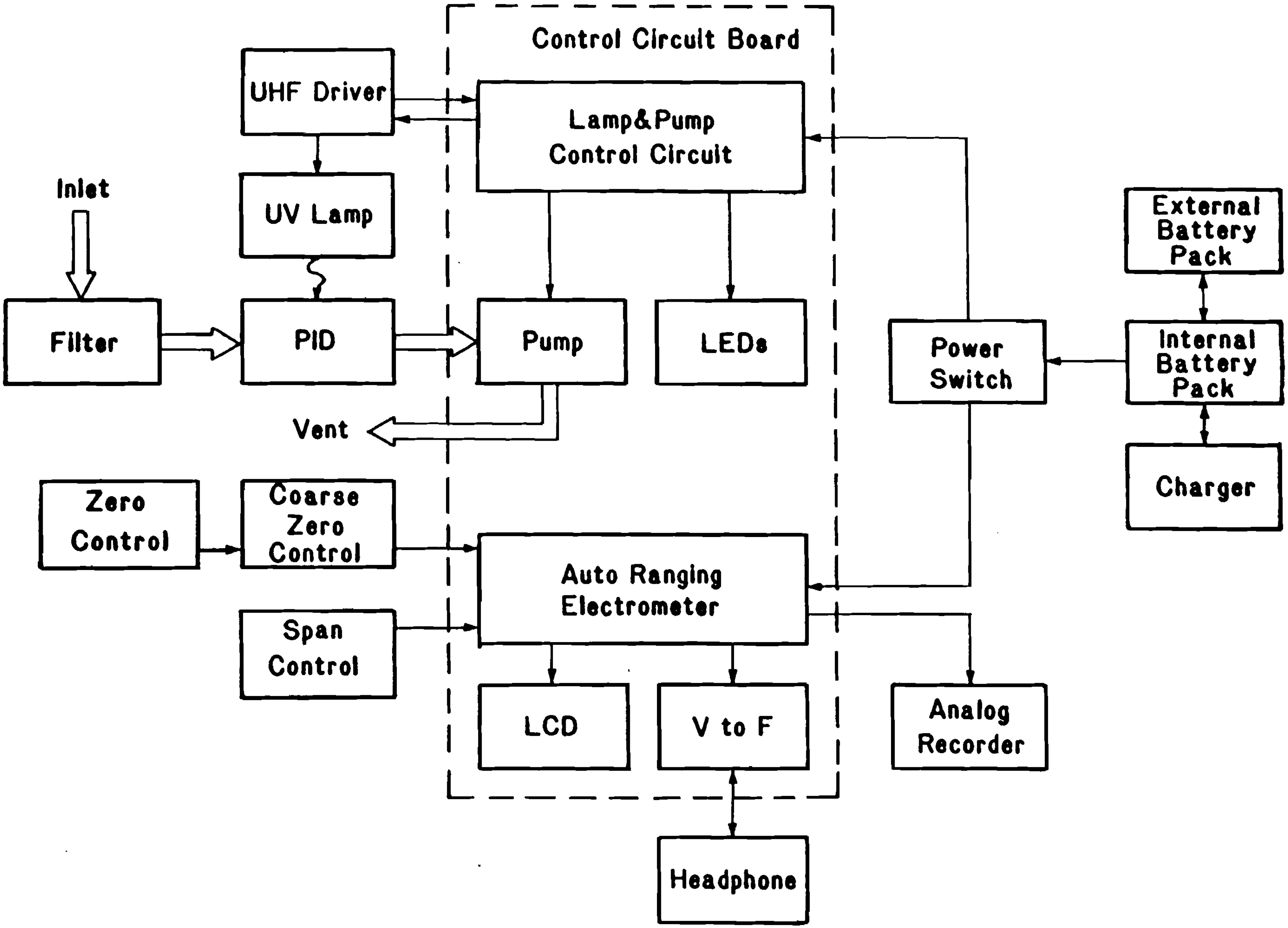
The photoionization detector (PID) used in TIP I* is exclusive to Photovac. The technology used involves what is known as an ultra high frequency (UHF)-excited electrodeless discharge lamp coupled with a very sensitive electrometer. Such technology provides striking sensitivity, the potential for miniaturization (because no high voltage power supply is needed) and a very simple lamp design which is inherently far less expensive than its high voltage counterparts. Again, the simplicity of our lamp increases its expected operational life and allows us to provide a 1-year warranty.

Careful miniaturization has allowed us to package TIP I* in a single flashlight-sized casing, weighing just over three pounds. This includes the photoionization detector, the sample pump, all necessary electronics with an autoranging electrometer, liquid crystal display (LCD) and sufficient rechargeable battery power for about four hours of use. Packaging materials are polycarbonate and aluminum and the unit has been designed with the expectation that it must operate under adverse conditions.

A single electrical connector is located at the base of the handle and this is used for battery recharging and for connection of external 12 V DC power. Two outputs are available at this same connector: an analog signal from the electrometer and an audio signal for connection to a headphone which is pulsed at a rate proportional to the concentration being measured.

TIP I* has four controls: a POWER switch, a SPAN control, a ZERO control, and a COARSE ZERO control. The SPAN and ZERO controls can be locked into position and are provided with numerical position indicators.

All the electronics with the exception of the UHF driver for the ultraviolet lamp are contained on a single printed circuit board. The Functional Block Diagram Figure 2.2 shows how the various parts interconnect.



2.2 Functional Block Diagram

Ref 140190

3.1 HOW TO USE TIP I - QUALITATIVE

Refer to Figure 3.3 Pictorial Diagram for the position of controls

1. Press POWER switch to turn on TIP I.
2. Unlock ZERO and SPAN controls by turning locking rings clockwise .
3. Set SPAN control to 5.
4. Lock SPAN control by turning locking ring counterclockwise .
5. Allow TIP I to sample clean air.
6. Adjust ZERO control until liquid crystal display reads 0.00.
7. Lock ZERO control by turning locking ring counterclockwise .
8. Observe sample concentration changes on liquid crystal display.
9. Do not allow TIP I to draw in any liquid.
10. Press POWER switch after use to turn off TIP I.

3.2 TUTORIAL - QUALITATIVE

1. Upon pressing the POWER switch, you will see numerals on the liquid crystal display (LCD), the pump will run for half a second, and the two yellow light-emitting diodes (LEDs) in the display compartment will flash on for half a second. Within two minutes the pump and LEDs will come on continuously indicating that the ultraviolet lamp of TIP I has started.

2. The locking ring on the ZERO and SPAN controls are designed to operate by pressing against the underside of the control knobs. Turn the locking rings clockwise to release the knobs.

3. A setting of 5 on the SPAN control gives TIP I a mid-range sensitivity. The highest sensitivity is at a span of 9, and at a span of 0, TIP I has no sensitivity. If the chemicals you wish to detect are at too low a concentration to cause much change in the LCD reading, then use a higher span setting. Conversely, lower the span setting if the LCD shows a "1" at the far left position and no other numerals. This indicates an off scale concentration.

4. Turn the ring up to press against the underside of the SPAN control.

5. Clean air is, of course, a relative term. Outdoor air is often a suitable zero reference. Zero TIP I upwind from a spill site or a waste site. For indoor leak detection work, zero TIP I on indoor air away from the suspected leak.

6. Turn the ZERO control clockwise to increase the reading or counter-clockwise to decrease it. By adjusting the LCD to read 0.00, any background chemicals in the air are cancelled out. If the reading is unstable you may have to use a lower span setting. Sampling in a windy location will also cause the reading to jump, so keep the inlet sheltered. If the chemical concentration in the air is fluctuating, then so will the output of TIP I. Such a sample is unsuitable as a zero reference, try moving further from the chemical source.

   You might find that the LCD never reads 0.00, no matter where you set the ZERO control. In this case a coarse zero adjustment is needed. Set the ZERO control to 5, then turn the COARSE ZERO control with a small slotted screwdriver like the one supplied. Remove the screwdriver when the LCD reads about 0. Now make any fine adjustments with the ZERO control.

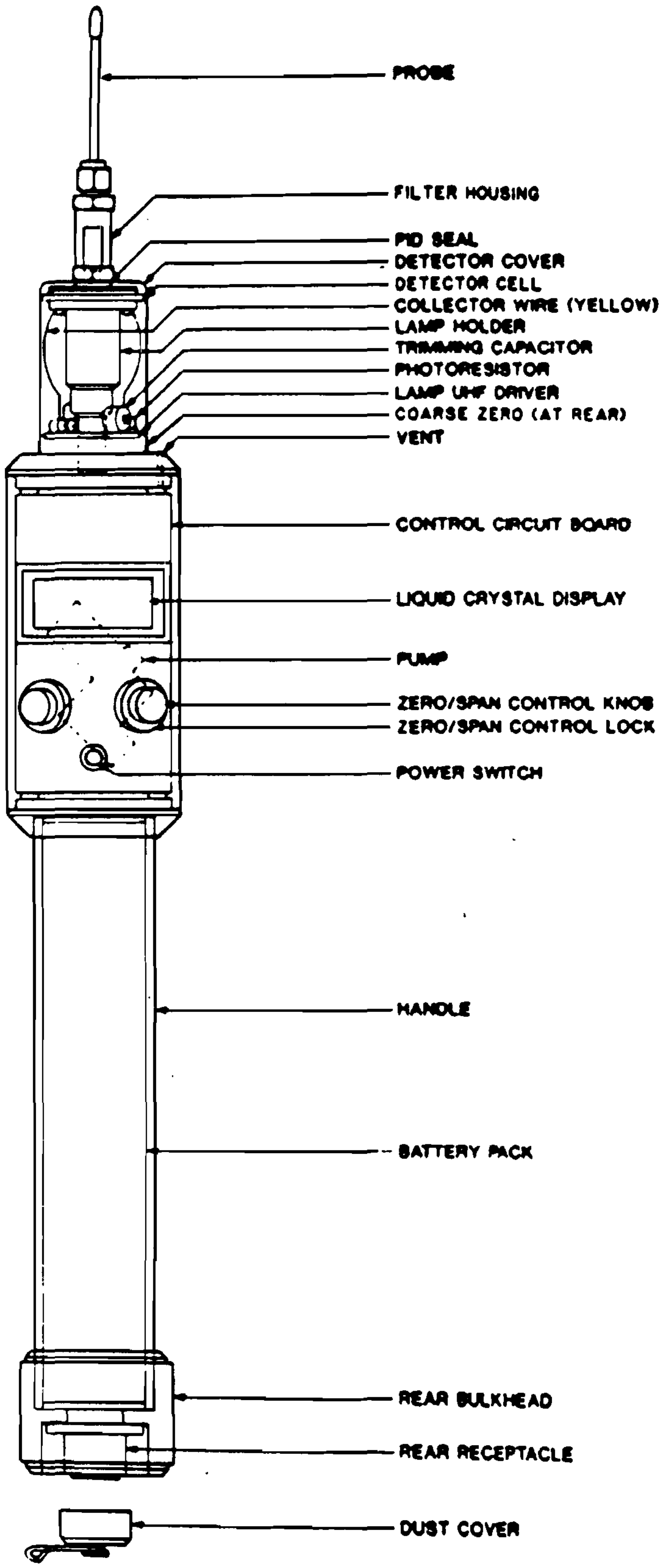
7. Again, turn the locking ring counterclockwise until it presses against the ZERO knob.

8. Now you're ready to begin your investigation. As you move close to chemical sources, the LCD will register higher concentrations, allowing rapid source determination. A negative LCD reading indicates the sample has fewer total ionizables than the zero reference air. With a headset connected to TIP I you can hear concentration changes as frequency changes, and you need not look at the LCD.

9. If you should, despite your best efforts, draw up some liquid into TIP I, the instrument may be permanently damaged if you don't quickly follow the instructions in Section 5 - Maintenance .

10. Turn TIP I off when you are finished, or when the LOBAT sign appears at the top left of the LCD.

3.3 TIP PICTORIAL

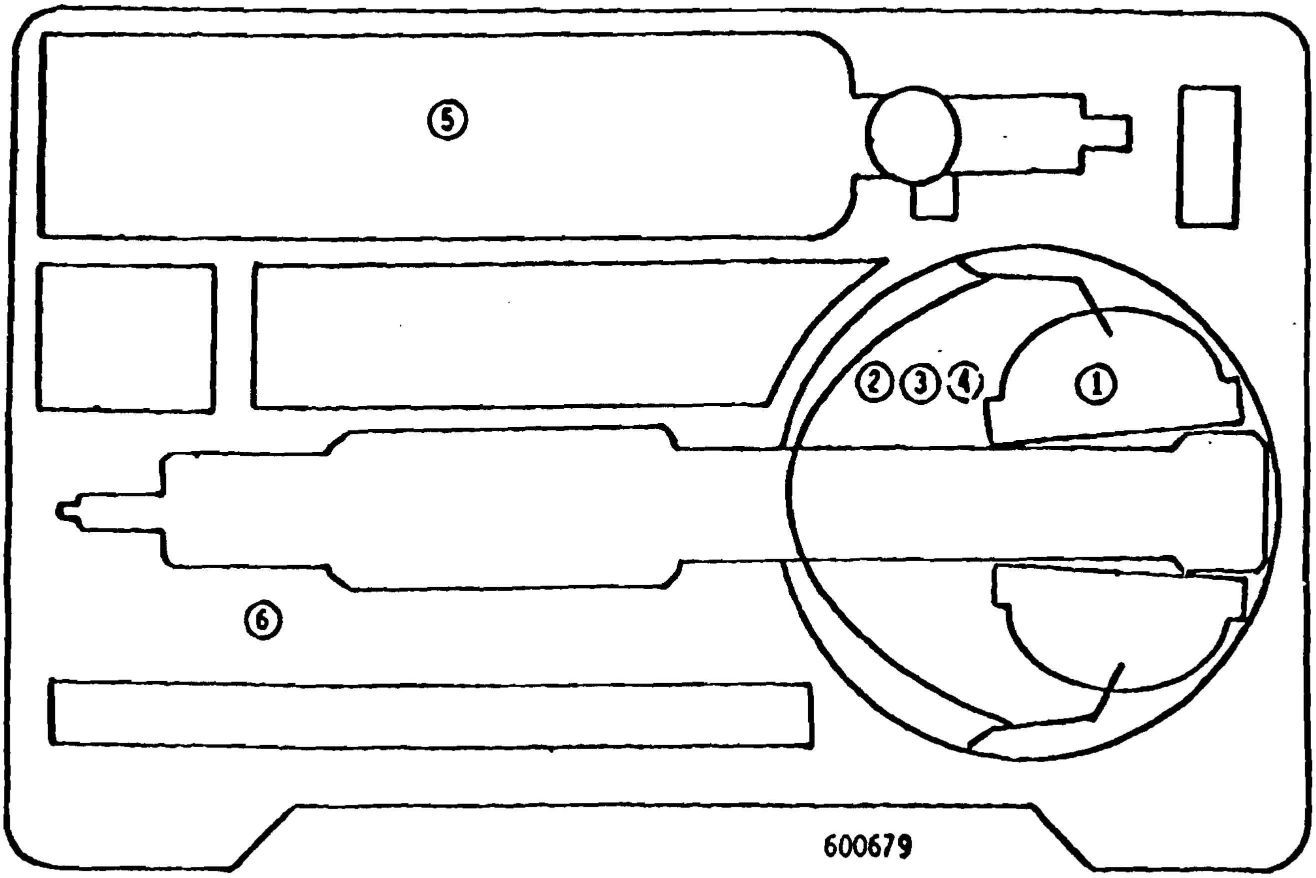


incorporated
Unit 2, 134 Doncaster Avenue, Thornhill, Ontario, Canada, L3T 1L3
Telephone (416) 881-8225
Telex 06-964034

YOUR TA104 TIP

FIELD KIT INCLUDES :

ITEM#	PART#	QUANTITY	DESCRIPTION
1	390001	1	Headset
2	390003	1	Power cord
3	390004	1	Output cord
4	390006	1	Probe
5	390008	1	Calibration kit
6	600652	1	Case



TA104 (cont'd)

TO REFILL BAG

1. Hand tighten regulator onto Span Gas tank.
2. Turn gas bag valve counterclockwise to open.
3. Hand tighten gas bag adapter nut onto regulator.
4. Turn regulator knob counterclockwise about one-half turn to start gas flow.
5. Fill bag about one-half full.
6. Turn regulator knob fully clockwise to shut off gas flow.
7. Turn gas bag valve fully clockwise to close.
8. Remove gas bag adapter nut from regulator.
9. Remove regulator from Span Gas tank.

4.1 HOW TO USE TIP I - DIRECT READING

TIP I is used as a direct-reading instrument in conjunction with the Span Kit (Part No. TA103)

1. Press POWER switch to turn on TIP I.
2. Unlock ZERO and SPAN controls by turning locking rings clockwise .
3. Set SPAN control to 5.
4. Allow TIP I to sample clean air.
5. Adjust ZERO control until LCD reads 0.00.
6. Connect bag of Span Gas to TIP I inlet.
7. Adjust SPAN control until LCD indicates the Span Gas concentration (usually 100 ppm). Disconnect Span Gas Bag.
8. Sample clean air again and readjust ZERO control until LCD reads 0.00, if necessary.
9. Lock ZERO control by turning locking ring counterclockwise .
10. Sample Span Gas again and readjust SPAN control until LCD indicates the Span Gas concentration, if necessary.
11. Lock SPAN control by turning locking ring counterclockwise . Disconnect Span Gas Bag.
12. Observe sample concentration changes on LCD. Concentration of total ionizables is displayed in Span Gas equivalent units.
13. Do not allow TIP I to draw in any liquid.
14. Press POWER switch after use to turn off TIP I.

4.2 HOW TO USE THE SPAN KIT

1. Hand tighten regulator onto Span Gas tank.
2. Turn gas bag valve counterclockwise to open.
3. Hand tighten gas bag adapter nut onto regulator.
4. Turn regulator knob counterclockwise about one-half turn to start gas flow.
5. Fill bag about one-half full.
6. Turn regulator knob fully clockwise to shut off gas flow.
7. Turn gas bag valve fully clockwise to close.
8. Remove gas bag adapter nut from regulator.
9. Remove regulator from Span Gas tank.

4.3 TUTORIAL - DIRECT READING

1. When you press the POWER switch, the LCD of TIP I will turn on and the pump and yellow LEDs will come on briefly. Wait for them to come on continuously, indicating the ultraviolet lamp has started.

2. Turn the locking rings down to release the ZERO and SPAN controls.

3. A mid-range sensitivity (Span setting of 5) is a good place to start.

4. The cleanliness of your Zero reference air should match your application. Outdoor air away from chemical sources is usually suitable. Although background chemicals will not be cancelled out as they are when TIP I is used qualitatively, the error they cause is usually insignificant. If the zero reference air contains 1 ppm equivalent of total ionizables, and TIP I is adjusted to read 100 when Span Gas is introduced, then in fact TIP I will read -1.0 when air with no ionizables is sampled. The error will decrease as concentration increases, and at 100 ppm, TIP I will read correctly. For critical applications, or if your outdoor air is too heavily contaminated, bottled Zero Air can be used.

5. Turning the ZERO control clockwise will raise the LCD reading, counterclockwise will lower it. Adjust the COARSE ZERO control with a small slotted screwdriver if you can't get TIP I to read 0.00 with the ZERO control alone. First set the ZERO control to 5, adjust the COARSE ZERO until the LCD reads near zero, then make a final adjustment with the ZERO control.

6. Hand tighten the gas bag adapter nut to TIP I inlet, and open the gas bag valve.

7. A clockwise turn of the SPAN control will raise the LCD reading, counterclockwise will decrease it.

8. If you had to change the span setting by more than one division then you should check the zero setting by sampling clean air again. Reset the ZERO control, if needed.

10. If you changed the zero setting by more than one division, then recheck the span setting by sampling Span Gas. Setting the ZERO and SPAN controls is an iterative procedure. With experience, your initial settings will be close to your final settings and you won't need to recheck them.

11. Sample clean air while locking the ZERO control and sample Span Gas while locking the SPAN control, and hold the controls so that they don't shift when their locking rings are turned against them.

12. The LCD will now show concentrations of total ionizables in the sample in Span Gas equivalent units. If TIP I were exposed to a 100 ppm sample of Span Gas, then of course the LCD would read 100. Thousands of other chemicals at higher or lower concentrations would also produce a reading of 100, because TIP I has different sensitivities to different chemicals. One Span Gas equivalent unit is defined as the concentration of total ionizables which gives the same TIP I response as 1 ppm of Span Gas. One of the reasons we have chosen isobutylene as the Span Gas is that TIP I has a medium response to it. TIP I responds about twice as well to benzene and about one-half as well to butyl acrylate and it does to isobutylene. Isobutylene equivalent units are a means of reproducibly reporting from one day to the next, or from one month to another, an average total ionizables concentration.

13. If TIP I aspirates some liquid, immediately turn to Section 5 - Maintenance and follow the instructions.

14. Switch off TIP I when you're finished taking readings or if the LOBAT sign appears at the top left of the LCD. Reading taken while LOBAT is on may not be reliable.

4.4 TUTORIAL - DIRECT READING FOR OTHER CHEMICALS

TIP does not have to be spanned against isobutylene Span Gas. If your monitoring situation is one where a single chemical is responsible for nearly all of the total ionizables, TIP can be spanned to read out directly the concentration of this specific chemical.

One way to do this is to use a span gas made of the specific chemical in air. Appendix 8-1 describes how to make your own span gas.

The other way is to use isobutylene span gas, and to adjust TIP SPAN control until the LCD reads a value other than 100. Table 4-5 lists span settings for specific chemicals.

To directly read benzene, for example, follow the <u>How to Use TIP - Direct Reading</u> instructions up to step 7 . Connect your isobutylene span gas to TIP and adjust the SPAN control until the LCD reads 52.6 (not 100), the specific span setting for benzene from Table 4.5.

Continue following the rest of the instructions as though the span gas concentration were 52.6 ppm. TIP is now set up to directly read benzene concentrations in the air, assuming benzene is the only ionizable in the sample. For a sample of 10 ppm benzene, TIP LCD will show 10.

Keep in mind that the reading still represents the total ionizables in the air. If benzene is the only ionizable present then its concentration is 10 ppm. No matter what other ionizables are present, however, the benzene concentration in your sample does not exceed 10 ppm.

4.5 TABLE OF SPECIFIC SPAN SETTINGS

Chemical	Threshold Limit Value (TLV)	Specific Span Setting*
Acetone	750	181
Analine	2	339
Benzene	10	52.6
n-Butyl Acrylate	10	633
Chloroform	10	215
1,2 - Dichlorobenzene	50	109 1
Diethylamine	10	62.3
Epichlorohydrin	2	6.9
Ethanol	1000	852
Furfural	2	4.4
n-Hexane	50	530
n-Heptane	400	407
Isopropyl Alcohol	400	1182
Methyl Ethyl Ketone (MEK)	200	145
Nitrobenzene	1	11.1
n-Pentane	600	1578
Propylene Oxide	20	781
Toluene	100	74.5
Trichloroethylene	50	40.9
m-Xylene	100	56.1

*Introduce 100 ppm isobutylene Span Gas and adjust SPAN control until LCD reads this value.

All chemicals were sampled at their TLVs to obtain these values.

5.1 MAINTENANCE

Keeping TIP I in top operating shape means charging the battery, cleaning the ultraviolet lamp window, and replacing the dust filter. The exterior of TIP I can be wiped clean with a damp cloth and mild detergent if necessary. Organic cleaning solvents might damage the finish.

5.2 BATTERY CHARGING

Charge TIP I battery when LOBAT appears at the top left of the LCD.

1. Switch off TIP I.
2. Remove any external devices connected to the rear receptacle, or unscrew dust cover.
3. Set switch on charger to correct AC mains voltage.
4. Connect charger plug to TIP I rear receptacle. Turn knurled collar clockwise to secure plug.
5. Plug charger into AC mains.
6. Allow TIP I to charge for 16 hours.
7. Remove charger plug from TIP I and replace dust cover.

TIP I handle and the charger may be warm to the touch during charging. This is normal.

By letting TIP I fully discharge until LOBAT appears, then charging for 16 hours, the operating time of TIP I is maximized. Occasional overcharging for up to two days will not be detrimental to the batteries. Do not leave TIP I on charge continuously when not in use.

If TIP I is consistently put on charge before LOBAT appears, the operating time of TIP I is diminished.

5.3 CLEANING THE LAMP WINDOW

As TIP I is used, a film of deposit will build up on the window of the ultraviolet lamp. The rate of film build-up depends on the chemicals and concentrations being sampled, and results from the action of ultraviolet light on the chemicals. Clean the lamp window when a span setting of 9 is insufficient to give a high enough LCD reading. Refer to Figure 3.3 for parts location.

1. Switch off TIP I.
2. Grasp the black detector cover and unscrew it from TIP I. The detector cell, lamp holder and UHF driver circuit board are now exposed. Be careful of the PID seal o-ring on top of detector cell.
3. Unplug red and yellow wires from UHF driver circuit board.
4. Grasp lamp holder so it will not rotate, and unscrew detector cell (with red and yellow wires attached) from lamp holder. Lamp will pop up.
5. Withdraw lamp from lampholder. Leave spring in lamp holder.
6. Moisten a lint-free tissue (Kimwipe TM or equivalent) with methanol.
7. Scrub lamp window with moistened tissue to remove film.
8. Dry lamp window with clean lint-free tissue.
9. Without touching window, slip lamp into lamp holder, window end out.
10. Install detector cell into lamp holder and tighten until just snug. Avoid cross threading.
11. Plug yellow wire onto gold pin and red wire onto tinned pin on UHF driver circuit board.
12. Install detector cover hand tight.

When the detector cell is removed, be careful not to touch the fine wire mesh inside it. Any dirt in the detector cell may be blown out with a gentle jet of dry compressed air.

5.4 REPLACING THE DUST FILTER

TIP I is equipped with a dust filter to reduce detector contamination. As the filter becomes clogged, TIP I inlet flowrate and sensitivity will drop. If TIP I sensitivity increases by more than 10% when the filter is removed then install a new filter. Don't run TIP I without a filter for more than a minute or so.

1. Switch off TIP I.
2. Hold filter housing near detector cap with 9/16" wrench.
3. Unscrew top of housing with another 9/16" wrench. Be careful of the metal sealing washer.
4. Remove spring and filter.
5. Install new filter open end first.
6. Slip spring into top of housing and assemble housing. Tighten with two wrenches.

5.5 IF TIP DRAWS IN LIQUID

Water drawn in TIP will not cause permanent damage if the instrument is promptly disassembled and cleaned. The most important parts to clean are the lamp and the detector cell. To clean the pump, allow TIP to run until no more water comes out of vent hole.

1. Refer to maintenance instructions 5.3 to remove detector cell and lamp.
2. Dry lamp with a clean lint-free tissue and clean the window.
3. Clean detector cell in clean water, preferably in an untrasonic cleaner. Do not touch the fine wire mesh.
4. Dry detector cell overnight at 50 degrees C.
5. Dry inside of lamp holder.
6. Remove filter following instruction 5.4.
7. Dry inside of filter holder
8. Install a new filter.
9. Assemble TIP following instruction 5.3.

6.1 CONNECTING EXTERNAL DEVICES TO TIP I

All devices which plug into TIP I's rear receptacle require that the dust cover be removed. Secure the plug by tightening the knurled collar.

6.2 HEADSET (Photovac TA200)

Plug headset into rear receptacle and turn on TIP I. A sound will be present whenever the LCD reads above 1 +/-0.4.

The frequency is proportional to the total ionizables concentration. Adjust the volume control on the headset as desired.

6.3 EARPHONE (Photovac TA201)

This small earphone is designed to provide an audio output to a user wearing a hard hat. Operation is the same as that of the headset, but the audio volume is fixed.

6.4 EXTERNAL BATTERY PACKS and POWER CORD (PHOTOVAC TA202, TA203, TA204)

External battery packs extend TIP's operating time by up to 36 hours. Each pack comes with its own battery charger and instructions. The power cord is required to connect TIP to either battery pack. It will also operate TIP from a vehicle cigarette lighter jack but only if the vehicle is 12V negative ground. Reversing the polarity may permanently damage TIP.

6.5 PORTABLE CHART RECORDER AND OUTPUT CORD (Photovac TA205 and TA206)

The output cord connects TIP I to the chart recorder. Plug the dual banana plug into the + and - jacks on the recorder lower front panel. Turn on the recorder, set it to 1V Input, and zero the pen at the left hand side of the chart. Connect the output cord to TIP I's rear receptacle and turn on TIP I. The TIP I LCD reads out directly in millivolts, so a reading of 1000 will be full-scale on the recorder. If the pen moves to the left as TIP I readings increase, reverse the dual banana plug. The recorder Input scale and attenuation may be adjusted to give full scale deflections for other LCD readings, and the chart speed adjusted between 0.5 cm/hr and 10 cm/min.

6.6 THREE METER INLET PROBE (Photovac TA207)

TIP I is equipped with an industry standard 1/8 inch Swagelok TM inlet fitting. Connect the probe nut to the inlet for remote sampling. Longer probes may be made and used, but TIP I's inlet flowrate must not be lower than 450 mL/min or the pump lifetime will be diminshed. When making inlet probes, use Teflon TM or stainless steel to minimize sample absorption, reaction, and probe memory.

7.1 SERVICE INFORMATION

TIP I is designed to be both rugged and field-serviceable.

If TIP I is not operating as you expect, look through the symptoms listed in Section 7.2 Troubleshooting to determine the cause of the problem, and turn to the appropriate Service Procedure in Section 7.3.

7.2 TROUBLESHOOTING

1. Nothing happens when POWER Switch pressed
    1. Battery discharged (Connect charger. Charge for 16 hours)
    2. Battery disconnected (Reconnect battery. See 7.3.1)
    3. Internal fuse blown (consult Photovac Service Department)

2. Numerals appear on LCD, but pump and LEDs never stay on continuously. TIP front end warms up quickly.
    1. Lamp driver circuit needs tuning (Adjust tuning. See 7.3.2)
    2. Lamp needs replacing (Install new lamp. See 7.3.3)
    3. Loose UHF driver mounting screw (Tighten screw. See 7.3.4)

3. LCD always reads "1" except at span setting of 0
    1. Short in detector cell (Repair or replace detector cell. See 7.3.5)
    2. Short in signal feedthrough (Consult Photovac Service Department)

4. LCD reading fluctuates randomly
    1. Span setting too high (Reduce span setting)
    2. Loose detector cover (Hand tighten detector cover)

5. LCD always reads "1", even at span setting of 0.
    1. Controls disconnected
    2. Fault on control circuit board (Consult Photovac Service Department)

7.3 SERVICE PROCEDURES

1. Reconnect battery

    1. Remove two hex socket screws securing handle to control housing.
    2. Remove handle from control housing by gently rocking handle. Be careful of 2,¼" plastic sealing washers.
    3. Inspect and secure battery connector on control circuit board.
    4. Replace two hex socket screws in handle bulkhead.
    5. Slip plastic sealing washers over screws.
    6. Tighten screws to secure handle to control housing.

2. Adjust tuning

    1. Unscrew detector cover.
    2. Locate trimming capacitor on UHF driver.
    3. Turn on TIP. Pump and LED should stay on.
    4. Slip detector cover on until pump and LEDs go off.
    5. With an insulated-blade screwdriver, adjust trimming capacitor until lamp starts (indicated by a blue glow from lamp holder). Pump and LEDs will come on when lamp starts, but also if photoresistor on UHF driver is exposed to ambient light.
    6. Turn off TIP and install detector cover.

3. Install new lamp

    1. Follow maintenance instructions 5.3 to remove lamp.
    2. Clean new lamp window with a lint-free tissue moistened with methanol.
    3. Dry lamp window with a clean tissue.
    4. Assemble TIP according to 5.3.

4. Tighten UHF driver mounting screw

    1. Unscrew detector cover.
    2. Locate mounting screw near edge of UHF driver.

3. Ensure screw is tight.
4. Replace detector cover.

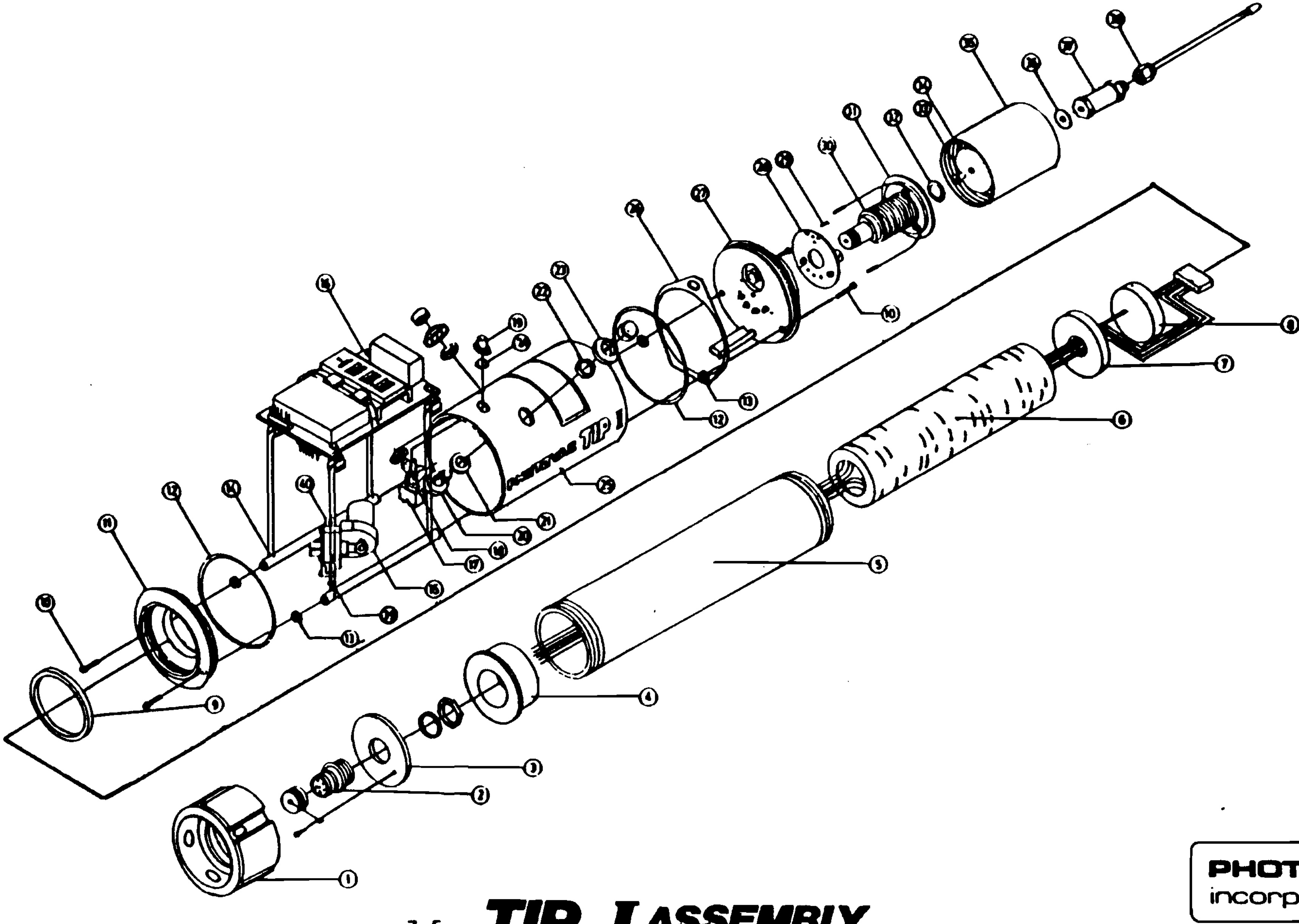
5. Repair or Replace Detector Cell

1. Follow maintenance instructions 5.3 to remove detector cell.
2. Measure resistance between red and yellow wires. Should be above 10 Megohms.
3. If resistance is below 10 Megohms, look for a short at wire connections or between fine wire mesh and stainless steel plate (with small inlet hole).
4. Clean detector cell in Freon TF ^{TM} in ultrasonic cleaner.
5. Dry detector cell overnight at 50 degrees C.
6. Install detector cell according to 5.3.
7. Install detector cover.

7.4 TIP I˜ PARTS LIST

Refer to 7.5 Tip Assembly Diagram

ITEM	DESCRIPTION	PART NUMBER
1	Rear Bulkhead	500128
2	Recept. Assembly	600140/400101-03
3	Recept. Mount	500129
4	Rear Bulkhead Seal	600144
5	Handle	500127
6	Battery Pack	300029
7	Battery Pad	600257
8	Current Limiter Assembly	300028
9	Center Bulkhead Seal	600350-03
10	Machine Screws	600005-20
11	Center Bulkhead	500026
12	O-Ring Seal	60035-04
13	Standoff Seal	600021-10
14	Standoff	500133
15	Pump	400503/500035
16	PCB - Control	200018
17	Power Switch	400201
18	Switch Seal	600427
19	Switch Boot	600669
20	Zero Pot/Span Pot	400079-03/400079-04
21	Pot Seal	600426
22	Jam Nut Supplied with item 20	
23	Lock Assembly (Zero/Span)	500031/500032-03
24	Boot Seal	600350-07
25	Control Housing	500030/600670
26	Strap Attachment	500073
27	Front Bulkhead Assembly	500121A
28	PCB - RF Oscillator	200007
29	Machine Screw	600001-22
30	Antenna Former/Lamp Assembly	500022/400267-02
31	Detector Cell	300024
32	O-Ring Seal	600350-02
33	Rivet	600252-02
34	Cap Washer	500034
35	Cap	600425
36	Inlet Seal	600021-07
37	Filter Body and Cartridges	600137
38	Nut and Probe	TA209
39	Machine Screw	600001-04
40	Pump Mounting Bracket	500035



7.5 TIP I ASSEMBLY

PHOTOVAC
incorporated

8.1 APPENDIX HOW TO MAKE SPAN GAS

Gas standards can be prepared in a Tedlar ^{TM} sample bag.
The sample bag should have known internal volume (when inflated to the point where the material just begins to stretch) and should have appropriate fittings for gas filling and connection to the TIP*. The bag is first filled with Zero air (TIP* can be used to check that this air is clear of contamination). A simple calculation can then be done to find out how much of the chemical, as gas or as vapor or liquid, must be added to provide the required concentration.

If we are dealing with a gas, the calculation is the simplest imaginable. If the volume of the bag is 25 L, we simply add 25 µL to yield a 1 ppm mixture. For higher or lower concentrations, we adjust accordingly.

If, however, we have to prepare a standard from liquid or solid sample, the procedure is slightly more complex (but only slightly!). The best way that we have found involves using headspace (this means taking a sample of vapor from above the liquid in a bottle). Vapor pressure of a given liquid varies with temperature. Let us imagine that we are working with benzene at room temperature 20 degrees C (68 degrees F). Vapor pressure tables tell us that benzene exerts a vapor pressure of 74 mm Hg at this temperature. If benzene was a gas, we would just add 25 µL to our 25 L bag to make a 1 ppm mix, but benzene is a liquid at this temperature, contributing only partially to the total atmospheric pressure above the liquid, and we need to take a larger volume from the headspace than this. Actually, we must take 25 x 760/74 = 257 µL and this will give 1 ppm in the bag (760 mm Hg is, near enough, atmospheric pressure). We could write a formula:

$$v = V \times 760/p$$

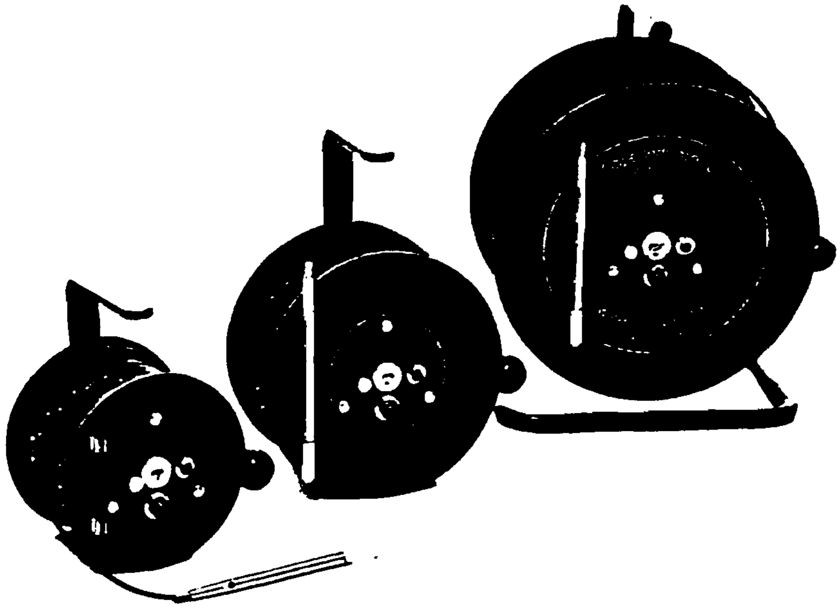
Where v = Volume of headspace required (µL)
V = Volume of bag (L)
p = Vapor pressure of sample material in mm Hg at ambient temperature.

One vital point not to be overlooked is the type of syringe used for this purpose which usually employs a steel plunger having a minute Teflon^{TM} tip and graduated glass barrel. The needle is either epoxy bonded to the end of the barrel or removable type having a knurled screw-on sleeve and a Teflon^{TM} sealing bush between itself and the glass. This type of syringe gives excellent service and a commercially available type is Hamilton 1750 RN (500 µL capacity with a replaceable needle).

We must be very careful, however, as this syringe ages. The Teflon^{TM} plunger tip gradually wears and leaks can develop between this and the glass wall; also, the screw-on needle seal can work loose and needs to be checked periodically. Leakage in syringes can be the major cause of problems associated with reproducibility and replication of standards and actual results.

model 51453
Water Level Indicator

Slope Indicator's Water Level Indicator is a self-contained transistorized instrument for determining ground-water level in boreholes and wells to 1000-ft. depths.



Model 51453 Water Level Indicators

The system consists of a reel with control panel, cable and sensor. A two conductor cable connects the control panel to the sensor. An insulating gap in the ⅜" diameter stainless steel sensor acts as a switch. The circuit is completed upon making contact with water which serves as an electrolyte. This low level signal is amplified and fed into an indicator light and audible buzzer, thus signalling when water has been contacted. The circuit has a test switch to insure proper operation prior to making depth readings. A sensitivity control has also been incorporated so adjustments can be made to compensate for very saline or contaminated water to prevent premature indication of water contact.

Permanent cable markings are hot-stamped at 1-foot or 1-meter increments to facilitate depth control. Copperweld (copper plated steel) conductors minimize stretch of cable for more accurate depth measurements.

SLOPE INDICATOR Co. 3668 Albion Place N., P.O. Box C-30316, Seattle, WA. 98103 U.S.A.
TWX: 910-444-2205 (SINCO SEA) cable: SINCO SEA phone: (206) 633-3073

Colorado Sales Office: Slope Indicator Company 511 Orchard St., Suite 107 Golden, Colorado 80401 U.S.A. phone (303) 279-7813

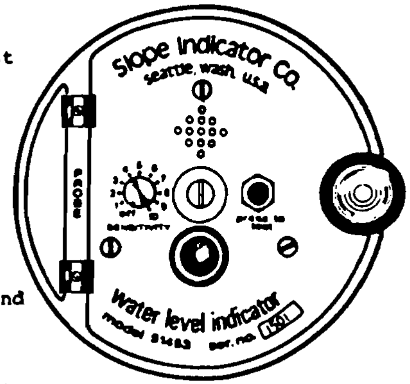
sinca Slope Indicator Canada Limited A subsidiary of The Slope Indicator Company
Unit #5-11300 River Road, Richmond, B.C. Canada V6X 1Z5 telex: 04-352848 VCR phone: (604) 276-2545

SINCO 70001436 - 0182 Printed in USA

operating instructions

model 51453 WATER LEVEL INDICATOR

The sensitivity knob on the reel panel is used to select the desired sensitivity setting on a scale from 1 thru 10. Setting (1) is the lowest sensitivity for very saline and/or contaminated water and setting (10) is the highest sensitivity for very pure or fresh water.



To determine proper setting, turn sensitivity knob to full setting (10) position and lower probe until it contacts water. Raise probe out of water and turn sensitivity knob to a lower setting until the light and buzzer turn off. Repeat and adjust sensitivity knob so that the light and buzzer turn off promptly when withdrawing the probe from the water. Do not turn the sensitivity knob lower than necessary or accuracy will be reduced.

Water level is measured at point where light first turns on.

Make certain the sensitivity setting is in the off position when measurements are not being taken. This will conserve battery life. To test the Water Level Indicator, turn the sensitivity switch on and press the "press to test" button.

The Model 51453 Water Level Indicator operates on 3 each (AA) Batteries.

To replace batteries:

1). Remove 3 peripheral screws and the center screw on the controls panel side.
2). Lift cover panel and replace 3 each AA batteries. Note polarity on batteries for series hook-up.
3). Replace cover.

Cable may be removed from reel to facilitate battery replacement.

SINCO
Slope Indicator Company
3668 Albion Place No., P.O. Box C-30316, Seattle, WA. 98103 U.S.A.
TWX: 910-444-2205 (SINCO SEA) cable: SINCO SEA phone: (206) 633-3073

SINCO 7600 1 [illegible] Printed in USA

CONDUCTIVITY METER

Model 1484-00
1484-10/1484-11
1484-20/1484-30

Instruction Manual

Cole Parmer

7425 North Oak Park Avenue, Chicago, Illinois 60648

WARRANTY

All instruments are fully guaranteed against defective materials and workmanship for one year. Any attempted repair voids the warranty on this instrument.

RANGE 5, FROM 10,000 TO 20,000 MICROMHOS, IS NONLINEAR AND SHOULD BE USED FOR RELATIVE MEASUREMENTS ONLY.

CONDUCTIVITY METER

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CONDUCTIVITY METER

1.0 Introduction

The Bench/Portable Conductivity Meter measures total ionized substances in solution. The meter displays conductivity in five ranges from 0-20,000 micromhos/centimeter (μmhos/cm) and comes with a break-resistant probe that has an internal thermistor for automatic temperature compensation.

2.0 Specifications

Range (μmhos/cm):	0-2 0-20 0-200 0-2,000 0-20,000
Accuracy:	±2% Full Scale
Temperature Compensation:	Automatic, 5-45°C
Sensor:	Dip Style — Gold Plated Electrodes
Power:	
Bench:	AC — 115 Volt Model or 230 Volt Model DC — Eight Size AA Batteries
Portable:	AC/DC Rechargeable NiCad Batteries 110 VAC or 220 VAC
Size:	
Bench:	8" W x 6" H x 6" D
Portable	12¼" W x 4¼" H x 8" D

3.0 Preliminary Set Up

3.1 Remove and inspect carton for the following:
- a. AC or DC Conductivity Meter
- b. Conductivity probe with six feet of cable
- c. Probe holder with support rod
- d. Instruction Manual
- e. Conductivity Standards — 10,000 μmhos, 1000 μmhos, 100 μmhos

3.2 Install the instrument in a location with adequate ventilation and freedom from vibration. In addition, close proximity to high voltage wires or transformers should be avoided.

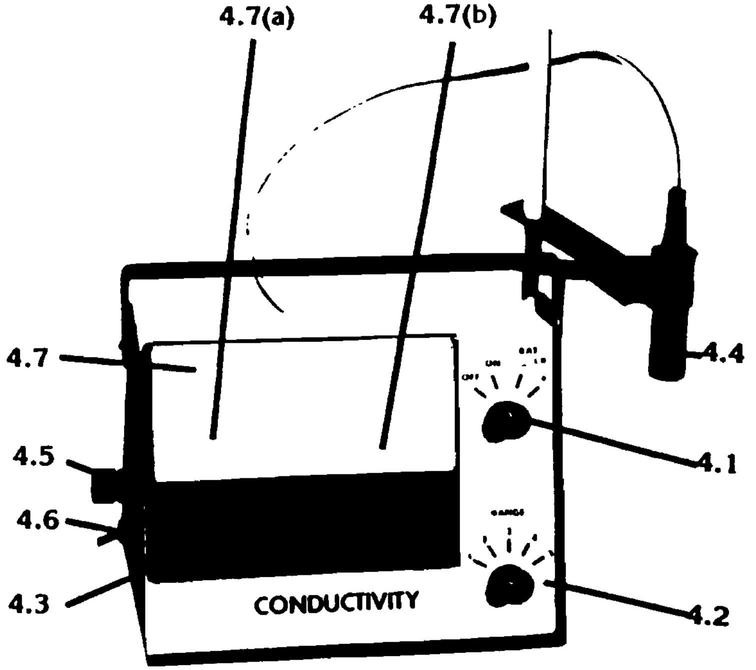
3.3 Turn top power switch to the Off position.

3.4 AC Models — Plug AC cord into appropriate electrical outlet. AC/DC Models should be allowed to charge for at least 24 hours to insure a fully charged battery.

3.5 Turn instrument On — both AC and DC units should be ready to use after a five minute warm-up.

3.6 Immerse and store probe in distilled or deionized water.

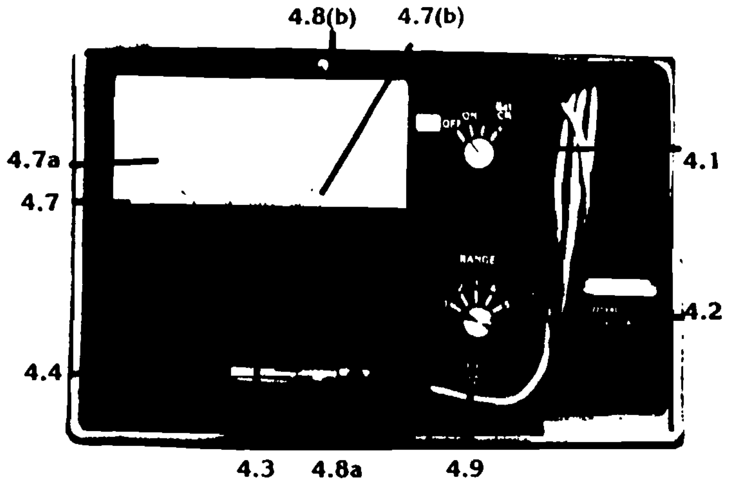
4.0 Front Panel



4.1 Function (Off/On/(– . +)BATT-CK)
- Off: Turns power Off to conserve battery/meter life
- ON: Activates meter
- (– , +) Batt CK: Each position will monitor the batteries(DC) or power supply (AC)

4.2 Range: Five position switch used to select proper conductivity scale

4.3 Zero adjustment screw
4.4 Conductivity probe
4.5 Fuse holder for 1/16 amp fuse (AC model only)
4.6 Line cord (AC model only)
4.7 Analog Meter Face: Containing 5 conductivity scales covering 0-20,000 µmhos/cm
  a. Range Selection
  b. Batt OK Zone — Acceptable zone when checking battery or power supply function
4.8 Front Panel Screws a&b: Two screws that fasten front panel to carrying case. Screws must be completely removed and panel lifted out to gain access to the rechargeable batteries.
4.9 Calibration Adjustment — Use to calibrate the meter using a conductivity standard (on back panel of bench model)



5.0 Checking Meter Function

5.1 Turn meter off — with flathead screwdriver turn the zero adjustment screw so that the needle reads zero
5.2 DC models — turn function switch to BATT CK – The needle should read in BATT OK zone. A reading below this zone indicates that the negative bank of batteries need to be replaced. Turn function switch to BATT CK + A reading below the BATT OK zone indicates that the positive bank of batteries need to be replaced.
5.3 AC models — turn function switch to BATT CK – or +. A reading below the BATT OK zone indicates power supply failure and the meter needs to be serviced.
5.4 AC/DC Models — Turn function switch to BATT CK – or +. A reading below the BATT OK zone indicates the batteries require recharging.
5.5 Turn instrument ON.

6.0 Sample Measurement

6.1 Turn the range switch to position 5. Rinse the probe with either distilled or deionized water.
6.2 Insert the probe into the unknown solution at least one inch without touching the sides or bottom of the container.
6.3 Decrease the range one step at a time until the meter reading is between 10% and 90% of full scale.
6.4 The probe will automatically compensate for sample temperatures between 5°C and 45°C.

It may take several minutes for the reading to stabilize when the temperature of the solution is different from the test environment. The reading is taken after the output has stabilized.
6.5 When you measure low conductivity levels, the sample should be protected from the atmosphere since dissolved gases will rapidly change the conductivity.
6.6 After the measurement range has been determined, select a standard within that range and calibrate the meter at the selected range.
6.7 Re-measure the unknown solution.
6.8 The probe should be rinsed and stored in distilled water after each measurement.

7.0 Theory

7.1 Conductivity is the measurement of the amount of electrical current that will flow across two noble metal surfaces when a constant voltage is applied. Conductivity is a non-selective measurement with any charged ion contributing to the total conductivity. Organic compounds such as phenols, alcohols, oils, etc., do not dissosiate (ionize) in water and therefore have little or no effect on the conductivity.

Conductivity is normally expressed as micromhos per centimeter (µmhos/cm). In the International System of Units (SI), conductivity is expressed as millisiemens per meter, where 1 mS/m is equal to 10 µmhos/cm or 1 µS/cm is equal to 1 µmho/cm.

Conductivities of some common liquids:	
Freshly distilled water	.5 to 2.0 µmhos/cm
Potable Water	50 to 1,500 µmhos/cm
Normal Saline	18,400 µmhos/cm

7.2 Conductivity can be used to determine concentration. A nearly linear relationship exists between conductivity and ion concentration for most ionic compounds below 2,000 µmhos/cm. As a result conductivity is often measured to determine total dissolved solids (TDS). It is important to note that this is only a valid methodology when the ionic solution is composed of a pure compound since the exact relationship between conductivity and concentration varies with each ionic compound.

Some examples of the relationship between concentration and conductivity are:

Salt	**Concentration**	**Conductivity at 25°C**
Calcium Carbonate ($CaCO_3$)	1 G/L (1000 ppm)	2300 µmhos/cm
Sodium Chloride (NaCl)	1 G/L (1000 ppm)	1990 µmhos/cm
Potassium Chloride (KCl)	1 G/L (1000 ppm)	1880 µmhos/cm

8.0 Troubleshooting

8.1 Symptom: Meter exhibits no response.

Action

a. Check power to meter.
  1. AC meter not plugged in
  2. AC meter has blown fuse
  3. Turn function switch to BATT CK to test power supply (AC) or batteries (DC)

Conclusion:

If the meter seems to be adequately powered, proceed to next step.

If meter needle does not register BATT OK when function is checked then:

- Replace batteries in DC model (negative bank only if battery is adequate in positive check, positive bank only if battery is adequate in negative check).
- Power supply needs to be serviced in AC model.

b. Check for electrical short.
  1. Turn meter on and turn range switch to position 5
  2. Hold a 100 ohm resistor across the metal surfaces at the end of the conductivity probe
  3. The meter needle should read at least 10,000 µmhos/cm

Conclusion:

If the meter needle does not deflect at all or deflects less than 10,000 µmhos/cm, then the meter needs to be serviced.

8.2 Symptom: Standard does not fall within acceptable limits.

Action:

a. Clean probe using a mild detergent to remove oil or debris.

b. Go to 8.1 B and check for electrical short.

Conclusion:

Meter needs to be serviced.

9.0 Parts List

Description	Part Number
Probe	300-7500-00
Meter	650-1070-00
½" Probe Cable Clamp	560-8916-00
Rod Clamp	536-0013-02
Probe Holder	538-0100-00
Test Tube Clip	559-1006-00
Nylon Rod	532-0011-00
100K Pot	634-0104-10
AC Unit:	
AC Power Board 115 Volts	600-0001-10
AC Power Board 230 Volts	600-0001-20
Power Cord	780-7136-00
Fuse Holder	567-2014-00
Fuse, 1/16 Amp	714-2062-00
Board	600-0017-03
DC Unit:	
Mercury Battery	709-0009-00
Battery	567-2182-00
Board	600-0017-03
AC/DC Unit:	
[1] Battery Holders	567-1290-00
[1] Battery Plate	534-0100-23
[1] Battery Plate Stands	538-0100-22
[1] Battery Straps	538-0100-21
Terminal Strip	734-8643-00
330 Ohm Resistor	631-0331-00
220 μF 16V Capacitor	627-2281-00
Rechargeable Batteries, 9V	706-0022-00
Battery Snaps	569-0745-00
[2] Charger, 115V	702-8113-00
[2] Charger, 230V	702-0504-20
Portable Case	526-2585-00
Board	600-0700-02
1484-00/1484-10/1484-11 1484-20/1484-30 Instruction Manual	175-1484-00
Model 70/700 Instruction Manual	175-7000-00

[1] To obtain total assembly — order all parts together.

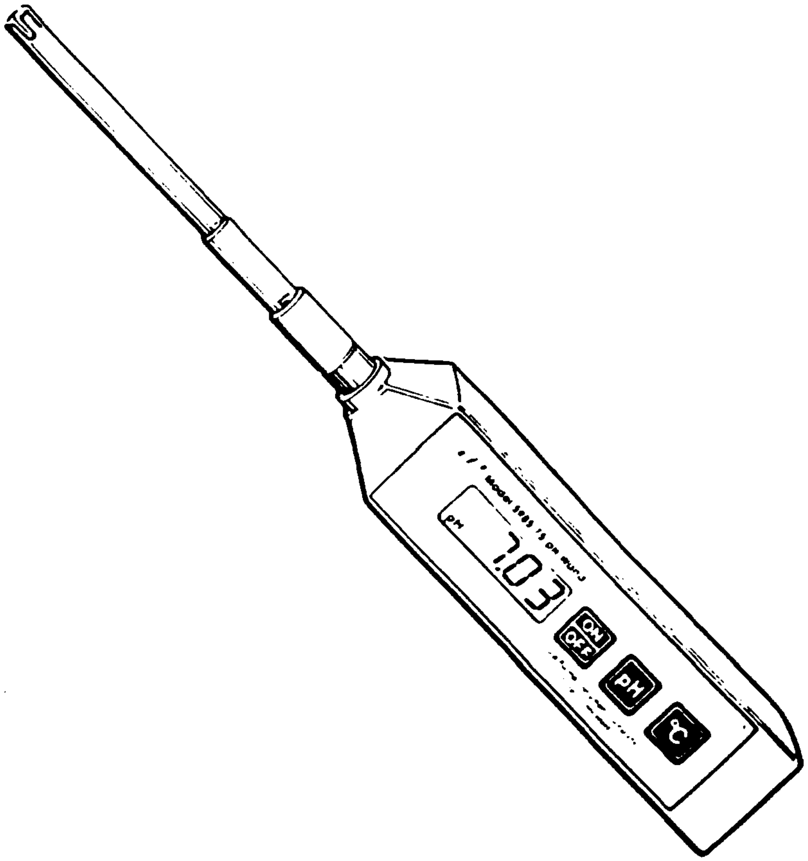
[2] Make certain to select correct chargers for your unit.

Cole-Parmer Instrument Company
7425 North Oak Park Avenue, Chicago, Illinois 60648
Phone 1-312-647-7600 or Toll-free 1-800-323-4340

Operating Instructions

Cole-Parmer's 5985-75

Digital pH wand with ATC



Cole Parmer

Cole-Parmer Instrument Company
7425 North Oak Park Avenue, Chicago, Illinois 60648
Phone 1-312-647-7600 or Toll-free 1-800-323-4340

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1. General information

Cole-Parmer's 5985-75 pH wand features pH measurement with automatic temperature compensation and temperature measurement. Mode selection keys are located on the splash-proof keyboard. Display indicates mode—pH or °C—in the lower left-hand corner.

When the instrument is switched on, it will be in the pH mode. Just press the °C key to change the instrument into a thermometer and display the temperature value of the liquid being measured. The temperature sensor is built into the bottom of the pH electrode, near the sensitive glass bulb.

The glass bulb and ceramic junction of the pH electrode should always be wet. A rubber cap is supplied for this purpose, to be filled with KCl solution. If KCl solution is not available, a pH 4.01 buffer or tap water can be used.

NOTE: The use of distilled water in the rubber cap is not recommended.

The pH wand comes with soft vinyl carrying case, an epoxy type pH electrode that screws directly onto the meter and 9-volt battery. Optional accessories include a replacement electrode, KCl filling solution, and pH buffers.

2. Before using the instrument

The 5985-75 pH wand comes with a protective plastic sleeve over the refill hole on the sheath of the electrode.

To improve response time, slide the plastic sleeve on the electrode down to uncover the refill hole during measurements.

NOTE: Response time will be quite slow if the sleeve remains over the hole.

For best results, the filling solution should be maintained at a level just below the filling hole.

3. Specifications

Ranges:	pH: 0 to 14.00 pH °C: 0 to 100.0°C
Accuracy:	pH: ±0.01 pH units, ±1 digit °C: ±0.2°C
Temp. compensation:	Automatic, 0° to 100°C
Battery:	One 9-volt (included)
Battery life:	Approx. 100 hours, continuous
Weight:	12 ounces
Size (L x W x D):	7¼" x 1⅝" x 1"

4. Optional accessories

Model 5985-76 Replacement epoxy electrode, with built-in temperature sensor.

Model 5992-45 KCl filling solution saturated with AgCl.

An assortment of pH buffer solutions and capsules.

Call Cole-Parmer, toll-free at 1-800-323-4340 for technical information, pricing or ordering information.

5. pH calibration

Because pH electrodes are inherently unstable, we recommend daily recalibration to ensure the most accurate results possible.

To recalibrate, follow these instructions carefully:

1. Switch on the instrument by pressing the key ON/OFF. The instrument will be in the pH mode, and the display will indicate "pH" in the lower left-hand corner.
2. Press the key °C, and the symbol "°C" will appear on the display.
3. Immerse the electrode in the pH 7 buffer solution and read the temperature of the buffer solution.
4. Refer to the temperature/pH chart (next page) for the buffer pH value corresponding to the measured temperature.
5. Press the pH key.
6. If the pH value displayed is not the same value as the chart indicates, adjust the left-hand potentiometer with a screwdriver until the display reads the correct value.
7. Rinse the electrode in distilled water and shake off the remaining water.
8. Immerse the electrode in a 4.01 pH buffer solution and stir gently. Use a 10.00 pH buffer if measurements are on the high end of the pH scale.
9. Repeat steps 2-5 using solution with pH 4.01 or 10.00.
10. If the display does not show the value of pH corresponding to the correct temperature, turn the right-hand potentiometer with a screwdriver to adjust the reading.

6. Temperature compensation

This pH wand automatically compensates for error as the temperature of the liquid being measured changes. The chart below shows pH value of buffers in response to temperature.

Temperature/pH chart

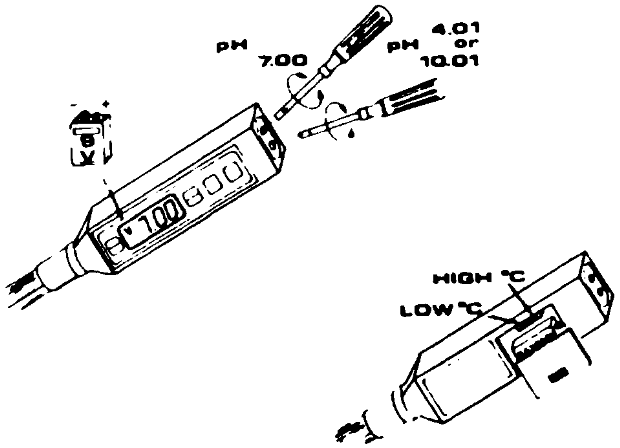
Temperature		Buffer Values (pH)		
°C	(°F)	4.01	7.00	10.00
0	32	4.01	7.12	10.33
5	41	4.01	7.09	10.25
10	50	4.00	7.06	10.18
15	59	4.00	7.04	10.11
20	68	4.00	7.02	10.05
25	77	4.01	7.00	10.00
30	86	4.01	6.99	9.95
35	95	4.02	6.98	9.92
40	104	4.03	6.98	9.88
45	113	4.04	6.97	9.85
50	122	4.06	6.97	9.82
55	131	4.07	6.98	9.80
60	140	4.09	6.98	9.77
70	158	4.12	6.99	9.73
80	176	4.16	7.00	9.69
90	194	4.20	7.02	9.66

7. Temperature calibration

When the pH electrode is replaced, the temperature mode must be recalibrated. To recalibrate for temperature, follow these instructions (refer to **Figure 1** as needed):

1. Press the key °C to make the °C symbol appear on the display.
2. Immerse the electrode in a solution at approximately 0°C (melting ice). Wait some minutes and if the display does not read the same value measured with a precision thermometer, adjust the left-hand potentiometer in the battery compartment.

Figure 1



8. Using the instrument

Make sure that the unit has been calibrated for pH before proceeding. The temperature mode must also be recalibrated if the pH electrode has been changed.

1. Attach the electrode to the meter. Slide the protective plastic sleeve down the electrode sheath to uncover the refill hole during measurements.
2. Switch on the unit. The symbol "pH" will be displayed.
3. Remove the protective cap.
4. Rinse the electrode with deionized water then shake gently to dry.
5. Immerse the electrode in the solution to be tested.
6. Stir and then wait approximately 20 seconds.
7. Read the pH value of the solution. The instrument will automatically compensate for temperature variations.
8. To read the temperature of the solution, press the °C key. The temperature value will appear on the display along with the "°C" symbol.
9. Upon completion of testing, rinse the electrode in deionized water and shake dry. Replace the protective cap containing KCl solution to keep it damp. Slide the plastic sleeve over the refill hole on the electrode.

9. Checking the pH electrode

If the instrument cannot be calibrated by the standard procedure, it is necessary to check the response of the electrode to locate the cause of error. There are two main causes of erroneous response: contamination of the reference and damaged glass.

Immerse the electrode in the 7.00 pH buffer solution. If the electrode can be calibrated to read 7.00 pH but can not be calibrated to 4.01 pH (it usually has a higher value), the electrode has been contaminated. If the instrument can not be calibrated to read 7.00 pH after adjusting the left-hand potentiometer, then the glass has has deteriorated.

Contamination of the electrode: The ceramic junction permits contact with the liquid and prevents the diffusion of the internal electrolyte and the liquid being measured. When the liquid succeeds in penetrating the reference because of deterioration of the junction or high differential pressure between the outside and the inside, contamination results and hence variation in response of the reference electrode. Damage can also be caused to the junction by long-term immersion in highly acid (less than 0.5 pH) or alkaline (pH higher than 13) environments.

Electrode with deteriorated glass: Scratches or liquids containing hydrofluoric acid can damage the special glass, with consequent low response. Scratches can also result when the user takes measurements directly in very abrasive solutions or those containing granules or pebbles.

NOTE: In such cases, contact our Technical Service Department for help in replacing the electrode.

10. Cleaning the electrodes

Before storage, rinse the electrode with tap water, shake it dry and replace the protective cap. Make sure that the cap contains enough KCl solution to cover the end.

If the reference junction is clogged with oil or fatty substances, it may be cleaned by soaking in methanol. Other substances may be removed with dilute hydrochloric acid solution.

11. Warranty

The Cole-Parmer Instrument Company warrants this product to be free from defects in material and workmanship for a period of six months from date of purchase. If repair or adjustment is necessary and has not been the result of abuse or misuse within the six month period, please return—freight prepaid—and correction of the defect will be made without charge.

Out-of-warranty products will be repaired on a charge basis.

12. Return of items

Authorization must be obtained from our Customer Service Department before returning items for any reason. When applying for authorization, please include data regarding the reason the items are to be returned.

For your protection, items must be carefully packed to prevent damage in shipment and insured against possible damage or loss. Cole-Parmer will not be responsible for damage resulting from careless or insufficient packing. A 15% restocking charge will be made on all unauthorized returns.

NOTE: The Cole-Parmer Instrument Company reserves the right to make improvements in design, construction and appearance of our products without notice.

TURBIDIMETER

MODEL 8391-35

MODEL 8391-37

Instruction Manual

Cole
Parmer

Cole-Parmer Instrument Company
7425 North Oak Park Avenue, Chicago, Illinois 60648

WARRANTY

All instruments are fully guaranteed against defective materials and workmanship for one year. Any attempted repair voids the warranty on this instrument.

Turbidimeter

Table of Contents

1.0 INTRODUCTION

The turbidimeter is a nephelometric instrument that quantitates light reflecting particles in solution. The instrument measures the scattered light captured by a photosensor that is located at a 90° angle to the incident light.

The turbidimeter is designed to conform to EPA requirements as described in the "EPA Manual of Methods for Chemical Analysis of Water and Wastes."

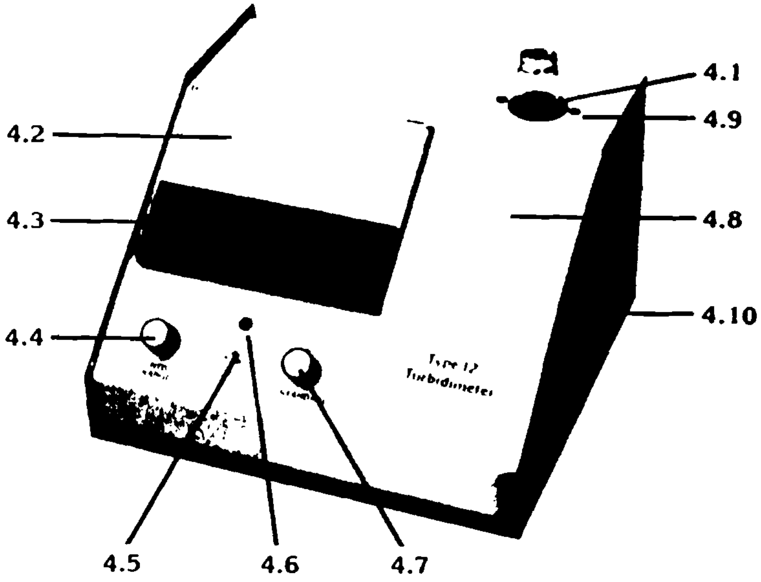
2.0 THEORY

When a liquid contains particulate matter, a beam of light passed through the sample will be scattered in all directions. The amount of light that is scattered can then be directly related to the concentration of the particulate matter. Nephelometry is based upon the measurement of the amount of scattered light detected by a photo cell located at a 90° angle to the incident beam of light. A common application of nephelometric measurement is in the area of drinking water monitoring. The US Congress established drinking water regulations in 1975. One of the key parameters in these regulations is the measurement of turbidity. Because turbidity in water can be be caused by clay, silt, organic matter, bacterial colonies, and plankton, turbid water can pose a significant health hazard. Therefore acceptable drinking water must fall below an established NTU value and water must be monitored daily.

3.0 SPECIFICATIONS

Range:	0-1, 0-10, 0-100 NTU
Accuracy:	±2% Full Scale
Recorder Output:	0-1 Volt Analog
Readout:	6-Inch Analog Meter
Light:	Tungsten
Power:	115 VAC (60 Hz) or 230 VAC (50 Hz/60 Hz)
Size:	10" W x 8.75" D x 6.5" H
Weight:	5 lbs.

4.0 FRONT PANEL



4.1 TEST WELL — one inch diameter test well for sample cuvette or sealed standard.

4.2 ANALOG METER FACE — Sample read-out of turbidity in Nephelometric Turbidity Units (NTU).

4.3 MECHANICAL ZERO — Screw used to adjust the meter needle to zero when the instrument is turned off.

4.4 NTU RANGE — Three position knob used to select proper turbidity range.

Position	Full Scale Range
x 1	0-100 NTU
x .1	0-10 NTU
x .01	0-1 NTU

4.5 ON-OFF — Main instrument power switch.
ON — Full power available to the instrument.
OFF — No power available to the instrument.

4.6 INDICATOR LIGHT — Red LED indicates power is available to the instrument.

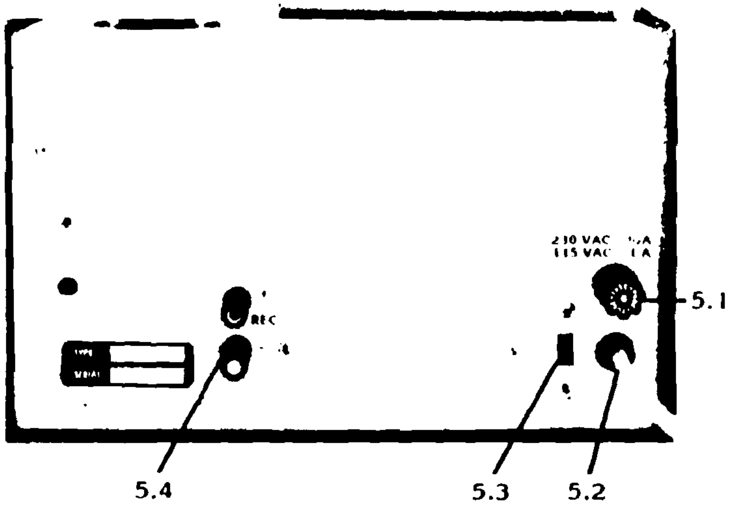
4.7 STANDARD SET — Adjustment knob used for instrument calibration.

4.8 INSTRUCTION PANEL — Brief calibration and operating instructions.

4.9 ALIGNMENT KEY — Key on test well used for sample tube alignment.

4.10 CALIBRATION ADJUSTMENT — Hole in shroud to access internal calibration.

5.0 BACK PANEL



5.1 FUSE — Holder for a replaceable fuse. ½ amp 230 VAC or 1 amp 115 VAC.

5.2 ATTACHED LINE CORD — Three prong plug with attached line cord for use with 115 VAC or 230 VAC outlet.

5.3 SELECTOR SWITCH — For 115 VAC or 230 VAC operation.

5.4 RECORDER OUTPUT + AND −: 0-1 Volt analog output for interface to a chart recorder.

6.0 PRELIMINARY SET-UP

6.1 Remove and inspect carton for the following items:

- a. Turbidimeter
- b. Light Shield
- c. Black Body
- d. Spare Lamp Assembly
- e. Four Sample Cuvettes
- f. Three Standards: .5, 5, 40 NTU
- g. Instruction Manual
- h. Registration and Warranty Card

6.2 Place meter on a flat, stable surface away from vibrations and direct sunlight.

6.3 Make certain the power is off by depressing toggle switch on the front panel toward OFF.

6.4 Select the appropriate line voltage with the switch on the back panel and correct fuse value.

6.5 Plug the line cord into the proper recepticle.

6.6 Turn power on by pushing toggle switch to ON. Red LED will illuminate.

7.0 CUVETTE ALIGNMENT

To eliminate reading errors due to irregularities in the sample cuvette and standard cuvette glass, it is important to establish the correct alignment of each cuvette in the test well. After the cuvettes have been aligned they should be marked with a waterproof pen to insure consistent and reproduceable readings. The procedure for correct alignment follows:

7.1 All cuvette alignment procedures should be performed with light shield to minimize the effect of stray light.

7.2 Determine proper alignment.

- a. Turn instrument on and warm-up for at least 5 minutes.
- b. Fill each clean sample cuvette with tap water.
- c. Clean the cuvettes with a soft, absorbant tissue to remove water drops and finger prints.

d. Place sample cuvette in test well.

e. Turn NTU scale selector switch to the X 1 position.

f. Set pot should be turned fully counter-clockwise.

g. Slowly rotate cuvette 360° in test well and observe meter response. Proper alignment is achieved when the cuvette position produces the lowest meter reading.

h. Mark cuvette with water proof marking pen to correspond to the key on the test well.

8.0 CALIBRATION

8.1 Zero Adjust

a. With the instrument turned off, check the meter needle position. If the needle does not read zero, adjust the mechanical zero screw.

b. Turn on the instrument and allow to warm-up for 5 minutes.

c. Insert the black body into the sample well.

d. Turn the set standard control fully clockwise.

e. Place the NTU range switch to the × .01 position.

f. Adjust the circuit board mounted potentiometer to read zero on the meter (an access hole is marked on the right hand side of the instrument).

Note: An insulated, non magnetized calibration screwdriver is required for both adjustments.

8.2 Do not expect all scales to be calibrated if you only calibrate one NTU scale. You must calibrate each scale with the appropriate NTU value standard. For example, if you calibrate the 0-100 NTU scale with the 40 NTU API Standard, do NOT expect the 0.5 NTU API Standard to register 0.5 NTU on the 0-1 NTU scale. That is why API provides standards for these different scales (0.5, 5, and 40).

Remember sealed standards are NOT primary standards. SEALED STANDARDS ARE REFERENCE STANDARDS AND MUST BE USED IN CONJUNCTION WITH OUR PRIMARY STANDARD TO MEET EPA REQUIREMENTS.

8.3 Calibrations of Secondary Standards

Note: Due to irregularities in glass cuvettes the EPA requires the use of primary standards for calibration. The EPA defines primary standards as an EPA approved standard (Formazin or the commercially available standard from Advanced Polymer Systems) that is read in the same glass cuvette as the sample. This can be very time consuming and expensive. The standards included with the instrument can be used if the following procedure is performed. The EPA defines sealed standards as secondary standards.

a. Choose one sample cuvette for reading all unknown samples. If the chosen sample cuvette is broken or replaced, the following procedure should be repeated for the new sample cuvette.

b. Make the Formazin standard or obtain the standard commercially available from Advanced Polymer Systems. These are the only two standards currently acceptable by the EPA.

c. Set the NTU Range switch to × 1 (0-100 NTU full scale).

d. Pour the 40 NTU Formazin or commercial standard into the chosen sample cuvette. Make certain that the sample cuvette is wiped clean of all dirt and fingerprints. Insert the cuvette into the sample well and align properly. Cover with the light shield.

e. Use the SET STANDARD knob to adjust the meter needle to read exactly 40 NTU.

f. Remove the sample cuvette and insert the 40 NTU standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value. This is the value that should now be used for the 40 NTU sealed standard.

g. Rinse the sample cuvette thoroughly and dry completely inside and out.

h. Fill the sample cuvette with the 5 NTU Formazin or commercial standard. Insert the sample cuvette into the test well. Align the cuvette properly and cover with the light shield.

i. Turn NTU RANGE knob to x .1 (0-10 NTU full scale). Use the SET STANDARD knob to adjust the meter needle to read exactly 50 (actually 5 NTU).

j. Remove the sample cuvette and insert the 5 NTU sealed standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value. This is the value that should now be used for the 5 NTU sealed standard.

k. Rinse the sample cuvette thoroughly and dry completely inside and out.

l. Fill the sample cuvette with the .5 NTU Formazin or commercial standard. Insert the sample cuvette into the test well, align properly and cover with light shield.

m. Turn NTU RANGE knob to x .01 (0-1 NTU full scale). Use the SET STANDARD knob to adjust the meter needle to read exactly 50 (actually .5 NTU).

n. Remove the sample cuvette and insert the .5 NTU sealed standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value. This is the value that should now be used for the NTU sealed standard.

IMPORTANT NOTE: The above procedure should be performed every three months or every time a new sample cuvette is used. Repeated use of both the sample cuvette and sealed standard cuvettes will cause wear and scratches on the glass. This wear will result in a change in the assigned value of the standard. It is important to realize that a change in the assigned value does not necessarily indicate degradation or deterioration of the standard material itself.

9.0 STANDARD OPERATION

9.1 Zero the instrument. When the instrument is off, check the meter needle position. If the needle does not read zero, adjust the mechanical zero screw.

9.2 Turn instrument on and allow 5 minutes to warm-up.

9.3 Choose the proper NTU range and standards for the unknowns to be read. The NTU range chosen should be the minimal range span required to read all unknowns.

NTU RANGE	SPAN (full scale)	STANDARD
x 1	0-100 NTU	40
x .1	0-10 NTU	5
x .01	0-1 NTU	.5

9.4 Calibration of NTU Scale.

a. Turn NTU RANGE knob to the correct position for the chosen range span.

b. Insert the proper standard into the test well. Make certain the standard cuvette is clean and properly aligned. Cover with the light shield.

c. Use the SET STANDARD knob to adjust the meter needle to read the assigned value of the standard.

d. The turbidimeter is now calibrated in the chosen range and ready for use.

9.5 Taking a measurement. All unknowns should be measured using the same sample cuvette. Unknown samples are read by inserting the sample cuvette, properly aligned with the key, into the test well. Cover with the light shield and take the reading off of the correct scale on the meter. Make certain to take the range factor (× 1, × .1, or × .01) into account when calculating the actual NTU value of the sample.

9.6 Possible sources of error. To insure accurate readings it is important to eliminate all possible sources of reading errors:

a. Always make certain that the cuvette being read is properly aligned

b. Never take a reading without the light shield in place.

c. Dirt and fingerprints on the cuvette can cause significant errors in turbidity readings. Make certain that the sample or standard cuvette is clean both inside and out before using. If possible always handle the cuvette by the top portion to avoid fingerprints.

d. Make certain that the sample being measured is free of bubbles and floating debris.

9.7 Highly concentrated samples. Samples with turbidity measurements above 40 NTU should only be used as a gauge of approximate concentration to indicate the amount of dilution required.

10.0 TROUBLESHOOTING

10.1 **Symptom** — Meter exhibits no response
ACTION

a. Check power to meter: Meter not plugged in, power not turned on, fuse burned out.

10.3 The lamp filament coil should be seen centered in the viewing tube.

10.4 If the filament is not near center, or not visible at all, it is necessary to readjust the lamp.

10.5 Turn the instrument off.

Note: 115/230 AC voltage near lamp adjustment. Use caution.

10.6 Remove the outer shroud by unscrewing the four rubber feet on the bottom of the instrument.

Note: Two adjustments are used to align the lamp. Horizontal — adjust to center the filament. Vertical — adjust to focus the filament.

10.7 Loosen the thumb screws holding the lamp plate to the vertical support bracket.

10.8 Turn the instrument on.

10.9 Adjust the lamp plate to center the filament in the viewing tube.

10.10 Turn the instrument off.

10.11 Tighten thumb screws to secure lamp plate.

10.12 Loosen screws securing vertical support brackets.

10.13 Turn the instrument on.

10.14 Hold a paper or cardboard horizontally approximately one foot over the test well. When in focus, the filament coil will be visible on the paper.

10.15 Adjust the lamp bracket as necessary.

10.16 Turn the instrument off.

10.17 Tighten the vertical support bracket screws.

10.18 Replace the outside shroud and secure with rubber feet.

11.0 TROUBLESHOOTING

11.1 Symptom — Meter exhibits no response
ACTION

a. Check power to meter: Meter not plugged in, power not turned on, fuse burned out.
CONCLUSION — If meter power seems to be present, continue.

b. Check tungsten lamp.
CAUTION — Do not look directly at the lamp. To check the lamp, look for the presence of the light beam on the side of the test well.
CONCLUSION — If the bulb is not on when the meter is on, the bulb needs to be replaced.

If the bulb appears to be working properly, the meter needs to be serviced to determine the source of the problem.

11.2 **Symptom** — Unable to calibrate or obtain full meter deflection

ACTION

a. Check the standard tube for damage. Scratches or wear on the standard tube can cause significant errors. Replace standard if necessary.

b. Check the standard for deterioration, mold growth, or other signs of obvious contamination. If any contamination is suspected, replace the standard.

c. Clean the focusing lens. Dirt or debris on the focusing lens can interfere with the light source. Clean the focusing lens with lens paper or a lens cloth.

d. Check for low supply voltage. Have an electrician or other qualified person check the line voltage. The line voltage should be between 105 VAC and 125 VAC for 115 VAC operation, and between 215 VAC and 250 VAC for 230 VAC operation. Insufficient power to the instrument can cause faulty meter function.

CONCLUSION — If none of the above procedures can solve the problem, the meter needs to be serviced.

11.3 **Symptom** — Meter exhibits no response when the NTU RANGE switch is changed.

ACTION

a. Meter needs to be serviced.

12.0 PARTS LIST

The following parts can be ordered individually to aid in maintenance and repair. For price, please call your supplier.

Part #	Description
650-1050-01	Meter, NTU
713-3500-00	Fuse, ½ Amp
713-3131-00	Fuse, 1 Amp
600-0060-21	Board, Subassy T12
670-0111-00	OP/AMP, High Input Impedance
662-5076-00	Photodiode
1001	T12 Calibration Accessory
1002	Lamp Assembly
1003	Sample Cell, 4/pkg
830-6093-00	Cuvette, 8 Dram, 25 x 95 mm
175-1200-03	Manual T12
1008	Sealed Std., 3/set (0.5, 5.0, 40)
300-0015-00	0.5 NTU Standard
300-1050-00	5.0 NTU Standard
300-1040-00	40 NTU Standard

CORRECTION NOTICE
Turbidimeter Instruction Manual
April 14, 1987

I. Lamp Adjustment Procedure

The position of the lamp with respect to the lens is very critical. A plastic tube is included with the turbidimeter to allow you to check the relative position of the lamp. Proceed as follows:

1. Turn the instrument on.
2. Position the plastic viewing tube in the test well with the blue lens on top.
3. The lamp filament coil should be seen centered in the viewing tube.
4. If the filament is not near center, or not visible at all, it is necessary to readjust the lamp.
5. Turn the instrument off.

NOTE: 115/230 AC voltage near lamp adjustment. Use caution.

6. Remove the outer shroud by unscrewing the four rubber feet on the bottom of the instrument.

NOTE: Two adjustments are used to align the lamp.
Horizontal - adjust to center the filament
Vertical - adjust to focus the filament

7. Loosen the thumb screws holding the lamp plate to the vertical support bracket.
8. Turn the instrument on.
9. Adjust the lamp plate to center the filament in the viewing tube.
10. Turn the instrument off.
11. Tighten thumb screws to secure lamp plate.
12. Loosen screws securing vertical support brackets.
13. Turn the instrument on.
14. Hold a paper or cardboard horizontally approximately one foot over the test well. When in focus, the filament coil will be visible on the paper.
15. Adjust the lamp bracket as necessary.
16. Turn the instrument off.
17. Tighten the vertical support bracket screws.
18. Replace the outside shroud and secure with rubber feet.

II. Parts list.

Bulb, frosted T12 P/N 652-1142-10, replaced with lamp assembly P/N 1002

III. The cell riser is not necessary and all references to it should be disregarded.

Neotronics N.A. Inc.,
P.O. Box 370
2144 Hilton Drive S.W.
Gainesville, Georgia 30601
Tel: 404 - 536 - 0600

Pat. Nos. 8034110; 1,497,867; 50583/75 (JAP); P2518364.4 (D); 1,477,334; 4020480 (US); 149,625 (US); 1,646,672; 1,600,618.
Pat. Applied for: 80.16848; 82.26139

059 - 0017 - 02
LIST NO. EX 4C

Distributor

1982

Neotronics

BASEEFA CERTIFICATE No. EX 84254X

EXOTOX™

PORTABLE MULTI — GAS MONITOR

Model 40
USER MANUAL

EXOTOX Models Available

EXOTOX Model 20 Series
Go/No-Go instruments for the detection of the following combinations of gases with alarm lights and audible alarms:

Model Code	Gases Monitored
20-OFH	Oxygen, Flammable Gases and Hydrogen Sulfide (H_2S)
20-OFC	Oxygen, Flammable Gases and Carbon Monoxide (CO)
20-OF	Oxygen and Flammable Gases
20-F	Flammable Gases only

EXOTOX Model 40 Series
With Liquid Crystal Display digital readout and alarm light and audible alarms:

Model Code	Gases Measured
40-OFH	Oxygen, Flammable Gases and Hydrogen Sulfide (H_2S)
40-OFC	Oxygen, Flammable Gases and Carbon Monoxide (CO)
40-OF	Oxygen and Flammable Gases
40-F	Flammable Gas only

EXOTOX Model 50 Series
Four Gas instrument with Liquid Crystal Display digital readout, Toxic Gas LED's, alarm LED's and audible alarms:

Model Code	Gases Measured
50-OFCH	Oxygen, Flammable Gases, Carbon Monoxide (CO) and Hydrogen Sulfide (H_2S)

WARNING

ALWAYS SWITCH THE EXOTOX OFF BEFORE REMOVING THE BATTERY PACK.

NOTE: For users of EXOTOX Models 20-OF/20-F/40-OF/40-F. Please ingnore sections referring to Oxygen and or Toxic Gas Monitoring as these sections are only relevant to triple Gas Instruments (OFH & OFC).

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CHAPTER 2 THE EXOTOX BATTERY PACK

CHAPTER 3 SUGGESTED ON SITE PROCEDURES

CHAPTER 4 GENERAL MAINTENANCE

CHAPTER 5 THE SENSORS

CHAPTER 6 ACCESSORIES

CHAPTER 7 RECORDS

LIST OF ILLUSTRATIONS

CHAPTER 1 THE MONITOR

1.1 How to use the EXOTOX Model 40

Switch on EXOTOX by firmly pressing button marked Power and On Off ('A' in Figure 1). The EXOTOX will automatically run through a self test sequence, flashing all LCD legends with audible and visual alarms operating for 6 seconds.

Following this automatic test, the EXOTOX will go into the Oxygen measurement mode and display digitally, real time percentage Oxygen. Consecutive operation of the 'Select' button ('B' on Figure 1) will display Toxic gas in parts per million (ppm), Time Weighted Average (TWA) to date, 'Hr (hours) time elapsed from switch on in decimal hours, and Explosive gas in percentage LEL LFL (Lower Explosive Limit Lower Flammable Limit). This sequence must always be completed before instrument is used to ensure correct calibration. The displays should read approximately 20 9% Oxygen, 0 ppm Toxic gas, 0 ppm TWA 0 0'Hr and 0% LEL (LFL) Explosive gas, in fresh air. Should the display read significantly different from these recommended figures check calibration as explained in Chapter 5.

1.2 The Operating Signal

Normally operating instruments will continue to emit a short audible bleep every ten seconds and flash the visual alarm lamp as indication that it is functioning correctly. **IF THE EXOTOX DOES NOT PRODUCE THE REGULAR OPERATING SIGNAL, THE INSTRUMENT SHOULD NOT BE USED**

1 3 Gas Testing Modes

Flammable gas, Oxygen and Toxic gas levels are monitored continuously on the Model 40 OFH and 40 OFC, and can be digitally displayed by pressing the 'Select' button, in sequence.

The user can select 5 different readouts

1 Real Time Oxygen 0 35%

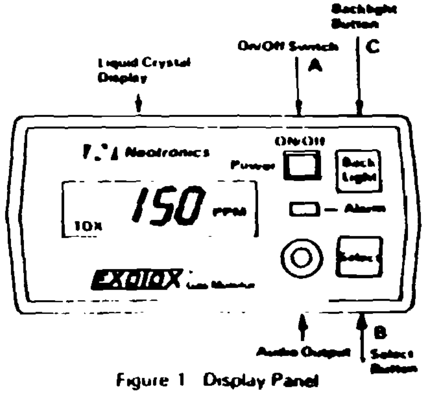


Figure 1 Display Panel

2. Real Time Toxic Gas 0 999 ppm CO, 0 500 ppm H_2S
3. Time Weighted Average (TWA) of Toxic Gas in ppm (see Technical Specifications for details).
4. Decimal hour (i.e. 0 1/Hr 6 minutes) representing how long the EXOTOX has been on, and therefore the basis for the TWA. 'Hr.' and decimal hours flash alternately.
5. Real Time percentage LEL (LFL) of explosive gas 0 99%

1.4 The LCD Backlight

The EXOTOX has a backlight facility to illuminate the LCD in low ambient light levels. To operate, press the 'Back Light' button ('C' on Figure 1) while reading the display The back light only operates while button is depressed.

1.5 Flammable Gas Sensor Fault Alarm

Should a fault condition occur with the Explosive Gas Sensor, the EXOTOX will give a continuous audible alarm, read 'Flt' on the LCD with a side legend of 'EXP' and illuminate the red 'Alarm' light. Under these circumstances the instrument must **not** be used.

1.6 Low Battery Alarms

The EXOTOX 40 has a two stage low battery indication. The first warning that the batteries are getting low is given by the flashing side legend 'BAT' on the digital display When this occurs, there is approximately 1 hour of battery life left. The second warning is an audible continuous tone and a blank digital display except for the side legend 'BAT' which indicates final battery discharge. Fit a fully charged, stand by battery pack or charge instrument complete with battery pack in accordance with Chapter 2

Completely discharged batteries will have insufficent power to operate display To confirm this is the problem, charge instrument for a few minutes and then re check.

N.B. For standard alarm settings of gases being monitored, see 'Technical Specifications' at back of manual.

1.7 Overrange Indication

If the EXOTOX is exposed to levels of gas exceeding the instruments readout, (see section 1 3 for ranges) the following will be displayed

Flammable Gas	'EEE'.
Oxygen	'OFL'.
Toxic	'OFL'

The display will return to normal when the high gas concentration is removed but the EXOTOX will need to be reset (switch off and on again) to cancel audible alarm.

CHAPTER 2 THE BATTERY

2 1 Removing the Battery Pack

All EXOTOX monitors are supplied complete with a battery pack connected to the instrument The battery pack may be charged when still connected to the monitor, or may be charged independently To disconnect the battery pack from the monitor the following procedure must be used (see Figure 2)

2 1 1 Unscrew self retaining lock screw 'A' on monitor using allen key provided (2 5mm A F)

2 1 2 Rotate the battery pack through 90° in the direction of arrow 'B' and pull away from monitor

Before reconnecting battery pack ensure that the contacts on both battery pack and monitor are clean, only clean cloth or paper wipes may be used **UNDER NO CIRCUMSTANCES MAY ABRASIVE CLEANING MATERIAL BE USED AS THIS WILL DAMAGE THE GOLD PLATING OF THE CONTACTS**.

To reconnect battery pack reverse the procedure for disconnection and ensure that the keyway 'C' on the monitor engages positively with the key slot in the top of the battery pack

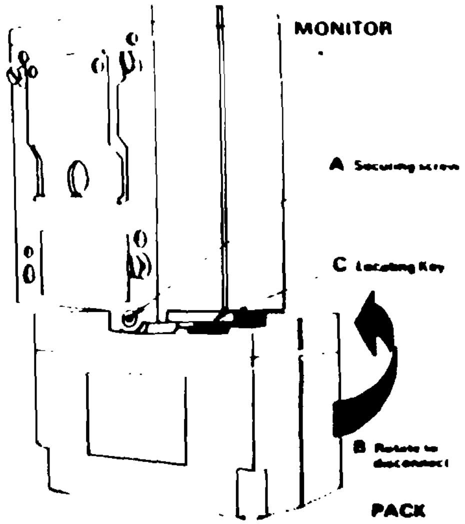


Figure 2 Connecting Battery Pack

2.2 Battery Pack Contacts

The contacts on the top of the pack are slightly recessed to prevent accidental discharge if placed in contact with a metal surface, although care should be taken to ensure that accidental shorting of these contacts does not occur when the battery pack is separated from the monitor. The recharging contacts at the base of the battery pack are electrically protected to ensure that the battery pack cannot be discharged through these contacts. This ensures that if the instrument or battery pack is stood on a wet surface, or if accidentally immersed, no discharge of the battery can occur through these contacts.

2.3 Charging the Battery

To ensure that the correct charge conditions are applied to the battery pack, only a Neotronics approved battery charger may be used. The Neotronics EXOTOX battery charger is designed to prevent battery damage due to overcharging. Before inserting the battery pack (with or without the monitor attached) ensure that the electrical contacts on the base of the battery pack are clean. **UNDER NO CIRCUMSTANCES MAY ANY ABRASIVE CLEANING MATERIAL BE USED.**

The battery pack may only be connected to the charger in the position indicated in Figure 3. Moulded in locators ensure correct orientation.

Press the battery pack, or complete monitor, into the charging recess on the battery charger; the weight of battery pack, or monitor, will ensure sufficient contact pressure. As soon as contact is made the red 'FAST' charge light on the battery charger will illuminate. If light does not illuminate ensure charger and battery contacts are clean and firmly press pack into charger.

The battery will be fully recharged from a discharged condition within five hours. Each hour of fast charge will provide about two hours of monitor use.

A built-in detection circuit automatically switches the charger to a 'SLOW' charge condition when sufficient charge has been given to the battery the red 'Fast' charge ligh automatically switches to a green 'Slow' charge light. The battery may be left on this charge for an indefinite period.

It is recommended that the battery pack is fully discharged at regular intervals, by leaving the monitor on until the low battery alarm sounds.

The monitor should then be fully recharged as per the above procedure. This will help in overcoming problems associated with Ni Cad battery charge/discharge memory patterns, which can reduce the charge capacity of the battery. To enable a precise check to be kept on battery pack performance, a record should be kept as illustrated at the back of this manual.

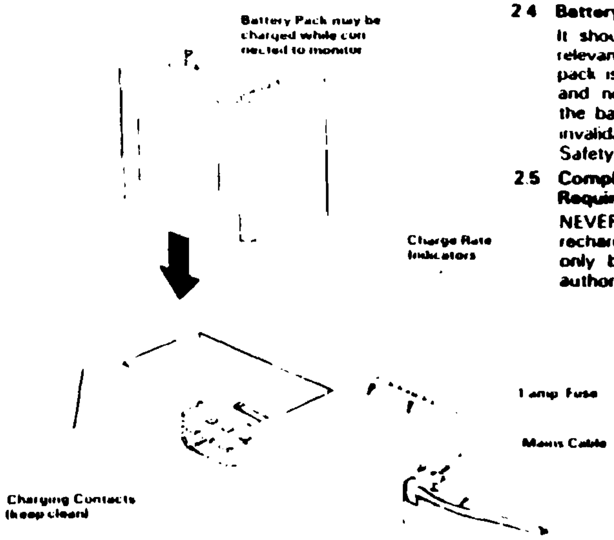


Figure 3 Single Way Battery Charger

2.4 Battery Replacement

It should be noted that, to comply with the relevant Intrinsic Safety standards, the battery pack is a sealed and encapsulated component and no attempt should be made to remove the batteries from the pack. Such action will invalidate the Neotronics guarantee and Intrinsic Safety certification.

2.5 Compliance with Intrinsic Safety Requirements

NEVER **allow battery packs to be charged or recharged in hazardous atmospheres. This must only be carried out in safe atmospheres by authorised personnel.**

CHAPTER 3 SUGGESTED ON-SITE PROCEDURES

3.1 Procedure prior to confined entry space

3.1.1 Check that the EXOTOX is fit for use.

3.1.2 Switch on monitor

3.1.3 Ensure that any hand line being used is securely attached to the monitor harness or belt clip. Use handline to lower EXOTOX into working space

3.1.4 Lift access covers to assist with the ventilation of the work space, prior to entry.

3.1.5 Ensure the means of access and escape are secure and fit for use in normal conditions.

3.1.6 Lower the monitor into the work space, checking where necessary, various levels. The correct time (5 MINUTES) must be allowed at each check point to ensure that monitor carried out a complete sensing cycle, and responds to all possible gas dangers.

3.1.7 Using the hand line, withdraw the monitor from the work space and observe any alarm indication. If no audible or visual alarm is operating the indication is that the work space is free of those gas hazards that the monitor is designed to measure

3.1.8 If alarm indication occurs, the work space should not be entered under any circumstances. Refer to your Work Supervisor for further instructions

Figure 4 How the EXOTOX should be Worn

3.1.9 If no alarm is indicated remove the EXOTOX from the hand - line and wear the monitor near the breathing zone (see Figure 4) prior to entry of work space.

3.2 Procedure While Working

Under most working conditions the monitor should be carried on the person at all times. The EXOTOX is designed specifically for personal monitoring, and working away from the monitor may lead to an alarm indication being unnoticed due, for example, to high noise levels in the working area. The size and weight of the monitor enable it to be carried comfortably for long periods without operator fatigue.

When carried, both audible and visual alarm conditions and LCD, are easily observed. In high noise environments encountered around pumps, or with fast flow conditions, use the accoustic earphone. This gives additional safeguard. If at any time while working within the confined space the monitor gives an alarm indication, for whatever reason, the confined space **MUST BE EVACUATED IMMEDIATELY**.

Point to Note

If, during the initial atmosphere testing prior to entry the monitor alarms, it must be withdrawn immediately. If upon examination, it indicates a hazardous atmosphere:

1 Switch off the monitor to re set the alarm condition.

2 Switch the monitor on.

3 Allow the monitor to auto check and then replace into the work space.

4 If the monitor again alarms and indicates a hazardous atmosphere, switch off the monitor and follow your local operating procedures for such conditions.

CHAPTER 4 GENERAL MAINTENANCE

4.1 The Outer Case

The outer casing of the monitor is moulded in heavy duty plastic and only requires wiping down with a clean damp cloth or paper No solvents or other proprietary cleaners should be used, as these may damage the moulding material.

4.2 The Grill

Check that the grill covering the sensors, on the front of the monitor, is clean and free from obstruction at all times

4.3 The Straps

Check that all carrying straps and attachment points are clean, undamaged and fit for use

4.4 Storage

When not in use, monitors should be stored in a cool dry room on racks or hung by their carrying straps or belt clip Alternatively, monitors may be kept on charge when not in use

TABLE 1: CHARACTERISTICS OF TYPICAL GASES AND VAPOURS
(FOR OTHERS NOT LISTED CONSULT OUR TECHNICAL ADVISORY SERVICE)

FLAMMABLE SUBSTANCE	STANDARD SENSITIVITY % LEL	 VOL %	SPECIFIC GRAVITY OF GAS AT 20°C
ACETIC ACID	36.8	2.00	2.10
ACETONE	38.6	1.00	2.03
ACETYLENE	35.2	0.88	0.91
AIR			1.00
AMMONIA	15.80	2.53	0.59
BENZENE	40.00	0.64	2.73
n BUTANE	34.0	0.65	2.03
n DECANE	61.0	0.49	4.97
DIPHENYL	80.0	0.48	1.33
ETHYL ALCOHOL	27.4	0.90	1.61
ETHYLENOXIDE	38.6	1.16	1.54
n HEPTANE	51.8	0.52	3.50
HYDROGEN	26.0	1.04	0.07
METHANE (Natural Gas)	20.0	1.06	0.56
METHYL ALCOHOL	23.2	1.69	1.12
PROPANE	36.2	0.80	1.54
TOLUENE	49.4	0.82	3.22
TRIMETHYLAMINE	41.7	0.82	2.08
XYLENE	61.0	0.56	3.70

For Model 40 EXOTOX Gas Monitor with Standard Calibration (20% Methane in Air)

CHAPTER 5 THE SENSORS

CALIBRATION USING THE NEOTRONICS CALIBRATION KIT

5.1 Preparation of Calibration Kit

Select the gas bottle required for the test

Check that the bottle contains adequate gas pressure

Connect tubing from the flow meter input to the gas bottle regulator

Connect the flow meter output to the Calibration Aspirator Hood Port which will be nearest to the sensor under test. Depress the button on top of the Gas Bottle Regulator and ensure that the flow meter indicates 250 to 300 cm³/minute. Keep the button depressed for 10 seconds to purge the system

Remove the Sensor Grill from the EXOTOX

Attach the Calibration Aspirator Hood to the instrument

ONLY ATTEMPT CALIBRATION OUTSIDE OR IN A WELL VENTILATED ENVIRONMENT.

The equipment is now set up for calibration of the EXOTOX.

5.2 Explosvie Gas Calibration Check (All Models)

To check the calibration of the flammable gas detection element use the Neotronics' standard calibration gas mixture of 1.15% Methane in Air with the following procedure

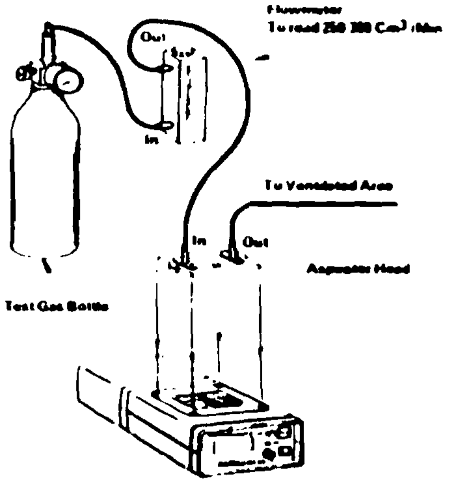


Figure 5 Calibration Kit Connection

5.2.1 Connect Calibration Kit as detailed in procedure 5.1.
Switch the EXOTOX ON and select Explosive display mode.

5.2.2 Depress the button on top of the Gas Bottle Regulator until either the EXOTOX goes into alarm condition (Audible, Display 'EXP' & 30%) or the maximum time limit is exceeded. The time limits for various models are listed in Figure 8. The time is measured from the depression of the button. If the results from this test fall outside those detailed in figure 8, the EXOTOX requires recalibration (procedure 5.3).

5.3 Explosive Gas Calibration Adjustment (All Models)

Only authorised, qualified personnel should attempt recalibration using the following procedure. Under no circumstances should unauthorised access to the calibration controls be allowed

5 3.1 **(Zero Adjusment)**
Remove the sensor grill using a 2m Hexagonal Wrench (Allen Key)

5.3.2 Switch EXOTOX ON and select the Explosive Gas Display Mode.

5.3.3 With the monitor in a Flammable Gas Free Environment (Fresh Air), slowly adjust the 'Explosive Zero' potentiometer (Figure 7 'G') until a reading of zero percent is achieved on the display.

5 3 4 (Span Adjustment)
NOTE: The type of gas used to calibrate the Explosive Span should be a mixture of between 1 & 1.5% of Methane in Air (20 to 30% LEL) The EXOTOX displays the Methane concentration in its LEL form For the purpose of calibration, the LEL is calculated as follows:

% LEL value of gas = % age concentration by volume × 20

5 3.5 Connect the Calibration Kit as detailed in procedure 5.1.

5 3 6 Depress the button on top of the Gas Bottle Regulator for 1 minute and then slowly adjust the 'Exp Span' potentiometer (Figure 7 'H') until the display reads the figure calculated above ± 1% LEL Turn OFF the gas

5.3 7 Allow the EXOTOX to settle for 15 minutes and then recheck the zero This may have changed during the calibration process If necessary, repeat procedure 5 3 3.
Replace the sensor grill

5.4 Oxygen Sensor Replacement and Recalibration (Models OF, OFH & OFC)

The low Oxygen alarm in the EXOTOX is set to activate at a concentration of 19% Oxygen in Air by Volume (19.5% U S)

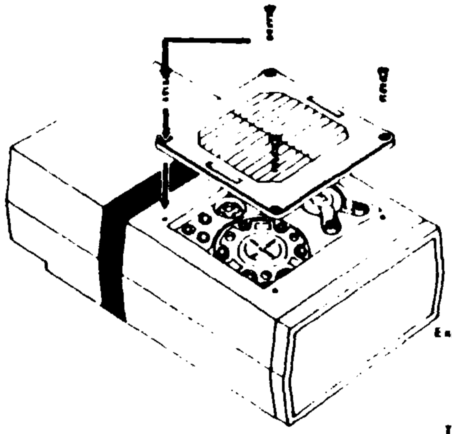


Figure 6 Sensor Grill
Removal and Replacement

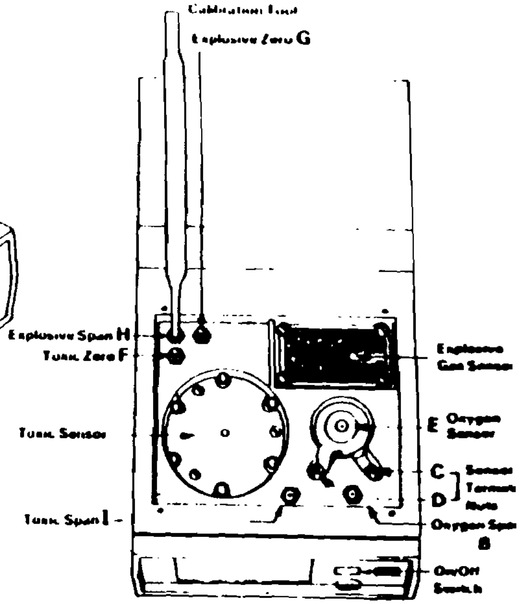


Figure 7 Calibration Controls

The response of this alarm may be checked simply using exhaled breath which, at a normal breathing rate, contains about 17% Oxygen by Volume.

At a constant temperature, the Oxygen sensor in the EXOTOX will remain stable Ambient temperature changes of ± 10 degrees centigrade will cause small changes on the display (typically ± 0 4% Oxygen) If the EXOTOX is to be used consistently at temperatures other than normal surface ambient conditions, it is recommended that the monitor be recalibrated for 20 9% Oxygen in conditions equivalent to the workplace

Recalibration may be achieved as follows:

5 4 1 Remove the sensor grill.

Ensure that the monitor is in a 'Fresh Air type environment Slowly adjust the Oxygen span control (Figure 7 'B') until the display indicates 20 9%. **NOTE**: Make sure that no exhaled breath enters the sensor chamber during this procedure

5 4.2 If an indication of 20 9% cannot be obtained, the sensor needs replacement

5 4 3 The Oxygen Sensor (Figure 7 'E') can be easily replaced by the removal of the two castle nuts (Figure 7 'C' & 'D') The new sensor is again secured firmly in place by the castle nuts and washers

5 4.4 After the sensor has been allowed a five minute settling in period (with the EXOTOX's power OFF), procedure step 5 4 1 must be carried out.

5 4.6 A 'HI' or 'LO' Oxygen display after a normal instrument power on and auto check cycle, indicates that the calibration is substantially incorrect

5 5 Toxic Gas Zero Adjustment (Models OFH & OFC)

5 5 1 Switch the EXOTOX ON in a Toxic Gas Free Environment (Fresh Air) and select the Toxic Gas Display.

5 5 2 Slowly adjust the Toxic Zero' potentiometer ('F' in Figure 7) until the digital display reads zero ppm TOX.

5.6 Toxic Gas Alarm Check (Models OFH & OFC)

5 6 1 Connect Calibration Kit as detailed in procedure 5.1

The Standard Gas to be used should be selected from Figure 8.

5 6 2 Depress the button on top of the Gas Bottle Regulator until the EXOTOX goes into alarm or the maximum time limit is exceeded The time limits for various EXOTOX models are detailed in Figure 8 The time is measured from the depression of the button If the results from this test falls outside those detailed in Figure 8, the EXOTOX requires recalibration

5.7 Toxic Gas Sensor Recalibration (Models OFH & OFC)

Only authorised, qualified personnel should attempt recalibration using the following procedure. Under no circumstances should unauthorised access to calibration controls be allowed

5.7 1 Ensure that the toxic sensor zero is correctly set using procedure 5 5

5.7.2 Connect the Calibration Kit as detailed in procedure 5 1

The calibration test gases used for different models are detailed in Figures 9 & 10.

5.7.3 Depress the button on top of the Gas Bottle Regulator and keep it depressed for 10 minutes (for H_2S and 5 minutes for CO) Slowly adjust the 'Tox Span' potentiometer (Figure 7 'I') for a display indication the same as the concentration quoted by the Gas Bottle Manufacturer ± 1%.

5 7 4 Release the button and turn the regulator OFF Disconnect the aspirator head and replace the sensor grill.

Allow the EXOTOX to settle for 15 minutes and then recheck the Toxic Zero as this may have changed slightly during the calibration process If necessary, repeat procedure 5 5

5 8 Sensor Warranty

The Toxic Sensors for H_2S and CO have a twelve month warranty They can be expected to provide sensing for a period of two years of normal instrument use

Explosive gas sensors (Pellistors) also have twelve month warranty and can be expected t provide sensing for 3 years of normal instrument operation

Oxygen Sensors have a six month warranty and can be expected to operate satisfactory fo 9 months of normal instrument use.

FIGURE 8: EXOTOX ALARM REACTION TIMES

Model	Gas Mixture	Minimum Toxic Alarm Time	Minimum Exp' Alarm Time	Maximum Alarm Time
EXOTOX 20 MkII OFH	65–75 ppm H_2S	30 seconds		90 seconds
	1% Methane (20% LEL)		30 seconds	90 seconds
EXOTOX 20 MkII OFC	550–600 ppm CO	15 seconds		45 seconds
	1% Methane (20% LEL)		30 seconds	90 seconds
EXOTOX 40 MkII OFH	65–75 ppm H_2S	30 seconds		90 seconds
	1.15% Methane (23% LEL)		30 seconds	90 seconds
EXOTOX 40 MkII OFC	550–600 ppm CO	15 seconds		45 seconds
	1.15% Methane (23% LEL)		30 seconds	90 seconds
EXOTOX 20 MkII OF & F	1% Methane (20% LEL)		30 seconds	90 seconds
EXOTOX 40 MkII OF & F	1.15% Methane (23% LEL)		30 seconds	90 seconds

Note All monitors shown above are 20% LEL models. Models with different Explosive Alarm point are calibrated with different test gas mixtures. If in doubt, contact the Neotronics Service Department or your national distributor for further details.

FIGURE 9: STANDARD GASES FOR HYDROGEN SULPHIDE CALIBRATION

Alarm Point (PPM)	Gas Mixture to be Applied (PPM)
50	60–70
100	115–125

FIGURE 10: STANDARD GASES FOR CARBON MONOXIDE CALIBRATION

Alarm Point (PPM)	Gas Mixture to be Applied (PPM)
50	65–75
100	130–150
300	340–360
400	440–480
500	550–600

CHAPTER 6 ACCESSORIES

6.1 The Acoustic Earphone

This is for use when monitor is being operated in high background noise conditions, such as are found in pumping station sumps, wet wells or in conditions of fast flow. The ear piece is retained in place by a plastic loop, which may be reversed for use in either ear. The rubber connector at the end of the hose is inserted into position on the monitor as shown in Figure 8.

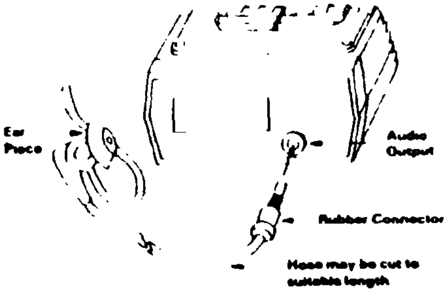


Figure 11 Earphone Connection

The connecting hose may, if necessary, be shortened to suit individual wearer need.

For reasons of hygiene, each user of the EXOTOX should have his own earphone. If re-issuing an earphone to a new user, ensure that it is cleaned and sterilized in a suitable sterilizing medium such as domestic disinfectant and a new replaceable earpiece fitted (see list of accessories)

6.2 The Hand Aspirator

This attachment enables work space atmospheres to be sampled without the necessity of exposing the whole monitor to the working environment.

This attachment should be used if service ducts, surface trenches, supply pipes, etc., require gas testing.

6.2.1 Remove aspirator grill attachment, aspirator bulb and rubber hosing from case, and snap the two mounting tongues into recess on the monitor grill (see Figure 12). Ensure that the aspirator hose is on the left side of the monitor (viewed from the display end).

6.2.2 Pump the aspirator three times in fresh air to ensure that the aspirator and sensor housing are free from retained gas. Check that the in-line filter is not obstructed; this is indicated by a slow return to normal shape after depressing the aspirator bulb. Replace with recommended type (see Accessories List).

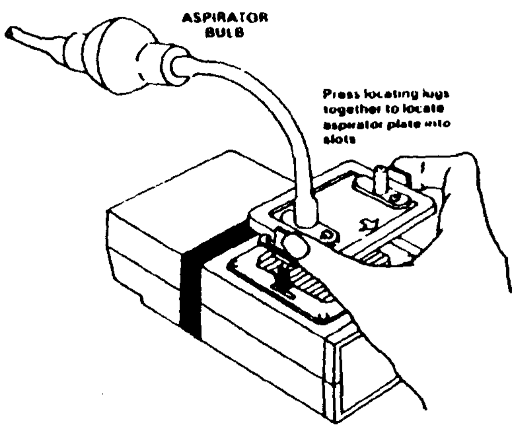


Figure 12 Aspirator Attachment

6.2.3 Always ensure that the end of the sampling hose, when inserted into the work space, is not in contact with standing liquids or solid deposits which could be accidentally drawn into the sampling hose

6.3 List of Accessories

300 0185 00	Earphone Extension
325 0347 00	10 Earpiece Replacements
300 0186 00	Aspirator Attachment
035 0020 00	Carrying Case for Aspirator Attachment
138 0014 00	Oxygen Sensor
138 0010 01	Hydrogen Sulphide Sensor
138 0009 01	Carbon Monoxide Sensor
080 0001 00	Calibration test Gas (1.5% Methane in Air)
325 0346 00	Ni Cad Battery Pack
300 0187 00	Replacement Harness
300 0184 00	Single Way Battery Charger
300 0184 01	4 Way Battery Charger
085 0005 00	Calibration Tool
085 0006 01	Pkt 10 2.5mm A/F Hexagonal Wrench/Allen Keys
085 0002 01	Pkt 10 2.0mm A/F Hexagonal Wrench/Allen Keys
300 0128 00	Box 100 Filters for Aspirator Attachment
059 0017 01	EXOTOX Model 40 User Manual
059 0018 01	EXOTOX Model 40 User Card
059 0017 02	EXOTOX Model 40 User Manual (USA)
059 0018 05	EXOTOX Model 40 User Card (USA)

CHAPTER 7 RECORD

7.1 Keeping a Log for each Instrument

Records should be kept of each monitor and battery pack. This will ensure that correct information is recorded concerning sensor and battery life, and will further ensure that periodic checks of the monitor's performance have be carried out

Two suggested monitor log sheets are illustra below.

INSTRUMENT SERIAL NUMBER		DATE OF PURCHASE	
SENSOR SERIAL NUMBER	SENSOR TYPE	DATE FITTED	DATE FAILED

BATTERY PACK			
BATTERY PACK SERIAL NO	DATE FITTED	DATE FAILED	COMMENTS

Summary of Technical Specification

BASEEFA CERTIFICATE NO. EX 84254X

Dimensions:
48mm × 98mm × 178mm (1 9″ × 3.9″ × 7 0″)

Weight:
1.1Kg (2.4lb).

Battery Capacity:
10 hours minimum with charged batteries

Operating Temperature:
- 15° to 40°C (5°F to 104°F)

Storage Temperature:
- 20° C to 45°C (- 4°F to 113°F)

Humidity:
0 to 99%, Non-condensing

LCD readout:
Percentage Oxygen: 0 35 0
Parts per million Toxic: H_2S 0 500, CO: 0-999
TWA at elapsed time
Elapsed time from instrument switch-on alternately displaying – 'Hr' (hour) and decimal hours. 0 99 9 Hrs
Percentage LEL (LFL) Explosive Gas: 0-99

Notes

Standard Alarm Settings

Oxygen:
19.5% Deficiency
23% Excess

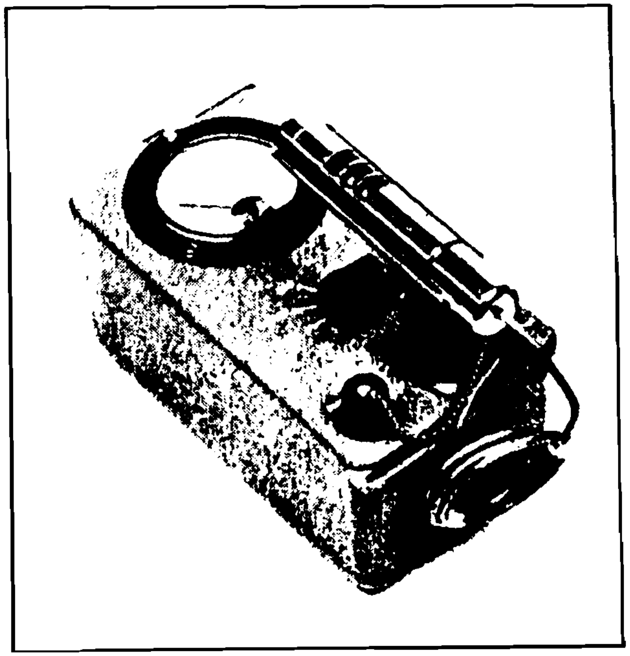
Toxic Gas:
8 hours Personal Exposure Limit
Excursion Limit
Additionally, Ceiling Limit is given

Flammable Gas:
20% Lower Explosive Limit of Methane in Air or equivalent

INSTRUCTION MANUAL

Survey Meter

Model 05-700



NUCLEAR ASSOCIATES

VICTOREEN

A Division of VICTOREEN, INC
100 VOICE ROAD
CARLE PLACE, NY 11514-1593

A Subsidiary of Sheller-Globe SG

Repairs (516) 741-2842 • Sales (516) 741-6360

.2-484 05-700

USER CAUTION

If this instrument is intended for the detection and measurement of ionizing radiation, it should be used only by persons who have been trained in the proper interpretation of its readings and the appropriate safety procedures to be followed in the presence of radiation.

All Instructions and warnings contained in this manual or on the instrument must be read before use and must be strictly followed. Failure to follow these instructions and warnings may result in inaccurate readings and/or user hazard. Battery and other operational checks must be performed prior to each use to assure that the instrument is functioning properly.

READ YOUR INSTRUCTION MANUAL

Table of Contents

I GENERAL DESCRIPTION

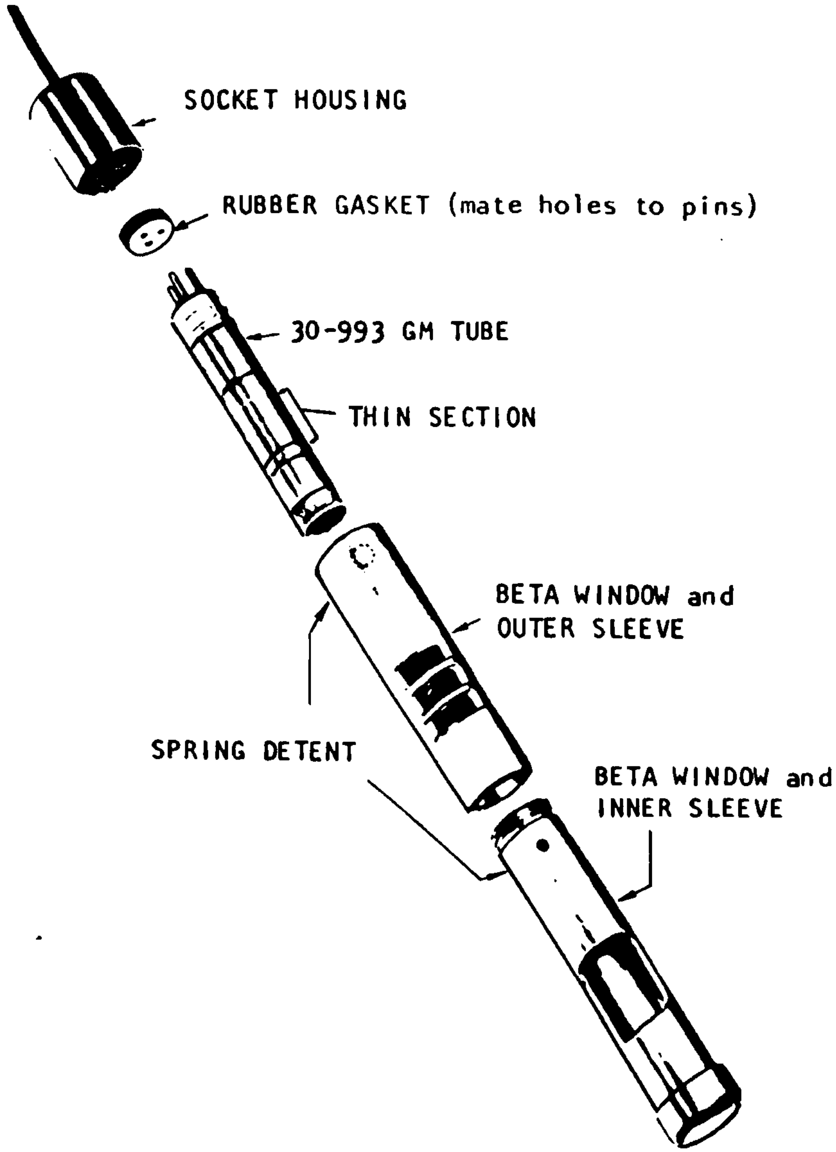
A. Introduction

The 05-700 Survey Meter is a beta-gamma type with a side-window GM probe. The radiation count rate is indicated by a 3-range meter, graduated from 0 to 50 mR/hr and from 0 to 30,000 cpm. Audio indication is by clicking sounds via an optional headphone attachment. One knob turns on the instrument and selects the proper range.

B. Probe

The probe consists of a side-wall, halogen-quenched GM tube (Model 30-993) located in a holder with a rotating metal shield. When the shield is closed, only gammas are detected. When the shield is opened, the exposed GM tube detects beta $\geq$ 175 keV. The probe is ideal for ^{131}I, ^{32}P, and higher-energy betas.

FIG. 1 - EXPLODED VIEW OF BETA-GAMMA PROBE AND TUBE ASSEMBLY



C. Panel Assembly and Case

The panel assembly and case consists of a battery compartment, a transistorized pulse shaping network, a detecting (metering) circuit, a regulated transistorized high voltage supply and an audio output circuit. The system is shock-proof and water-proof and is secured with rapid takedown clamps. The battery bracket faces out for the rapid replacement of batteries and protecting the circuitry from battery leakage.

D. Optional Head Set

The head set is a one-piece magnetic phone with a connector mated to the watertight jack that is mounted on the lid. The jack is covered by a plastic dust cover.

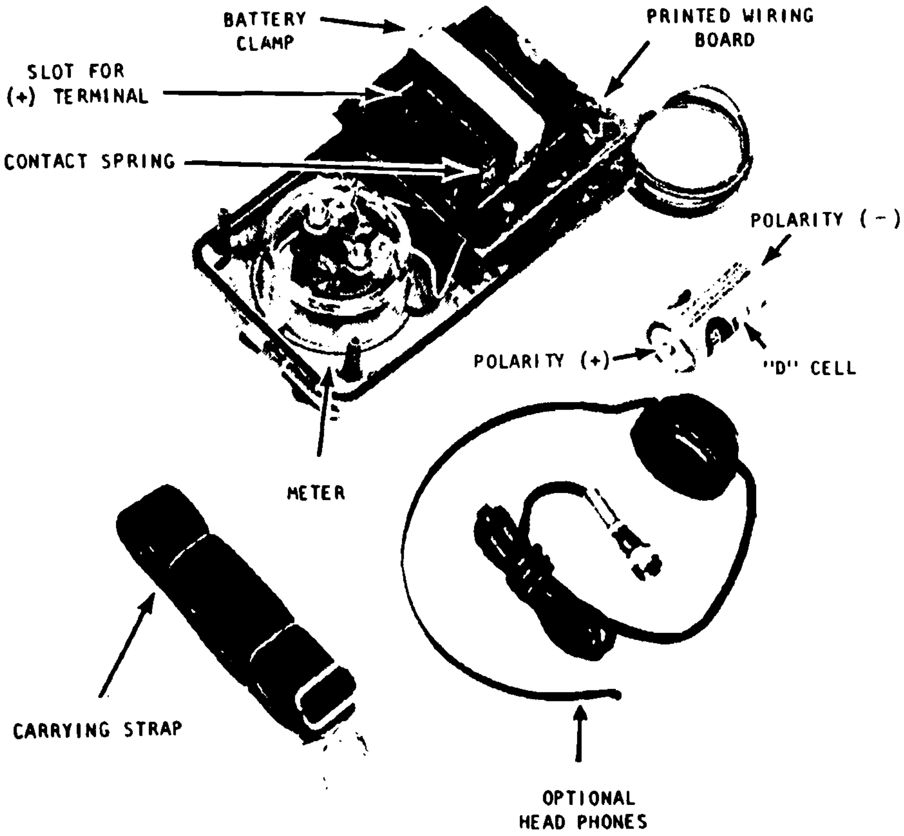
II INSTALLATION

A. Installing Batteries--
Four 1.5 volt "D" are required.

1. Open the case by releasing the clamps at both ends, and remove the lid assembly.
2. Remove the battery clamp by squeezing its edges together with moderate hand pressure. This causes the clamp to disengage from the battery holder.

3. Place the "D" batteries, negative end first, against the "finger" springs. Slide the positive terminals down in their respective grooves. Be sure all spring contacts are pressing against each battery. This may be adjusted with long-nosed pliers, if necessary (see Fig. 2).

FIG. 2--BATTERY SECTION



4. Replace the clamp.

5. Replace the lid assembly on the case.

III OPERATION

A. Operating the Unit for the First Time

With the probe in the handle clip, switch the instrument to the times ten (X10) scale, with the beta window closed. Wait 30 seconds. Switch to the X1 (0.5 mR/hr) range and observe the background. The meter should read 0.01 - 0.04 mR/hr.

The survey meter can also be checked by using an optional 62-103 Cesium-137 Check Source (10uCi on a 1" diam. flat plastic disc). Expose the window of the probe to the flat unlabelled surface of the check source. The indicator should fall between 5 and 15 mR/hr on the X100 range.

B. Calibration Adjustment

Note: A check source is NOT A CALIBRATION STANDARD but merely an operation check. The instrument is factory-calibrated with standards traceable to NBS. Re-calibration should be accomplished only by a laboratory.

C. "On-Off" and Range Switch

The range switch controls an "OFF" position and three ranges: X100, X10, and X1. These are respectively 100 times, 10 times and 1 time the scale reading in mR/hr or counts per minute. The printed meter scale goes to 0.5 mR/hr and 300 cpm respectively.

D. Using the Head Set

Attach the phone connector to the terminal at the left of the post of the handle. The counting rate is indicated by distinct clicks. As the count rate increases, the clicks blend into a continuous static tone.

E. Normal Background

Since normal background is about 0.01 to 0.04 mR/hr on this type of instrument, little activity will normally be seen or heard. Under background conditions only, about 20 clicks will occur per minute. They are randomly spaced, and you may wait several seconds before a click is heard. Then there may be two or three in rapid succession, followed by a long pause, then more clicks.

IV PREVENTIVE MAINTENANCE

A. Battery Life

Caution: Make Sure the Instrument is Turned OFF When Not in Use. Battery life is at least 100 hours under continuous use. For intermittent use, the life may be extended.

B. Storage

Leave the instrument in its shipping container until ready to be put into operation. This prevents the accumulation of dirt, moisture and radioactive contamination, which interfere with proper operation. For storage purposes, try to keep the instrument in a moderately cool area--this will provide greater battery shelf life. Always prevent contamination of the instrument, particularly the probe. The instrument should NOT be stored with the batteries installed.

C. Decontamination

Clean the instrument, probe and accessories in an accepted manner to avoid both spurious counting or residual radiation hazards. The beta-gamma probe housing has been designed to permit decontamination. To clean its parts, unscrew the cap end and slide the beta shield sleeve off the housing. All the component parts of the probe may now be cleaned (See Fig. 1).

D. Battery Inspection

Even under continuous use with leak-proof cells, it is advisable to check the batteries for leakage at least once per month.

V OPERATOR'S MAINTENANCE

A. Replacing the Batteries

Whenever the instrument fails to respond to radiation, check the batteries. Cells showing signs of corrosion or providing less than 1.5 volts should be replaced at once.

B. Replacing the Geiger Tube

The geiger tube is halogen-quenched. Its operating life is unaffected by use and, therefore, it rarely requires replacement. However, if fresh batteries are installed and the instrument still does not work correctly, try a new geiger tube before attempting to check the circuitry.

> CAUTION: When Removing or Replacing the Geiger Tube, Do Not Grasp It at Its Thin Section (See Fig. 1).

Replacement Parts and Accessories

05-701	Headphone Set
30-993	GM Tube (Beta-Gamma)
62-103	Check Source, Cs-137, 10 µCi

LIMITED WARRANTY

This instrument and its accessories, excluding those listed below, are warranted by VICTOREEN, INC. against defects in materials and workmanship for a period of one year* from the date of original shipment. During the warranty period, VICTOREEN will repair or, at its option, replace, at no charge, an instrument containing such defect provided it is returned, transportation prepaid, to the VICTOREEN repair facility listed below. Instruments repaired in warranty will be returned transportation prepaid.

In addition, the calibration of each instrument is warranted to be within its specified accuracy at the time of shipment. If an error in this initial calibration is discovered, the instrument will be recalibrated at no charge, provided it is returned as described above. This does not apply to any calibration deviation that may result from normal use.

THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS, WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. THIS EXPRESS WARRANTY EXCLUDES COVERAGE OF, AND DOES NOT PROVIDE RELIEF FOR, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND OR NATURE, INCLUDING BUT NOT LIMITED TO LOSS OF USE, LOSS OF SALES OR INCONVENIENCE. THE EXCLUSIVE REMEDY OF THE PURCHASER IS LIMITED TO REPAIR, RECALIBRATION OR REPLACEMENT OF THE INSTRUMENT AT VICTOREEN'S OPTION.

This warranty does not apply if the product, as determined by VICTOREEN, is defective because of normal wear, accident, misuse, or as a result of service or modification by other than an authorized VICTOREEN repair facility. This warranty is void if the unit is subjected to temperatures above 55° C.

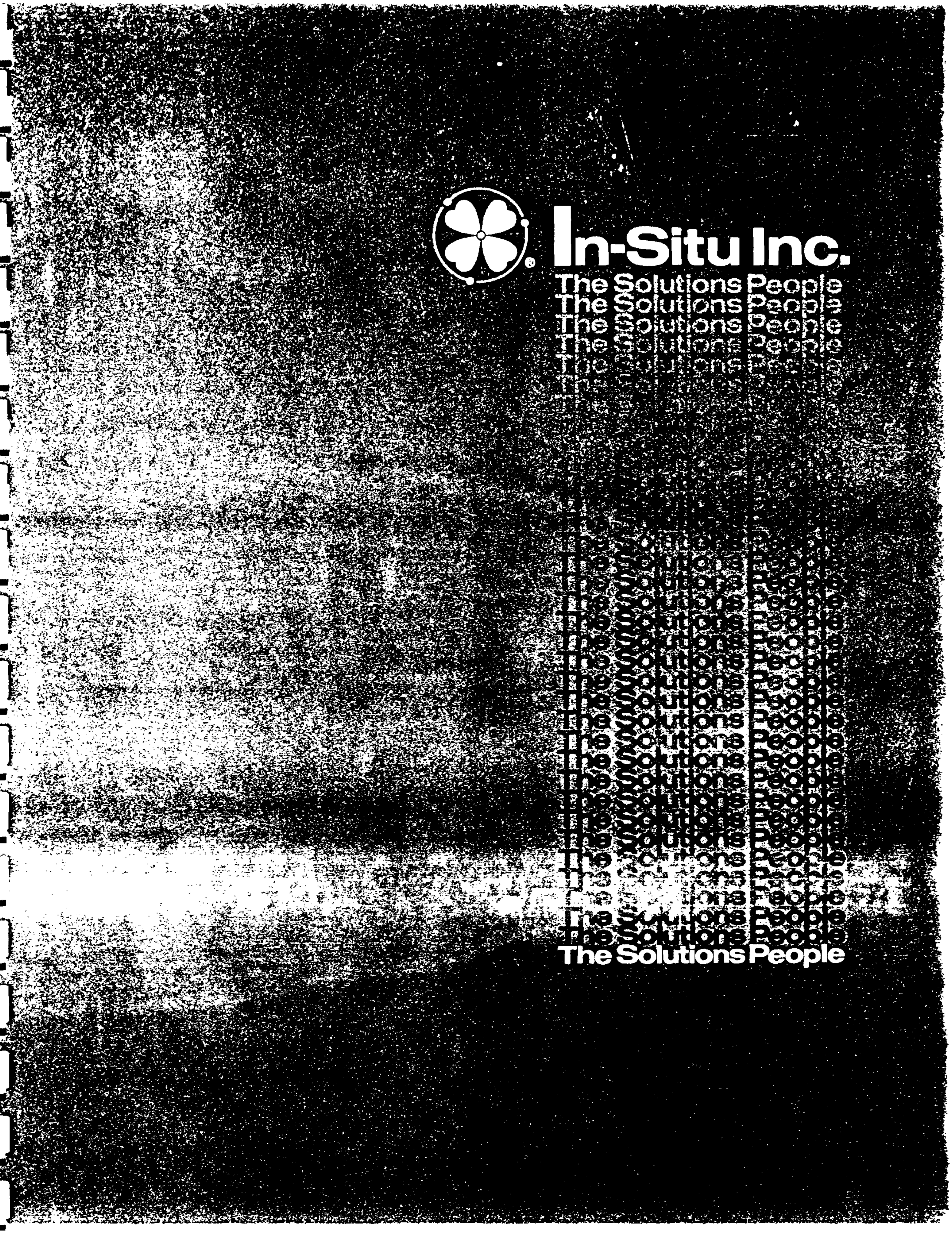
*This warranty specifically excludes any items covered by their original manufacturer's warranty: photomultiplier, geiger and proportional tubes, crystal and other solid state detectors, batteries and major ancillary items of instrument systems such as, but not limited to, recorders, pumps, computers and peripherals.

NON-WARRANTY SERVICE

If repairs or replacement not covered by this warranty are required, a repair estimate will be submitted for approval before proceeding with the repair or replacement.

REPAIR SERVICE: Return the product, prepaid, to:
Nuclear Associates, Division of Victoreen, Inc.
100 Voice Road • Carle Place, N.Y. 11514-1593

> **IMPORTANT:** To expedite your repair, please supply the following: (1) Complete detailed description of problem. (2) Purchase Date. (3) Name of Vendor. (4) Order Number. Also indicate which, if any, accessory items (batteries, carrying case, check source, voltage converter, etc.) are included in the return.



In-Situ Inc.

The Solutions People
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The Solutions People

HERMIT
ENVIRONMENTAL DATA LOGGER
MODEL SE1000B

OWNER'S MANUAL

June 1986

In-Situ, Inc.
Laramie, Wyoming 82070

CONTENTS

CONTENTS (Continued)

Section Page

Appendix

WARNING

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the Owner's Manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

1. INTRODUCTION

The SE1000B is a rugged field instrument oriented towards the acquisition of environmental data. It automates the measuring and recording of water level changes in pump tests, long and short term monitoring of aquifers, surface water, dams and waste disposal sites. The unit has full stand-alone capability with its internal high performance battery pack and tolerance of wide temperature ranges. Special programming features allow the SE1000B to monitor and record additional parameters such as temperature, pressure, conductivity, pH and many others.

Flexibility of data recovery is one of the SE1000B's distinctive features. Stored data can be reviewed directly on the LCD display, printed on an accessory printer or transferred to most personal and portable computers via the RS232 interface. No matter which form of data recovery is used all data is presented directly in the selected measurement units. Communication options are available that allow data recovery and programming from remote locations.

Several options are currently available for the SE1000B which greatly expand its versatility. These include expansion to two inputs, memory expansion to 16,000 data points, high and low limit alarm outputs and a high resolution measurement option. All fit within the standard instrument enclosure and are discussed in this manual.

The best way to feel at ease with the unit is to sit down with the Owner's Manual and the SE1000B and actually key in the examples provided for each function. It will not take long to become familiar with the unit and the time spent will help realize the maximum potential of the SE1000B.

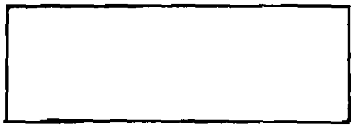
2. GENERAL OPERATION

The front panel controls consist of a five digit liquid crystal display and an eight key keypad. The keys are divided into two groups: the white keys for basic operations and the blue keys for data entry and modification. Basic operations include CLOCK, XD (short for transducer) and DATA; each of which can be accessed with a single keystroke. Data modifying operations such as START, STOP and changing test parameters require a sequence of keystrokes to prevent their accidental use.

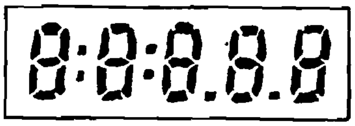
Wakeup

The SE1000B uses a technique referred to as "sleeping" to help minimize power consumption and achieve a battery life measured in years instead of months. Whenever there is no immediate task to be performed the unit enters its sleep mode, recognized by a blank display. Only the internal clock, memory and keypad remain active. The unit will "wake" when the internal clock indicates the time for a data point or the operator presses a key on the front panel.

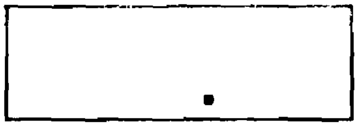
The unit is sleeping, recognized by a blank display.



Lightly press any key to wake the unit. The SE1000B responds with a self test...



...then the status display. The unit is now ready for a keypad command.

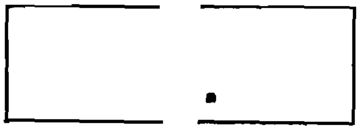
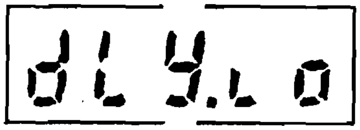
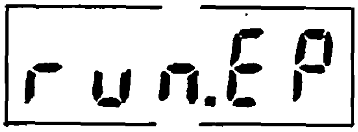
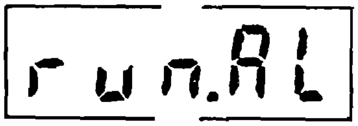


Self test is performed every time the unit wakes up and takes five to ten seconds depending on the options installed. Refer to Section 9 of this manual if the unit does not show a standard status display after completing a self test.

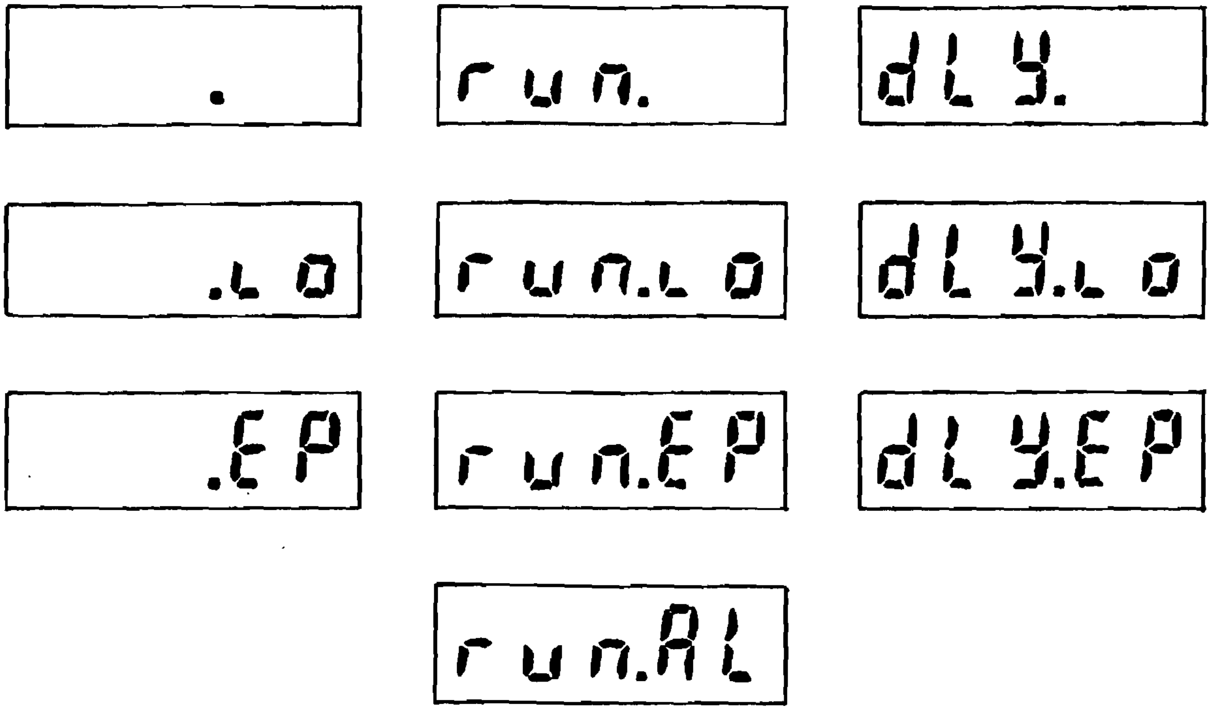
In most cases the unit will return to the sleep mode if no key has been pressed for thirty seconds. If the operator pauses long enough between key presses to let the unit sleep, the operator must wake the unit and repeat the operation.

Status Display

The status display is presented whenever the unit is awake and is ready to accept a keypad command. It also gives information regarding the current operating status of the unit.

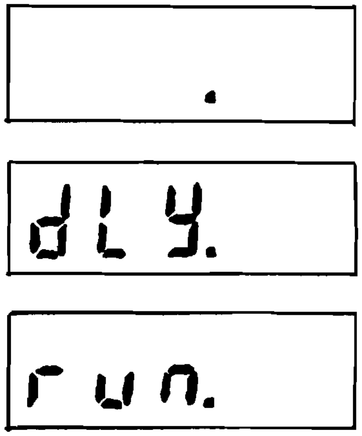
Test Status		Alarm/Power Status
Idle, no test running		Normal battery operation
Waiting for a delayed start		Low battery indicator
Running a test		External power operation
		Alarm activated

The following combinations of the test and power status indicators are possible. The alarm indicator only occurs in the "run" mode.

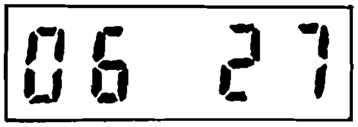


Displaying the Clock

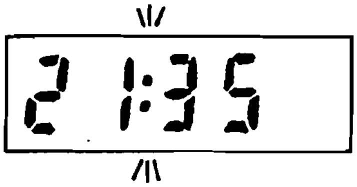
Start from the status display. The clock can be displayed in any mode.



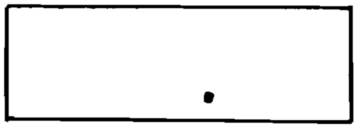
Press the CLOCK key. The unit first displays the month and day...



... then the hours and minutes in a twenty four hour format with the colon blinking...

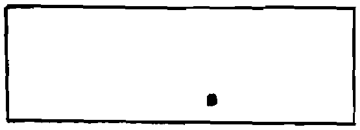


... then returns to the status display.

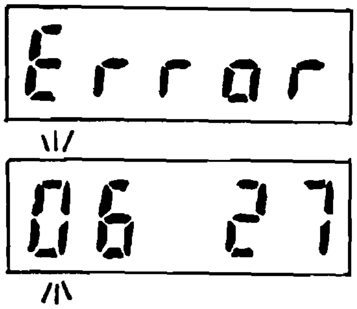


Setting the Clock

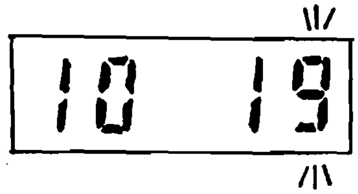
Start from the status display. The clock can only be set when the unit is in the idle mode.



Hold down the ENTER key and press the CLOCK key. If the unit is in the wrong mode, "Error" will be displayed. Otherwise the current date is displayed with the leftmost digit flashing.

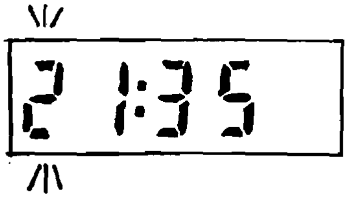


Use the SCAN keys to change the blinking digit to the correct value. Use STOP/NEXT to blink the next digit. Press ENTER to set the date.

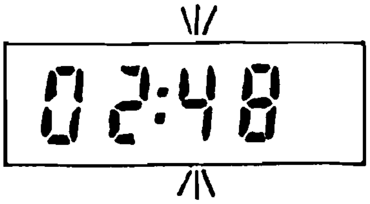


The month must be in the range 1-12; the day in the range 1-31 depending on the month. The clock runs on a four year cycle and cannot accommodate leap year.

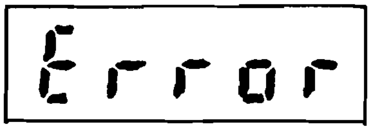
If the date setting is valid, the current time is displayed with the leftmost digit flashing.



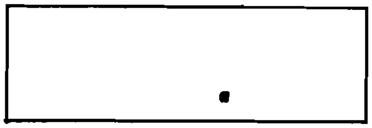
Use the SCAN and STOP/NEXT keys to change the time to the correct value. Press ENTER to set the time. The seconds are automatically set to zero.



The hours must be in the range 0-23; the minutes in the range 0-59. The clock runs in a twenty four hour format where 0 is midnight.



If the time setting is valid, the unit returns to the status display.



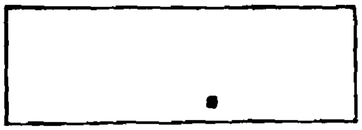
To synchronize the SE1000B's clock with an external clock, set the time one minute ahead of the external clock and press ENTER when the clocks match. The sleep delay is extended from the usual thirty seconds to ninety seconds to simplify synchronization.

NOTE: All keys will repeat automatically when pressed longer than one second. This is particularly useful when entering numeric values using the SCAN keys.

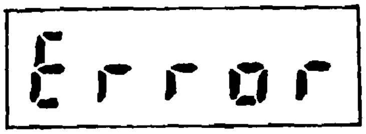
3. DEFINING A TEST

Four parameters define the data collection process: 1) where in memory to store the test, 2) how often to sample the inputs, 3) how many inputs to sample, and 4) what type of transducers are connected to each input. The selections made for each of these parameters will govern how the unit prompts and responds to other functions; so this menu should always be set up first when preparing for a test.

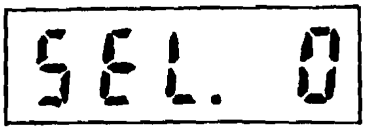
Start from the status display. A test can only be defined while the unit is in the idle mode.



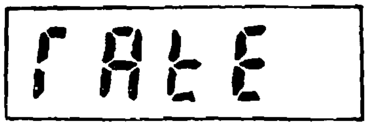
Hold down the ENTER key and press the DATA key. If the unit is in the wrong mode "Error" will be displayed. Otherwise the top selection of the menu is displayed.



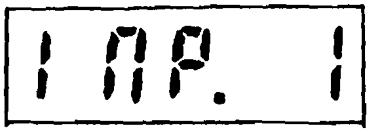
Use the SCAN DOWN key to move the display towards the bottom of the menu; SCAN UP to move the display towards the top of the menu. STOP/NEXT will exit the menu and return to the status display. Press ENTER to modify the displayed parameter.



Top pg. 9



pg. 11



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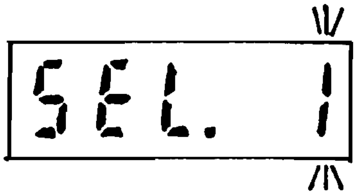
Bottom pg. 15

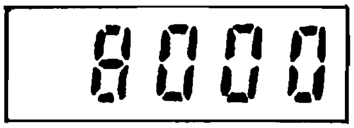
Test Number

To select the test number press ENTER when the display shows the select parameter.

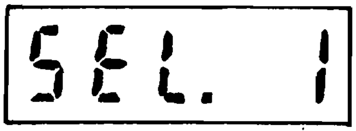
The current test selection will blink. Use the SCAN keys to change the test number to the desired value. STOP/NEXT will abort the selection process without changing the current test number. Press ENTER to set the new test number.



The display shows the number of sample points that can be taken during the test ...

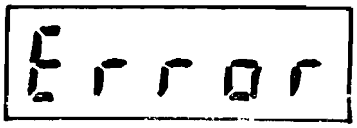


... then returns to the test menu.

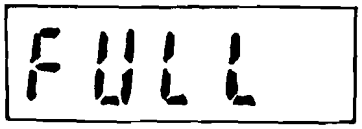


pg. 8

The test number must be in the range 0-9 and can only be incremented by one to the next higher number (test numbers cannot be skipped). The test number cannot be incremented if the currently selected test contains no data.



This message is displayed if there is insufficient memory remaining to set up a new test.



The test number shown in the display is the test number that data will be recorded under when the test is started. The SE1000B is capable of storing ten unique tests in memory numbered consecutively from zero to nine. As an example, suppose that a test has been completed with its data stored as test zero. If the unit were started again without changing the test number, the new data would overwrite the old and the old data would be lost. To run another test without disturbing the previous data, the test number could be incremented to one. New data would then be stored as test one, leaving the test zero data stored safely in memory. When a test number is selected, the SE1000B sets up its memory for the test as follows:

1. Data for the selected test and all higher numbered tests is erased from memory. Data for tests stored in lower numbers than the selected test is unaffected. All unused memory becomes available to the selected test for new data. Selecting test zero effectively clears all data from the memory and provides the maximum amount of memory for the test.

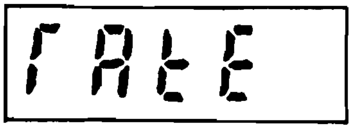
2. The display will show the number of sample points that can be taken based on the number and type of active inputs currently selected.

3. All test definition and transducer parameters are initialized to the same values as the previous test. This allows tests to be repeated easily without having to reenter all of the test parameters. These parameters may, of course, be changed if the new test is not identical.

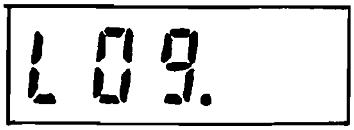
4. Data and parameters for lower numbered tests become "locked-in" and cannot be modified. This prevents accidental manipulation of important data.

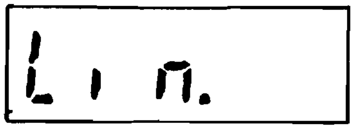
Sample Rate

To select the sampling rate, press ENTER when the display shows the rate parameter. The display then shows the currently selected sample mode.

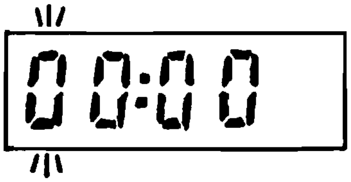


Press SCAN UP to select the logarithmic mode. Press SCAN DOWN to select the linear sampling mode. The STOP/NEXT key will abort the selection without changing the current setting. Press ENTER to set the new mode.



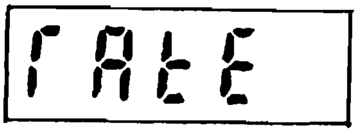


The unit then displays the current sampling rate in hours and minutes with the leftmost digit flashing. Use the SCAN and STOP/NEXT keys to change the digits to the desired values. Press ENTER to set the sampling rate.



The display shows the number of sample points that can be taken during the test...

... then returns to the test menu.



The sampling rate can range from 00:00 to 99:99. Ninety minutes can be entered as 00:90 or as 01:30 (one hour and thirty minutes). In the linear mode a sample rate of 00:00 defaults to one minute. In the logarithmic mode the sample rate value determines the longest allowed sampling interval. The unit will sample using the schedule outlined below until the preprogrammed rate would exceed the selected value. The unit then begins sampling using the selected linear rate. Setting the rate to 00:00 causes the unit to default entirely to the preprogrammed logarithmic schedule.

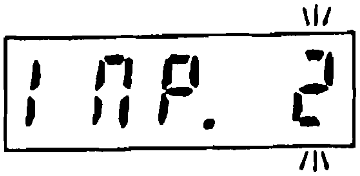
Cycle	Elapsed Time	Log Sample Interval
1	0-2 sec	0.2 sec
2	2-20 sec	1 sec
3	20-120 sec	5 sec
4	2-10 min	30 sec
5	10-100 min	2 min
6	100-1000 min	10 min
7	1E3-1E4 min	100 min
8	1E4 min -	500 min

NOTE: Entering the sample rate has a similar effect on memory as selecting the test number. Data for the selected test and all higher tests is erased from memory and the memory is reorganized to accommodate the rate change. Always make sure the test number is set correctly before changing the rate.

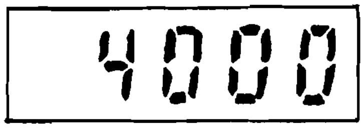
Number of Inputs

To select the number of active inputs press ENTER when the display shows the input parameter.

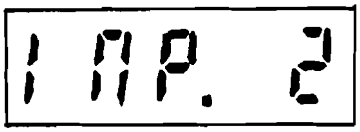
The current number of active inputs will blink. Use the SCAN keys to change the number of inputs to the desired value. STOP/ NEXT will abort the selection process without changing the number of inputs. Press ENTER to set the new selection.



The display shows the number of sample points that can be taken during the test ...

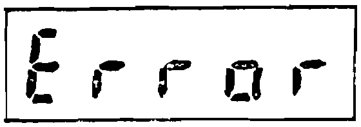


... then returns to the test menu.



pg. 8

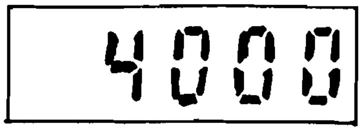
The number of inputs must be in the range 1-2. On units without the second input option an error will occur on any entry other than 1.



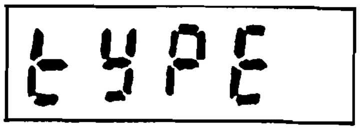
On units with two inputs, INPUT 1 is used when only one input is selected active. INPUT 1 and INPUT 2 are used when two inputs are active. Selecting two inputs active will reduce the number of sample points available for a test by at least half, will increase the average power consumption of the unit during data collection, and will increase the complexity of the instrument setup. If only one input is being used, select only one active input. It will literally save the operator's time and the battery's energy.

NOTE: Entering the number of inputs has a similar effect on memory as selecting the test number. Data for the selected test and all higher tests is erased from memory and the memory is reorganized to accommodate the selected number of inputs. Always make sure the test number is set correctly before changing the number of inputs.

The display shows the number of sample points that can be taken during the test ...



... then returns to the test definition menu.



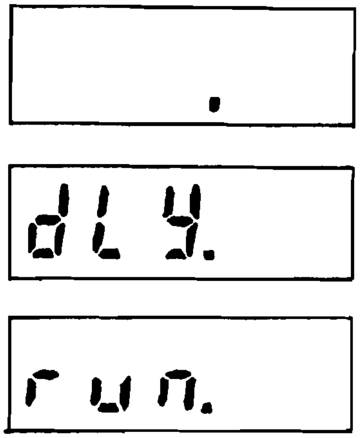
pg. 8

Selecting the input type determines both the measurement technique and the equations that will be used to convert measured values to the appropriate units. The LEVEL mode is intended for standard pressure transducers only and will convert measured values of PSI directly to water levels. The FUNCTION mode is selected for standard 4-20 mA transducers for direct readings of PSI, temperature, flow, etc. The DUAL mode is selected for use with two parameter transducers such as In-situ's conductivity plus temperature and pH plus temperature transducers. Refer to the section on Transducer Parameters for details on each type of transducer.

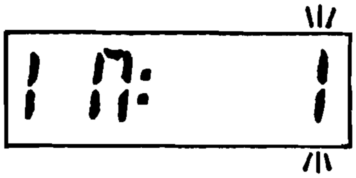
When two inputs are selected active, the TYPE function is selected independently for each input. After selecting the type for one input, do not forget to check the type setting on the second input. Some very confusing data will be collected if the number and type of inputs are not properly selected to match the transducers.

NOTE: Entering the input type has a similar effect on memory as selecting the test number. Data for the selected test and all higher tests is erased from memory and the memory is reorganized to accommodate the test definition. Always make sure the test number is set correctly before changing the input type.

The transducer parameters define how raw transducer data is to be converted to meaningful units and displayed and what alarm limits if any are to be monitored. The menu presented varies with the selected input type, however accessing the menu is the same in each case. Only the transducer parameters of the currently active test can be modified.



Start from the status display. These parameters can be modified in any test mode.



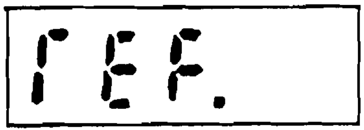
Hold down the ENTER key and press the XD key. If two inputs are active, the input number is displayed with a blinking digit. Use the SCAN keys to change the input number to the desired value. STOP/NEXT will abort the selection and return to the status display. Press ENTER to select the input and display the transducer menu. This prompt is skipped if only one input is active.

The display proceeds to the appropriate menu as described in the following sections.

LEVEL Mode XDs

The LEVEL mode is used to convert PSI values obtained with a pressure transducer to water levels. This mode must not be used with any other type of transducer. The parameters listed in the menu allow a wide variety of transducer ranges and water level data display modes. Equations showing the effects of all values are presented with the display modes on page 22.

Use the SCAN DOWN key to move the display towards the bottom of the menu; SCAN UP to move the display towards the top of the menu. STOP/NEXT will exit the menu and return to the status display. Press ENTER to modify the displayed parameter for the selected input.



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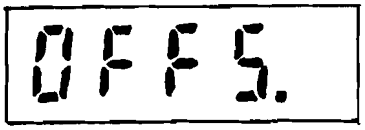
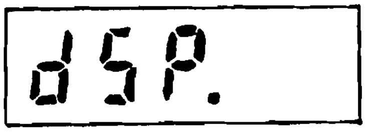
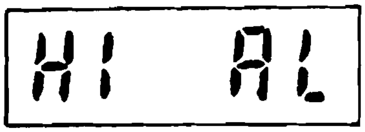
pg. 19



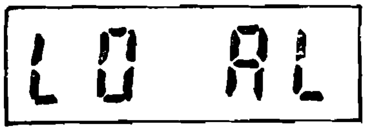
pg. 20



pg. 20



pg. 29



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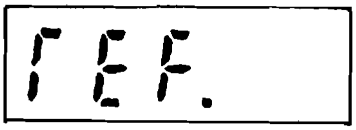
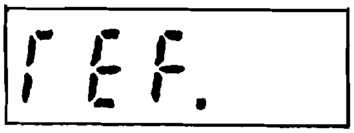
NOTE: The high and low limit alarm parameters will not be presented if the alarm output option has not been installed.

To modify the reference level, press ENTER when the display shows the reference parameter.



The current value of the reference level is displayed with the leftmost digit blinking. Use the SCAN and STOP/NEXT keys to change the digits to their correct values.

Press ENTER to set the new value. The display returns to the transducer menu.



pg. 18

The reference level parameter is used to reference the transducer readings to a known initial condition. In hydrologic applicatons, this allows top of casing and surface water values to be derived from transducer head readings. The transducer must be connected to the instrument and placed at its initial depth before entering the reference level. If absolute level values are not important and only changes in level are required, the reference level must be set to zero. All water level display modes require that the reference level be entered for proper operation.

To modify the transducer scale factor press ENTER when the display shows the scale parameter.

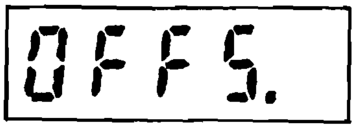
The current value of the scale factor is displayed with the leftmost digit blinking. Use the SCAN and STOP/NEXT keys to change the digits to their correct values.

Press ENTER to set the new value. The display returns to the transducer menu.

pg. 18

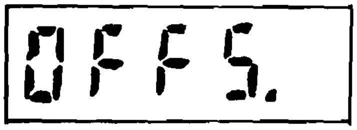
The scale factor is stamped on the body of the transducer. Additionally, if the transducer is on a reel, the scale factor will be found on the data plate on the side of the reel. If the transducer is on free cable, the scale factor can be found on the data tag at the connector end of the cable.

To modify the transducer offset, press ENTER when the display shows the offset parameter.



The current value of the offset is displayed with the leftmost digit blinking. Use the SCAN and STOP/NEXT keys to change the digits to their correct values.

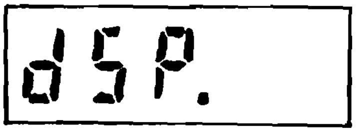
Press ENTER to set the new value. The display returns to the transducer menu.



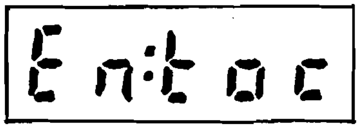
pg. 18

The offset is usually stamped on the body of the transducer. If not specified, the offset should be set to zero.

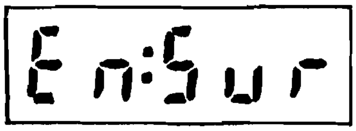
To modify the display mode press ENTER when the display shows the display mode parameter.

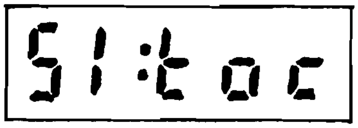


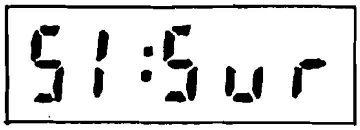
The currently selected mode is displayed. Use the SCAN UP key to move the display towards the top of the menu; SCAN DOWN to move the display towards the bottom of the menu. STOP/NEXT will exit this menu and return to the transducer menu without changing the current display mode.



Top







Bottom

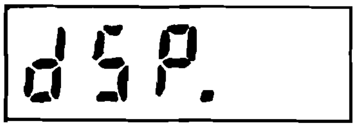
En: English units, feet of water

SI: Standard International Units, meters of water

toc: Top of casing readings (positive down)

sur: Surface level readings (positive up)

Press ENTER to set the new display mode. The display returns to the transducer menu.



pg. 18

The unit computes transducer head as follows (this mode is used when checking out the transducer before running a test):

$$\mathrm{HEAD}(t) = \left[\frac{\mathrm{READING} * \mathrm{SCALE}}{16} + \mathrm{OFFSET}\right] * \mathrm{UNITS}$$

where: READING = XD reading 0-16 mA
SCALE = Scale factor in PSI full scale
16 = 16 mA full scale
OFFSET = Offset in PSI
UNITS = 2.30667 feet/PSI or
= 0.703072 meters/PSI

Top of casing levels are computed as:

$$\mathrm{toc}(t) = \mathrm{REF} + (\mathrm{HEAD}(r) - \mathrm{HEAD}(t))$$

where: REF = Reference level
HEAD(r) = Head reading at reference level

Surface levels are computed as:

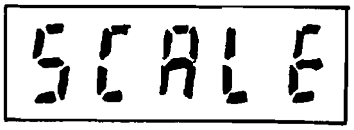
$$\mathrm{LEVEL}(t) = \mathrm{REF} - (\mathrm{HEAD}(r) - \mathrm{HEAD}(t))$$

IMPORTANT NOTE: If the transducer is not connected and set at its initial depth in the water when the reference level is entered (or the reference level is not entered at all), then HEAD(r) will be an arbitrary number and displayed data will be garbage !

Function Mode XDs

The function mode is used to convert the 4-20 mA current values obtained from a transducer to meaningful measurement units. This mode can be used to obtain direct readings in PSI from the pressure transducers or used with other transducers to measure temperature, flow rate, etc.

Use the SCAN DOWN key to move the display towards the bottom of the menu; SCAN UP to move the display towards the top of the menu. STOP/NEXT will exit the menu and return to the status display. Press ENTER to modify the displayed parameter for the selected input.



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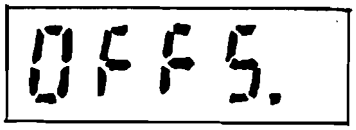
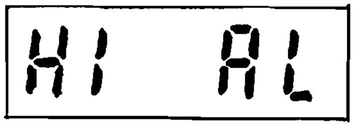
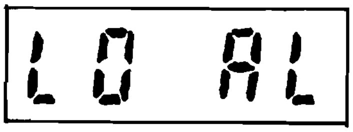


pg. 20



pg. 29



Bottom pg. 29

NOTE: SCALE and OFFSET values are set in the same manner as a LEVEL mode transducer. The high and low limit alarm parameters will not be presented if the alarm output option has not been installed.

The unit computes function data as follows:

$$\text{DATA} = \frac{\text{READING*SCALE}}{16} + \text{OFFSET}$$

where:
READING = XD reading 0-16 mA
SCALE = Scale factor in units full scale
16 = 16 mA full scale
OFFSET = Offset in appropriate units

The values of SCALE and OFFSET determine the measurement units of the data. For example, a 4-20 mA flow meter output with a range of 10 to 100 GPM would have the following values entered:

SCALE = 100-10 = 90 GPM full scale

OFFSET = 10 GPM

All data values would read directly in GPM. Using a conversion factor of 60 sec/min, direct readings in GPS could be obtained:

10 GPM * 60 sec/min = 600 GPS

100 GPM * 60 sec/min = 6000 GPS

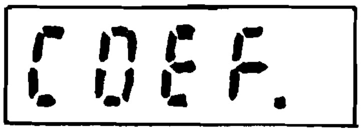
New SCALE = 6000 - 600 = 5400 GPS full scale

OFFSET = 600 GPS

DUAL Mode XDs

In-situ's unique dual mode transducers allow the measurement of temperature and a temperature dependent parameter, such as conductivity or pH, to be measured with a single input channel. The SE1000B can also temperature compensate the primary parameter. Due to the length of time it takes to sample a dual mode tansducer, the logarithmic sampling mode cannot be used.

Use the SCAN DOWN key to move the display towards the bottom of the menu; SCAN UP to move the display towards the top of the menu. STOP/NEXT will exit the menu and return to the status display. Press ENTER to modify the displayed parameter for the selected input.



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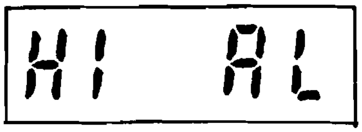
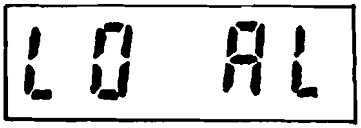


pg. 29



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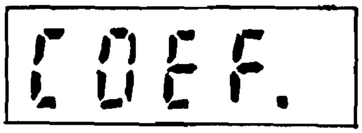
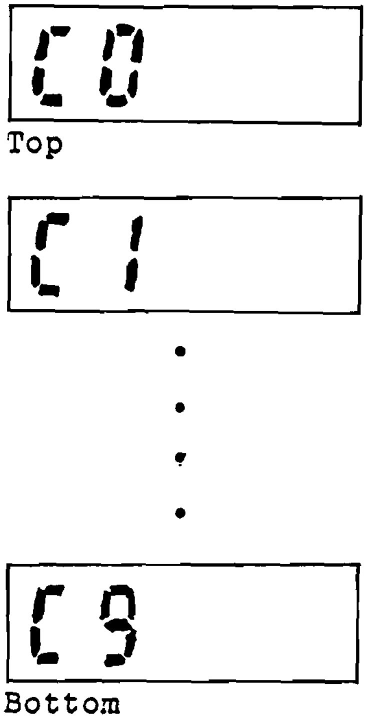
NOTE: The high and low limit alarm parameters will not be presented if the alarm output option has not been installed.

To modify a coefficient, press ENTER when the display shows the coefficient parameter.



The top selection of the coefficient menu is displayed. Use the SCAN DOWN key to move the display towards the bottom of the menu; SCAN UP to move the display towards the top of the menu. STOP/NEXT will exit the menu and return to the transducer menu. Press ENTER to modify the displayed coefficient.



Each coefficient is set in the same manner as a SCALE or OFFSET value for other transducer types.

Temperature, always expressed in centigrade in the dual mode, is computed as follows:

$$TEMP = C0 + \frac{C1*T}{10} + \frac{C2*T^2}{100}$$

where: T = XD reading

The primary value is computed in three stages.

1) $$VALUE = C3 + \frac{C4*V}{10} + \frac{C5*V^2}{100}$$

where: V = XD reading

2) $$KFACT = C6 + \frac{C7}{1000} * VALUE$$

3) $$FINAL = \frac{KFACT}{1 + \frac{C8}{1000}(TEMP-25)} + C9$$

Refer to the transducer manuals for coefficient explanations and variations.

Numerical Input

Up to this point all entry of numerical values have been limited to positive numbers less than 1000. This is sufficient for most applications, but the SE1000B is capable of more flexible input. During the entry of a number, all of the keys can actually be used as follows:

SCAN - change the blinking digit

STOP/NEXT - move the blinking digit

ENTER - enter the number as displayed

START - change the sign of the number

CLOCK - clear number to 000.00

XD - clear number to 0000.0

DATA - clear number to 00000

The CLOCK, XD and DATA keys are used to change the decimal point position to accommodate larger numbers and also offer an easy way to clear the entry to zero. Note that the negative sign occupies one digit position causing a loss of significant figures.

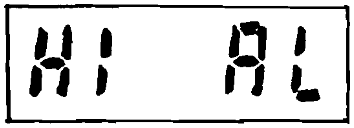
Alarm Settings

The high and low limit alarm outputs are an option on the SE1000B. Prompts pertaining to the setting of the alarms will not be presented if the option has not been installed.

Each input has an independently programmable high and low limit alarm. Since there is only one contact output for a high alarm and one for a low alarm, the alarms for each input are "OR'ed" together. A high alarm on input 1 OR a high alarm on input 2 will close the high alarm output contact. Similarly a low alarm on input 1 OR a low alarm on input 2 will close the low alarm output contact.

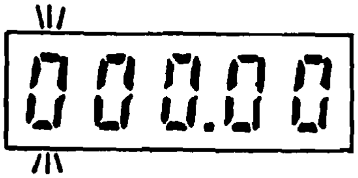
The values programmed for each alarm setting must be in the same units as the measured value. The alarm outputs are only active while the unit is running a test and are updated at each sample interval. When in the logarithmic sample mode, alarms are not checked during the first ten minutes of the test. Only the primary parameter of a dual mode transducer is compared with alarm settings (dual mode temperature does not have alarm settings).

To modify the high alarm setting, press ENTER when the display shows the high alarm parameter.

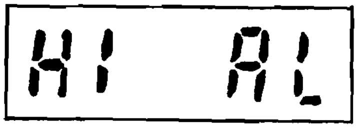


The current on/off status of the alarm is displayed. Use SCAN UP to turn the alarm on; use SCAN DOWN to turn it off. STOP/NEXT will abort the selection and return to the transducer menu without changing the current alarm setting.

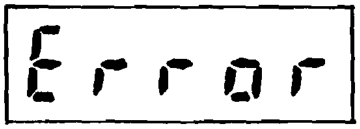
Press ENTER to set the on/off condition. If selected off, the display returns to the transducer menu. If selected on, the current alarm setting is displayed with the leftmost digit flashing. Use the SCAN and STOP/NEXT keys to change the digits to their correct values.



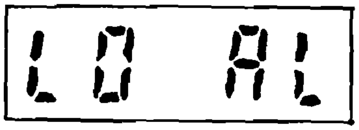
Press ENTER to set the new value. The display returns to the transducer menu. The high alarm will be activated if a data point is greater than or equal to the programmed value.



The high alarm setting must be greater than the low alarm setting.



To modify the low alarm setting, press ENTER when the display shows the low alarm parameter.

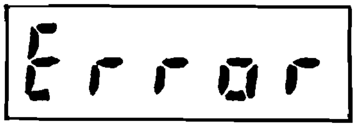


The current on/off status of the alarm is displayed. Use SCAN UP to turn the alarm on; use SCAN DOWN to turn it off. STOP/NEXT will abort the selection and return to the transducer menu without changing the current alarm setting.

Press ENTER to set the on/off condition. If selected off, the display returns to the transducer menu. If selected on, the current alarm setting is displayed with the leftmost digit flashing. Use the SCAN and STOP/NEXT keys to change the digits to their correct values.

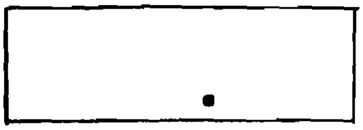
Press ENTER to set the new value. The display returns to the transducer menu. The low alarm will be activated if a data point is less than or equal to the programmed value.

The low alarm setting must be less than the high alarm setting.

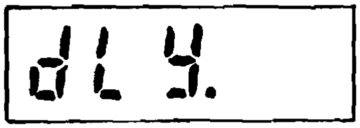


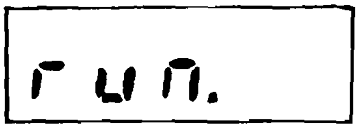
5. PRE-RUN CHECKOUT

It is very important to check the operation of the unit before starting a test. A quick reading taken on each active input ensures that all cables are connected and that the transducers are properly set to their pre-run conditions.

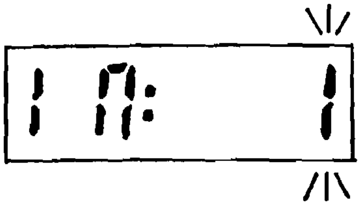


Start from the status display. A transducer can be read in any test mode.

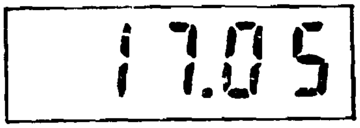




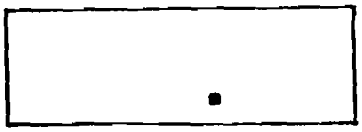
Press the XD key. If two inputs are active, the input number is displayed with a blinking digit. Use the SCAN keys to change the input number to the desired value. STOP/NEXT will abort the selection and return to the status display. Press ENTER to select the input. This prompt is skipped if only one input is active.



The unit takes a reading and displays the transducer value...

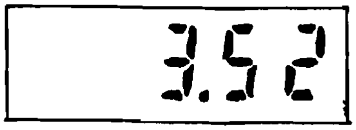


... then returns to the status display.

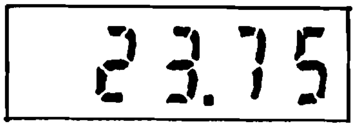


A dual mode reading takes about 12 seconds ...

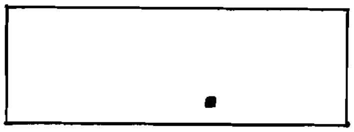
... the primary parameter is displayed...



... then the temperature in degrees centigrade ...



... then returns to the status display.

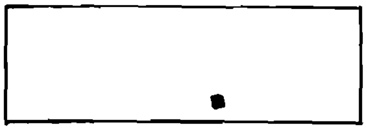


NOTE: When the level mode is selected and the unit is idling or waiting for a delayed start, the transducer depth (head) is displayed instead of the water level. This allows the operator to properly set the transducer below the largest expected drop in water level.

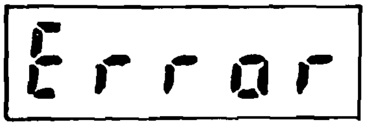
6. COLLECTING DATA

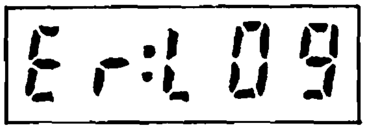
Starting a Test

Start from the status display with all test and transducer parameters set. A test can only be started from the idle mode.

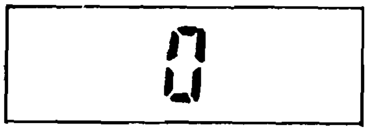


Press the START key. If the unit is in the wrong mode, "Error" will be displayed. The "Er:LOG" message is displayed if logarithmic sampling is selected with a dual mode transducer.

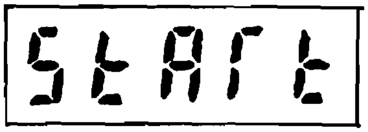




The selected test number is displayed ...



... then the top selection from the start menu. Press SCAN DOWN to select the delayed start mode; SCAN UP to select immediate start. Press STOP/NEXT to cancel the start function without collecting data. Press ENTER to select the displayed start type.



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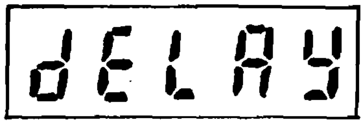

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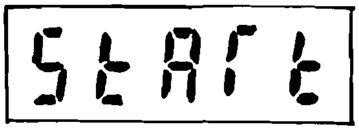
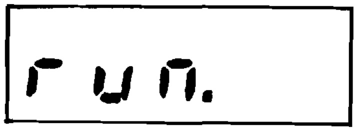
NOTE: Pressing the START key does NOT begin data collection; it only initiates the preparation to start procedures.

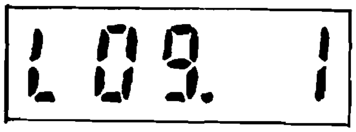
To perform an immediate start, press ENTER when the display shows the immediate start selection.



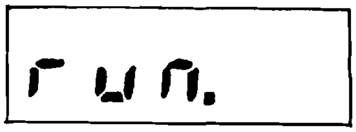
If the linear sampling mode has been selected, the display returns to the status display.



During the first ten minutes of log mode, the unit displays the log cycle. Only the STOP function is active until ...

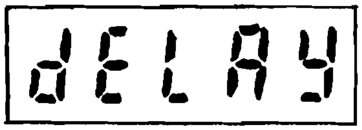


... the display returns to the status display.

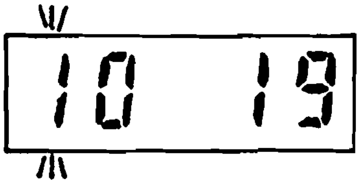


The normal sleep delay of thirty seconds is extended to ninety seconds to simplify synchronizing the immediate start to an external event.

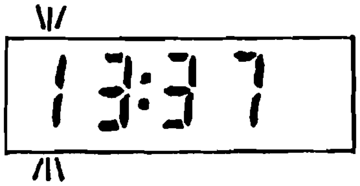
To set up a delayed start, press ENTER when the display shows the delayed start selection.



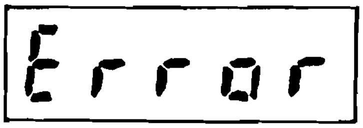
The current date is displayed with the leftmost digit flashing. Use the SCAN and STOP/NEXT keys to change the digits to the delayed start date. Press ENTER to set the delay date.



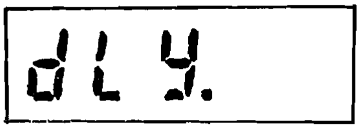
If the date setting is valid, the current time is displayed with the leftmost digit flashing. Use the SCAN and STOP/NEXT keys to change the digits to the delayed start time. Press ENTER to set the delay time.



The delayed start date and time must meet the same criteria as an internal clock setting.

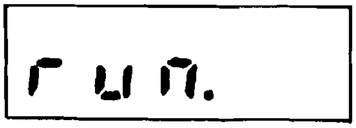


If the time setting is valid, the display returns to the status display. The unit will automatically perform the start function (as outlined for immediate start) at the programmed date and time.

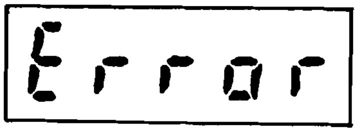


Stepping a Test

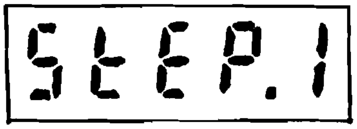
A step can only be started when the unit is in the run mode.



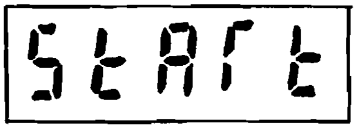
Press the START key. "Error" will be displayed if the unit is in the wrong mode, if the last step (4) is already running, or if there is insufficient memory to start the next step.



Otherwise the next step number is displayed ...



... then the top selection from the start menu. The start menu options are identical to those for starting a test (starting a test is actually starting step 0.



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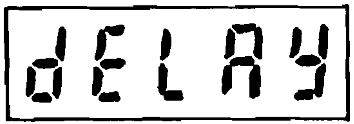

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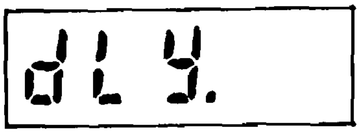
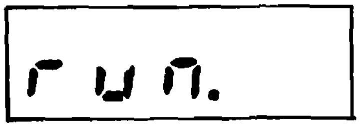
NOTE: When a delayed start is programmed for a step, data collection will stop for the previous step. The unit will not collect further data until the delayed start time.

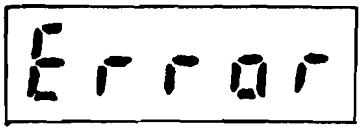
Stopping a Test

Start from the status display with the unit in an active data collection mode. Hold down the ENTER key and press the STOP/ NEXT key.

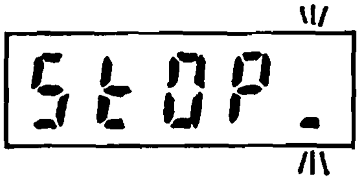




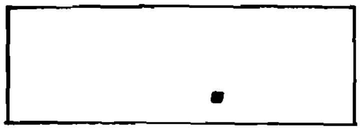
The "Error" message is displayed if the unit is already stopped and is in the idle mode.



Otherwise the stop prompt is displayed with an underline cursor flashing. Press STOP/NEXT to cancel the stop selection; ENTER to confirm the selection.



When the stop function is confirmed, the unit returns to the status display.

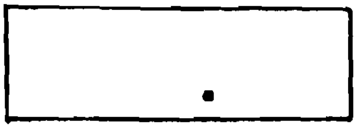


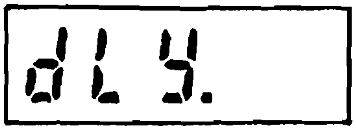
NOTE: During the first ten minutes of log mode data collection the stop function acts immediately with no opportunity to confirm or cancel the selection.

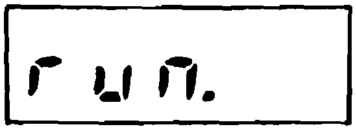
7. REVIEWING COLLECTED DATA

Displaying Data

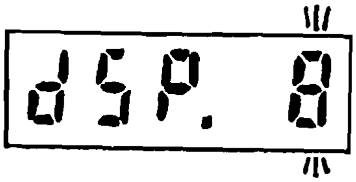
Start from the status display. Data may be viewed in any test mode.



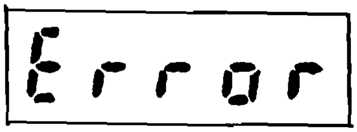




Press the DATA key. The unit will blink the current test number. Use the SCAN keys to change the test number to the desired value. STOP/NEXT will abort the selection and return to the status display. Press ENTER to select the test for display.

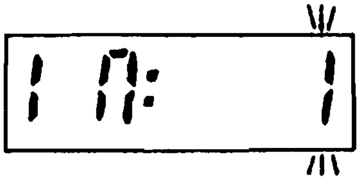


The selected test number must be in the range zero to the currently active test.

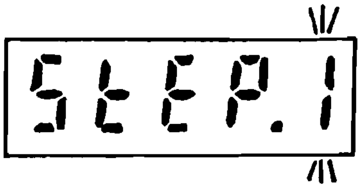


The active test has not been run and contains no data.

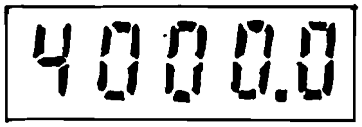
If more than one input is active select the input to be displayed and press ENTER. If only one input is active, this prompt is skipped.



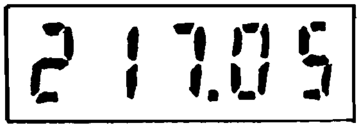
If more than one step has been used, the highest step number is displayed. Select the step number to display and press ENTER. This prompt is skipped if no steps have been used.



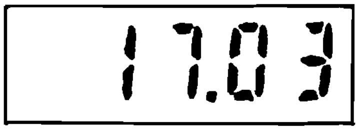
The unit then displays the elapsed time in minutes of the last sample point ...



... then the sample point value in the selected units.

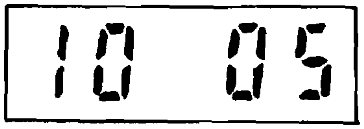


If a dual mode transducer is selected, the unit will then display the temperature in degrees centigrade.

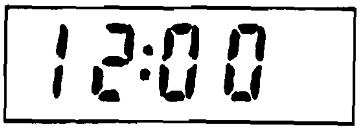


Use the SCAN DOWN key to display earlier data points; the SCAN UP key to display later data points. STOP/NEXT will abort the data display and return to the status display. Holding down the ENTER key and pressing a SCAN key will cause the unit to scan up or down by ten data points. Each time a SCAN key is pressed, the display shows the elapsed time in minutes and the data point value.

To view data from the start of the test or step, press the START key. The display shows the start date ...

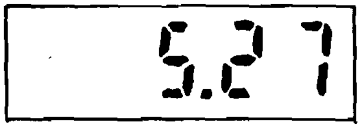


... the start time ...



... moves to time T = 0 ...

... then displays the data at T = 0.



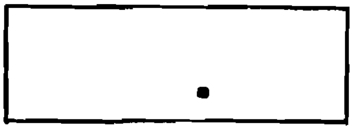
NOTE: Elapsed time values for the first two seconds of log mode data will appear somewhat ambiguous due to the display's inability to show small decimal values. Elapsed time up to two minutes cannot be displayed with full resolution. Use the following table to convert the displayed times to their full resolution.

Log Mode Elapsed Time Values

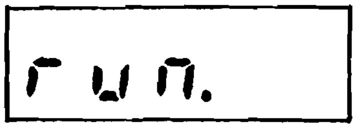
Sample Number	Display (min)	Actual (min)
0	0.00	0.0000
1	0.00	0.0033
2	0.00	0.0066
3	0.00	0.0099
4	0.01	0.0133
5	0.01	0.0166
6	0.02	0.0200
7	0.02	0.0233
8	0.02	0.0266
9	0.03	0.0300
10	0.03	0.0333
11	0.05	0.0500
12	0.06	0.0666
13	0.08	0.0833
14	0.10	0.1000
15	0.11	0.1166
16	0.13	0.1333
17	0.15	0.1500
18	0.16	0.1666
19	0.18	0.1833
20	0.20	0.2000
21	0.21	0.2166
22	0.23	0.2333
23	0.25	0.2500
24	0.26	0.2666
25	0.28	0.2833
26	0.30	0.3000
27	0.31	0.3166
28	0.33	0.3333
29	0.41	0.4167
30	0.50	0.5000
31	0.58	0.5833
32	0.66	0.6667
33	0.75	0.7500
34	0.83	0.8333
35	0.91	0.9167
36	1.00	1.0000
37	1.08	1.0833
38	1.16	1.1667
39	1.25	1.2500
40	1.33	1.3333
41	1.41	1.4166
42	1.50	1.5000
43	1.58	1.5833
44	1.66	1.6667
45	1.75	1.7500
46	1.83	1.8333
47	1.91	1.9167
48	2.00	2.0000
49	2.50	2.5000
50	3.00	3.0000

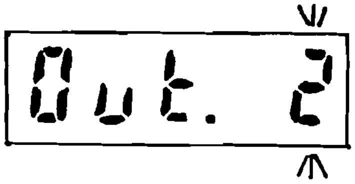
Outputting Data

Although it is quite time consuming, the entire contents of the SE1000B's stored data can be retrieved using the display. A much faster method is to output the data to a printer or computer. To output data, the RS232 port must be connected and the receiving device switched on. Refer to Section 8, System Configuration, for setting the proper port parameters.

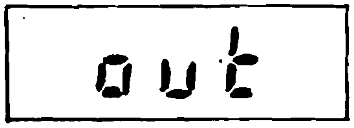


Start from the status display. Data may be output in any test mode.



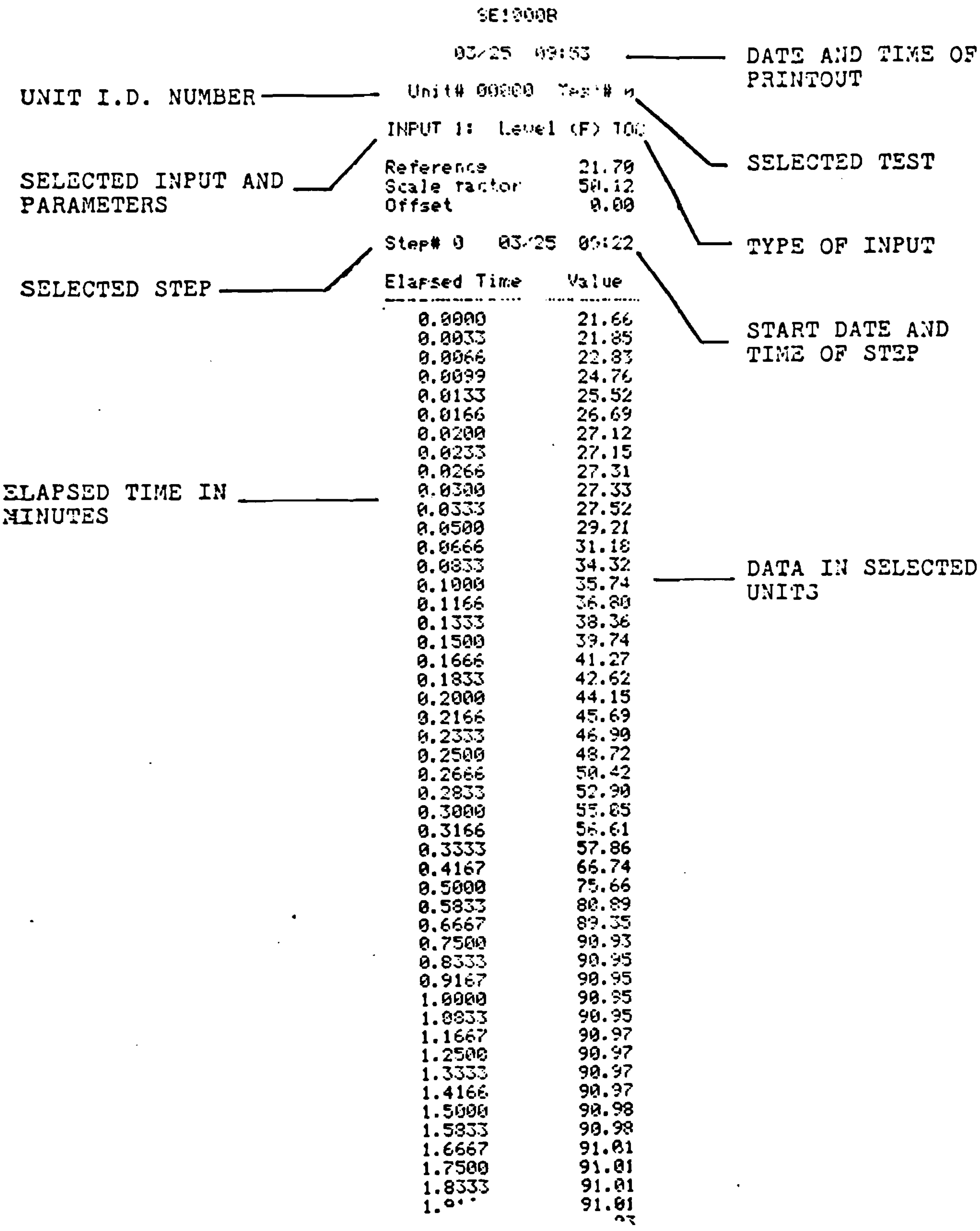


Press the DATA key. If the RS232 port is properly connected, the unit will automatically direct data to the port instead of the display. The remaining setup is identical to setting up for displaying data.



While output is in progress, pressing STOP/NEXT will abort the output and return to the status display.

IMPORTANT NOTE: Transferring data to a computer will require a program on the receiving computer that allows proper handling of the incoming data. This does not happen automatically! In many cases a terminal emulation program with file storage capabilities may be sufficient.



DATE AND TIME OF PRINTOUT

UNIT I.D. NUMBER

SELECTED TEST

SELECTED INPUT AND PARAMETERS

TYPE OF INPUT

SELECTED STEP

START DATE AND TIME OF STEP

ELAPSED TIME IN MINUTES

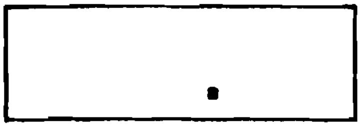
DATA IN SELECTED UNITS

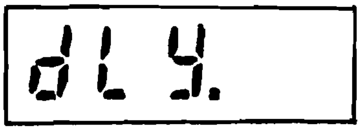
```
          SE1000B

       03/25  09:53

     Unit# 00000  Test# 0

  INPUT 1:  Level (F) TOC

  Reference          21.70
  Scale factor       50.12
  Offset              0.00

  Step# 0   03/25  09:22

  Elapsed Time      Value
  ------------     -------
     0.0000          21.66
     0.0033          21.85
     0.0066          22.83
     0.0099          24.76
     0.0133          25.52
     0.0166          26.69
     0.0200          27.12
     0.0233          27.15
     0.0266          27.31
     0.0300          27.33
     0.0333          27.52
     0.0500          29.21
     0.0666          31.18
     0.0833          34.32
     0.1000          35.74
     0.1166          36.80
     0.1333          38.36
     0.1500          39.74
     0.1666          41.27
     0.1833          42.62
     0.2000          44.15
     0.2166          45.69
     0.2333          46.90
     0.2500          48.72
     0.2666          50.42
     0.2833          52.90
     0.3000          55.85
     0.3166          56.61
     0.3333          57.86
     0.4167          66.74
     0.5000          75.66
     0.5833          80.89
     0.6667          89.35
     0.7500          90.93
     0.8333          90.95
     0.9167          90.95
     1.0000          90.95
     1.0833          90.95
     1.1667          90.97
     1.2500          90.97
     1.3333          90.97
     1.4166          90.97
     1.5000          90.98
     1.5833          90.98
     1.6667          91.01
     1.7500          91.01
     1.8333          91.01
     1.9             91.01
```

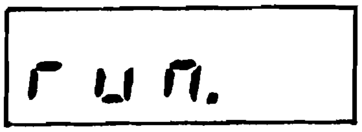
Sample Printout

8. SYSTEM CONFIGURATION

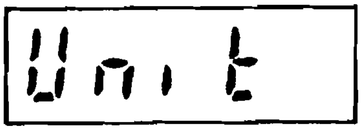
The system configuration menu is available while in any test mode by holding down the ENTER key and pressing START. The display shows the top selection of the menu.







Use the SCAN DOWN key to move the display towards the bottom of the menu; SCAN UP to move the display towards the top of the menu. STOP/NEXT will exit the menu and return to the status display. Press ENTER to view or modify the selected parameter.



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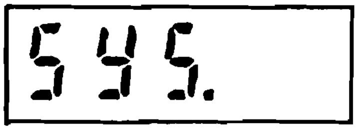

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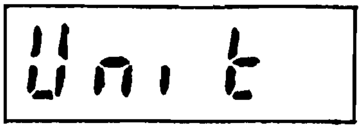
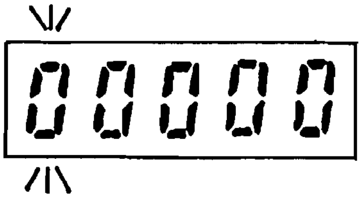
Unit Identification

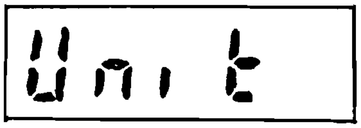
To modify the unit's identification number, press ENTER when the display shows the unit parameter.



The current value of the unit i.d. is displayed with the leftmost digit blinking. Use the SCAN and STOP/NEXT keys to change the digits to their correct values.



Press ENTER to set the new value. The display returns to the system menu.



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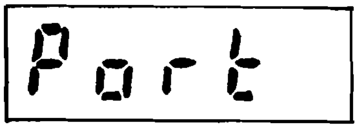
The unit identification number is used to help identify printouts and data transfers when data is output to the RS232 port.

RS232 Port

To modify the RS232 port, press ENTER when the display shows the port parameter. The display shows the top selection of the port menu.



Use the SCAN DOWN key to move the display towards the bottom of the menu; SCAN UP to move the display towards the top of the menu. STOP/NEXT will exit the port menu and return to the system menu. Press ENTER to view or modify the selected parameter.

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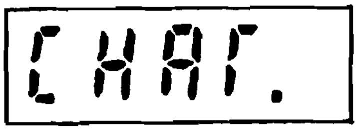

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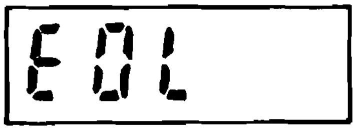

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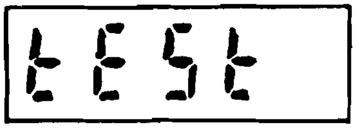

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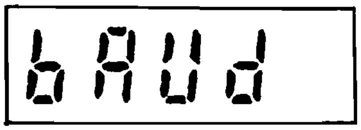
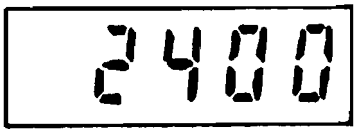
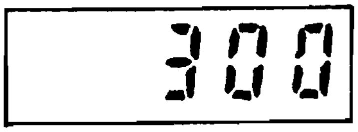
To modify the port baud rate, press ENTER when the display shows the baud parameter.



The current baud setting is displayed. Use the SCAN UP key to move the display towards the top of the menu; SCAN DOWN to move the display towards the bottom of the menu. STOP/NEXT will exit this menu and return to the port menu without changing the current baud setting.

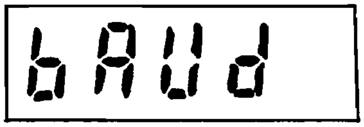


Top



Bottom

Press ENTER to set the new baud rate. The display returns to the port menu.



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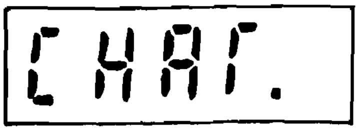
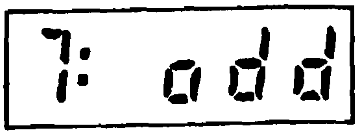
NOTE: A setting of 1200 baud is required for use with the SE1004B field printer.

To modify the port character parameters, press ENTER when the display shows the character parameter.



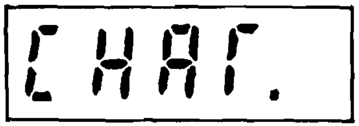
The current character configuration is displayed. Use the SCAN UP key to move the display towards the top of the menu; SCAN DOWN to move the display towards the bottom of the menu. STOP/NEXT will exit this menu and return to the port menu without changing the current character configuration. Select seven or eight character bits and odd, even or no parity.

Top



Bottom

Press ENTER to set the new character configuration. The display returns to the port menu.



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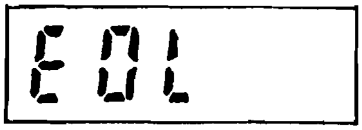
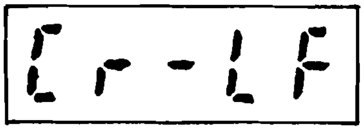
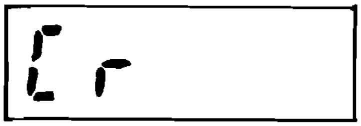
NOTE: A setting of eight bits with no parity is suggested for use with the SE1004B field printer.

To modify the port end of line sequence, press ENTER when the display shows the EOL parameter.

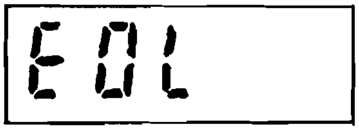


The current EOL sequence is displayed. Use the SCAN UP key to select carriage return plus line feed or SCAN DOWN to select carriage return only. STOP/NEXT will exit this menu and return to the port menu without changing the current EOL sequence.





Press ENTER to set the new EOL sequence. The display returns to the port menu.



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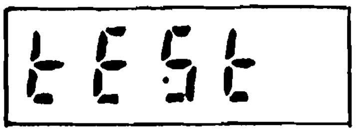
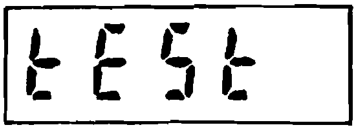
NOTE: The EOL sequence must be set to carriage return only for use with the SE1004B field printer.

To test the RS232 port, press ENTER when the display shows the test parameter.



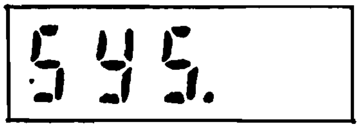
The unit will repeatedly output the line "SE1000B TEST LINE." until the unit sleeps or STOP/ NEXT is pressed.

The display will then return to the port menu.

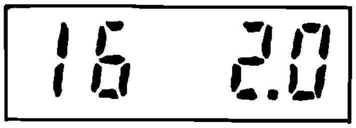


System Status

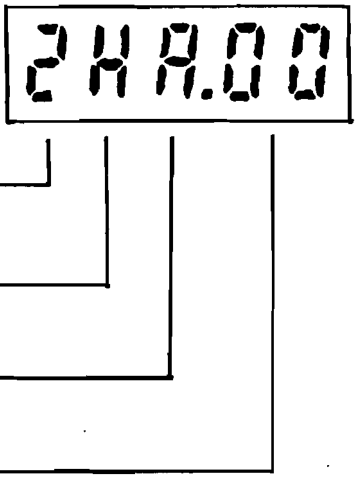
To view the system status, press ENTER when the display shows the system parameter.



The display first shows the number of kilobytes of data memory installed and the unit's program version ...



... then a list of the options installed ...



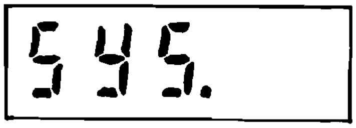
1 or 2 inputs

High resolution option, blank if not installed

Alarm option, blank if not installed

Communiations option, 00 indicates none installed

... then returns to the system menu.



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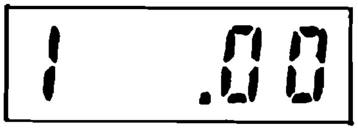
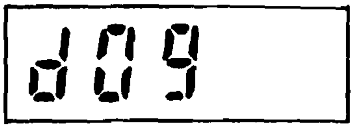
This display shows, for example, a unit with only one input, no alarms or other communications options.



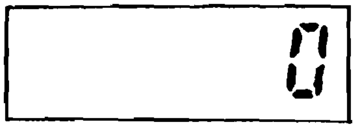
Watchdog Counter

The SE1000B has an internal timer called a "watchdog" that aids in restoring the unit when normal operation is upset by nearby lightning strikes, static electricity, etc. When the unit recovers from an event of this sort, the watchdog counter is incremented. Ideally the counter will always be zero. Small counts indicate normal recoveries from transient events. A high count may indicate a malfunctioning instrument.

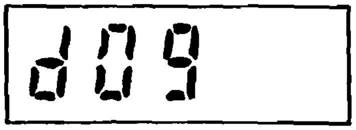
To view the watchdog counter, press ENTER when the display shows the watchdog parameter.



The display shows the counter value ...



... then returns to the system menu.



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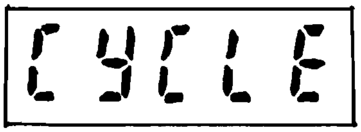
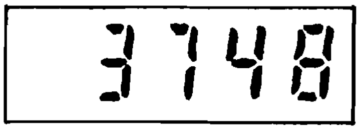
Power Cycle Counter

The SE1000B has a second diagnostic counter that is incremented once each time the unit wakes up. This counter may be used as an aid to judging system usage and battery life.

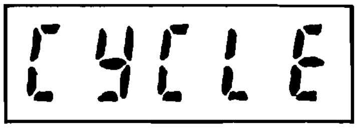
To view the number of wakeup cycles, press ENTER when the display shows the cycle parameter.



The display shows the number of cycles ...



... then returns to the system menu.



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9. DATA COLLECTION EXAMPLES

The procedures presented in this section will give the operator a guide to setting up the SE1000B for various test situations. Many more data collection configurations are possible, but all will follow one or more of these basic outlines. Detailed key press sequences are omitted to provide a quicker reference. Refer to the sections on front panel operation when necessary.

The Complete Pump Test

This outline presents procedures for collecting down hole water level data in a well during a pump test. The SE1000B will be used to collect background data prior to the test, drawdown data during the test, and recovery data after the test. A pressure transducer will be used to measure head and the SE1000B will be programmed to present all readings as water levels measured from the top of the well casing (positive numbers increasing into the well). A transducer is selected that is capable of measuring the maximum drawdown expected in the well.

Begin by programming the unit to collect background data in the well:

1. Check that the clock is correct and set it if necessary.
2. Enter the test definition parameters:
    - Select test 0.
    - Select a linear sampling rate with the required interval.
    - Select 1 active input.
    - Select the type of input as LEVEL.
3. Enter the transducer parameters:
    - REF.: skip this parameter for now.
    - SCALE: set to value as marked on transducer.
    - OFFS.: set to zero or as marked on transducer.
    - DSP.: select top of casing mode and English or metric units.
    - HI AL: set off or to desired value (if installed).
    - LO AL: set off or to desired value (if installed).

4. Connect the transducer to the unit and set the transducer into the well at the desired depth. The transducer must be set below the lowest anticipated drawdown, though it is not necessary that it be at the bottom of the well.

5. Use the XD key to display the transducer's depth and to verify that all connections have been made properly.

6. Go back and enter the reference level of the water. This can be the initial level of the water with respect to the top of the casing, or zero if only changes in level are important.

7. Use the START function to begin collecting data.

The unit is now left in the field to collect background data on the well. Upon returning to the field the day of the pump test, the STOP function is used to end background data collection and the unit is set up for the pump test.

1. Enter the test definition parameters:

   - Select test 1.

   - Select the log sampling mode.

   - The number and type of inputs do not need to be changed.

2. The transducer parameters do not need to be reentered. They were automatically copied when test 1 was selected.

3. Double check the transducer setting and connections by observing the transducer depth with the XD key.

4. Use the START function to begin collecting data. The immediate start mode can be used if the pump starting mechanism is conveniently close to the unit or synchronization is not critical. The delayed start mode can be used when the unit is remotely located from the pump.

5. During the first 10 minutes of a log mode test, STOP is the only active keyboard function. After 10 minutes full keyboard operation is restored. Stored data may then be viewed or printed at any time without affecting the data collection process.

Recovery data is treated as a step in the main pump test. When pumping is complete, the unit is set up for recovery.

6. Use the START function to begin collecting recovery data. The immediate start mode or delayed start mode is selected based on the convenience of synchronizing with the pump shutoff.

7. Use the STOP function to end data collection. The final data may be viewed or output, or another test may be run by selecting a new test number (memory capacity permitting).

Many extensions to this basic scheme are possible. A second input could be used, in the function mode, during drawdown to monitor the flow rate out of the well. More steps could be used during drawdown to monitor a stepped flow rate test. Fast data sampling coupled with the ability to store as many as ten sets of data at once also make the SE1000B an excellent slug test recorder.

Monitoring Surface Water

This outline presents the procedure for monitoring the depth of a reservoir, lake or stream over an extended period of time. As in the previous example, a pressure transducer is used to measure head; but this time the SE1000B will be programmed to present the water levels referenced as elevation. Additionally, the second input will be used to monitor conductivity as a measure of the water quality. A bonus to the conductivity transducer is that temperature is also monitored so in effect three parameters are recorded. The unit is set up as follows:

1. Check that the clock is correct and set it if necessary.

2. Enter the test definition parameters:

   - Select test 0 (to maximize test length)

   - Select a linear sampling rate with the required interval

   - Select 2 active inputs.

   - Select input 1 as a LEVEL input.

   - Select input 2 as a DUAL input.

3. Enter the transducer parameters for input 1:

   - REF.: skip this parameter for now.

   - SCALE: set to value marked on transducer.

   - OFFS.: set to zero or as marked on transducer.

   - DSP.: select surface mode and English or metric units

   - HI AL: set off or to desired value (if installed).

   - LO AL: set off or to desired value (if installed).

4. Enter the transducer parameters for input 2:

   - COEF.: set coefficients per values marked on transducer.
   - HI AL: set off or to desired value (if installed).
   - LO AL: set off or to desired value (if installed).

5. Connect both transducers to the unit and set the transducers at the desired depth. The transducers must be set below the lowest anticipated water level.

6. Use the XD key to display the pressure transducer's depth and the values of conductivity and temperature. This will verify that all connections have been made properly.

7. Go back and enter the reference elevation of the water surface. This reference is arbitrary and may reflect the actual elevation, the depth of the water or, set to zero, only changes in water level.

8. Use the START function to begin collecting data. Often it is convenient to use the delayed start to begin at a convenient time of day, such as on the quarter hour when a fifteen minute rate is used.

The unit is now left in the field to collect data. Data may be displayed or output at any time without affecting data collection. Use the STOP function to end data collection (data collection will stop automatically when the memory is full).

10. MAINTENANCE, SERVICE AND WARRANTY

Maintenance

There are no customer servicable parts inside the SE1000B. The unit should require no calibration or periodic maintenance during its service life. It should not be necessary to clean the connectors or cable contacts. The action of installing the cables is normally sufficient to clean contamination from the contacts. The front panel may be wiped cleaned with a soft, damp cloth.

Battery Replacement

The battery pack used in the SE1000B is of special design, requiring that the unit be returned to In-situ's customer service facility for replacement. Permanent damage to the unit can result from improper replacement packs and procedures. When the low battery indicator appears in the display, the unit has approximately ten hours of "wake" time left. External power may be used to supplement battery power until the unit can be returned for a replacement pack.

Service

The SE1000B may need to be returned for service if any of the following symptoms appear:

1. A display of the form "Err.20" indicates that the unit does not pass its internal self tests. The unit will not permit itself to be used for data collection and data already stored in the unit is inaccessible (upon waking up, the unit will display the error and immediately go back to sleep).
2. An unusually high number of watchdog counts may indicate an intermittent problem. The unit may be used for data collection but should be returned for a checkup as soon as possible.
3. A low battery indication in the display. The unit can probably finish the current test and dump the data. Long term tests should not be started when the unit is in this condition.

If symptoms other than these are apparent, check the cable interconnections and the programming of the SE1000B before requesting service on the unit. One incorrect scale factor or coefficient setting can cause data to appear way off!

Warranty

The SE1000B is warranted against defects in materials and workmanship for ninety (90) days from the date of delivery. During the warranty period, In-situ will repair or, at its option, replace at no charge components that prove to be defective, provided the instrument is returned, prepaid, to In-situ's Customer Service Facility.

This warranty does not apply if the instrument has been damaged by accident or misuse, or as a result of service or modification by other than In-situ. No other expressed or implied warranty is given by In-situ. IN-SITU SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES.

11. SHIPPING INSTRUCTIONS

WARNING

THE SE1000B USES BATTERIES CONTAINING LITHIUM WHICH THE DEPARTMENT OF TRANSPORTATION (DOT) CONSIDERS AS A HAZARDOUS MATERIAL. THE SE1000B MUST NEVER BE TRANSPORTED ON PASSENGER AIRCRAFT. FOLLOW ALL SHIPPING INSTRUCTIONS CAREFULLY.

General

Instruments returned for repair should be sent to In-situ, Inc., Customer Service Facility, 210 South 3rd Street, Laramie, WY 82070. All shipments to In-situ's Customer Service Facility must be made prepaid, even if the unit is in warranty. Warranty repairs will be shipped prepaid back to the customer. Damage occurring during transit is not covered by warranty. In-situ suggests that the customer insure all shipments.

Because of the hazardous materials requirement, it is necessary to prepare special documentation for shipping the SE1000B. The process is greatly simplified when the original packing materials are used. All proper packing materials, labels and exemption papers were provided. Sample copies of the necessary documents are provided in this section in the event the originals are lost.

Federal Express

When shipping Federal Express, include the following with the shipment:

1. One copy of the DOT exemption DOT-E 7052 (see Figure 1). Note item 8a on page 2 of the exemption.

2. SHIPPER'S CERTIFICATION FOR RESTRICTED ARTICLES which carries the number of the attached Federal Express AIRBILL (see Figure 2).

3. Print with marker on upper left-hand corner of carton:

   PER DOT-E 7052.

4. Labels shown in Figure 3 <u>must</u> be affixed to outside of carton.

United Parcel Service (UPS)

When shipping UPS, include the following with shipment:

1. One copy of the DOT exemption DOT-E 7052 (see Figure 1). Note item 8a on page 2 of the exemption.

2. A UPS FIVE-PART-FORM to be affixed to the outside of the carton (see Figure 4). A standard UPS weigh bill must also be completed for shipment.

3. Print with marker on upper left-hand corner of carton:

   PER DOT-E 7052.

4. Labels shown in Figure 3 <u>must</u> be affixed to outside of carton.

US Department
of Transportation

Research and
Special Programs
Administration

400 Seventh Street, S.W.
Washington, D.C. 20590

JUN 9 1989

DOT-E 7052
(NINETEENTH REVISION)

1. Power Conversion, Inc., Elmwood, New York, is hereby granted an exemptions from certain provisions of this Department's Hazardous Materials Regulations to offer packages prescribed herein of a certain flammable solid for transportation in commerce subject to the limitations and special requirements specified herein. This exemption authorizes the shipment of lithium batteries and provides no relief from any regulation other than as specifically stated. Each of the following is hereby granted the status of a party to this exemption (SEE APPENDIX I).

2. BASIS. This exemption is based on Power Conversion's application dated September 2, 1987, submitted in accordance with 49 CFR 107.105. The granting of party status is based on the following applications submitted in accordance with 49 CFR 107.111 and the public proceeding thereon (SEE APPENDIX II).

3. HAZARDOUS MATERIALS (Descriptor and class). Lithium batteries and cells containing Metallic lithium, Vanadium pentoxide, Chromium oxide, Lithium cobalt dioxide, Manganese dioxide, Monofluorographite, Sulfur dioxide, Lithium bromide salts, Acetonitrile, or mixtures of Acetonitrile and Propylene carbonate, Methyl formate and Methyl acetate; also lithium batteries and cells containing lithium copper oxide and lithium copper oxyphosphate, Lithium Ferrosolfate, Lithium metal, a depolarizer such as Titanium disulfide, Thionyl chloride or Sulphuryl chloride or Polycarbonmonofluoride and a Lithium salt such as Lithium tetrachloroaluminate or Lithium perchlorate or Lithium tetrafluoroborate, Lithium molybdenum disulfide and Lithium hexafluoroarsenate, Vanadium pentoxide - classed as flammable solid; rechargeable lithium batteries and devices containing any lithium batteries other than those excepted under or Section 173.206(f) must be specifically identified to, and acknowledged in writing by, the Office of Hazardous Materials Transportation (OHMT), prior to the first shipment.

This exemption does not authorize the transportation of cells containing lithium metal which have been discharged to the extent that the open circuit voltage is less than two volts, or batteries containing one or more such cells. However, cells or batteries discharged to below 2 volts, not to exceed 100 cells or batteries per shipment, may be shipped for testing purposes by highway only.

4. PROPER SHIPPING NAME (49 CFR 172.101). Lithium batteries.

5. REGULATION AFFECTED. 49 CFR 172.101, 172.400, 175.3.

6. MODES OF TRANSPORTATION AUTHORIZED. Motor vehicle, rail freight, cargo vessel and cargo-aircraft only and crew carrying helicopter used to service off-shore oil rigs only.

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7. SAFETY CONTROL MEASURES. Packaging prescribed is as follows:

a. Cells and batteries must be packed in strong inner fiberboard containers limited to a maximum of 500 grams of lithium in one inner container. No cell containing more than 12 grams of lithium may be shipped under this exemption.

b. When drums are used, the inner containers must be separated from each other and all inner surfaces of the drum by at least one inch thickness of vermiculite or other equivalent noncombustible cushioning materials.

c. Inside boxes must be further overpacked as specified in paragraphs (8c) or (8d).

d. Packages must be marked as prescribed in Subpart "D" of 49 CFR Part 172. Packages must be labeled with the FLAMMABLE SOLID label shown in 49 CFR 172.420 or in Fig. 4-8 of ICAO Technical Instructions.

e. Each cell and battery must be equipped with an effective means of preventing external short circuits.

f. Each cell and battery must incorporate a safety venting device or be designed in such a manner that will preclude a violent rupture under any condition incident to transportation such as a "dead short". The design of cells and batteries not equipped with a safety venting device must be specifically identified to this office prior to the first shipment of package. Batteries containing cells or series of cells connected in parallel must be equipped with diodes to prevent reverse current flow.

g. Three representative cells must be taken from each week's production of each cell type and be subjected to the test prescribed in Section 3.2.1(1) of Appendix B, Report ECOM730242F on file with the OHMT.

h. One representative battery must be taken from each week's production of each battery type and must be subjected to the test prescribed in Section 3.2.2(1) of the above referenced report.

i. At least 10 cells and one battery of each type of each week's production must be subjected to a thermal stability test at 75°C., for 48 hours and show no evidence of distortion, leakage or internal heating.

j. When shipped in oil rig service helicopter maximum amount of lithium in one inner packaging shall not exceed 300 grams.

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8. SPECIAL PROVISIONS.

a. Persons who receive cells and batteries covered by this exemption may reship them pursuant to the provisions of 49 CFR 173.22a in any of the packagings authorized in this exemption including those in which they were received.

b. A copy of this exemption must be carried aboard each vessel and aircraft used to transport packages covered by this exemption.

c. For shipment by cargo-aircraft only, the outside conntainer must be a removable head drum of the DOT Specification 17H or 17C series (or equivalent) and be equipped with a gastight gasket.

d. For shipment by water, motor vehicle, rail freight, the outside container must be either: (1) strong wooden box, (2) DOT Specification 12B fiberboard box (or equivalent), (3) DOT Specification 21C fiber drum, or equivalent, or (4) metal drum as authorized in paragraph (c) above.

e. Cells containing no more than 12 grams of lithium metal and also containing lithium molybdenum disulfide and lithium hexafluoroarsenate or vanadium pentoxide, polycarbommonofluoride, manganese dioxide, titanium disulfide, thionyl chloride and lithium tetrachloroaluminate, lithium tetrafluorobonate or acetonitrile and sulfur dioxide, or thionyl chloride/bromine complex or sulfuryl chloride and chlorine which are hermetically sealed, and batteries constructed of such cells, are excepted from the requirements of 7.g., 7.h., and 7.i. and 8.c., of this exemption when in compliance with the following:

Prior to the first shipment, 10 cells or 4 batteries of each type to be offered for transportation must be tested as follows, without showing any evidence of out-gassing, leakage, loss of weight, or distortion:

i. The cells or batteries shall be stored for 6 hours at a pressure corresponding to an altitude of 50,000 feet at 24°C ± 4°C.

ii. The cells or batteries shall then be subjected to the thermal stability test at 75°C for 48 hours as required in paragraph 7.i.

iii. The cells or batteries shall be rigidly clamped to the platform of a vibration machine. A simple harmonic motion having an amplitude of 0.03 inch (0.06 inch maximum total excursion) shall be applied. The frequency shall be varied at the rate of 1 cycle per second per minute between the limits of 10 and 55 cycles per second. The entire range of

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frequencies and return shall be traversed in 95 ± 5 minutes for each of three mutually perpendicular mounting positions of the battery and two perpendicular positions of the cells. One of the directions of vibration shall be perpendicular to the terminal face of the battery or cell. Open circuit voltage shall be observed for 30 seconds during the last quarter of each vibration period. Periodic retesting is not required.

iv. The batteries (not cells) must be subjected to a shock test as follows:

The battery shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of the battery. Each battery shall be subjected to a total of three shocks of equal magnitude. The shocks shall be applied in each of three mutually perpendicular directions. Each shock shall be applied in a direction normal to a face of the battery. For each shock, the battery shall be accelerated in such a manner that during the first 3 milliseconds the minimum average acceleration is 75 gravity units (G). The peak acceleration shall be between 125 and 175 G. Cells and batteries meeting the requirements of this paragraph must be packaged in accordance with 7.a. and 8.d. of this exemption.

f. For transportation by motor vehicle, the labeling requirements in paragraph 7.d. of this exemption do not apply to package(s) containing lithium/manganese dioxide batteries provided:

1. The batteries contain no more than 4 cells with each cell containing not more than 0.5 grams of lithium, and.

2. The gross weight of a package(s) in one motor vehicle does not exceed 65 pounds.

g. This exemption also constitutes the approval of the appropriate authority of the United States for shipment of these batteries on cargo aircraft pursuant to Special Provision A2 of the International Civil Aviation Organization (IACO) Technical Instructions.

h. The "FLIGHTS OF CARGO-AIRCRAFT ONLY" requirements of Appendix B to 49 CFR Part 107 do not apply to operations subject to this exemption.

9. REPORTING REQUIREMENTS.

a. Any incident involving loss of contents of the packages must be reported to the OHMT as soon as practicable.

[illegible] 9

b. Test data obtained under 7.g., 7.h., and 8.e. of this exemption must be kept on file and be made available upon request by the OHMT.

10. EXPIRATION DATE. December 1, 1989.

Issued at Washington, D.C.:

[illegible] 9

Alan I. Roberts (DATE)
Director
Office of Hazardous Materials
Transportation

Address all inquiries to: Director, Office of Hazardous Materials Transportation, Research and Special Programs Administration, U.S. Department of Transportation, Washington, D.C. 20590. Attention: Exemptions Branch.

Dist: USCG, FAA, FHWA, FRA

APPENDIX I

Honeywell Incorporated, Horsham, Pennsylvania - PTE-1
Saft America, Inc., (Formerly Durcell International, Inc.) Cockeysville, MD - PTE-2
Eagle-Picher Industries, Inc., Joplin, Missouri - PTE-3
GTE Government Systems Corporation, Waltham, Massachusetts - PTE-4
U.S. Department of Defense, Washington, D.C. PTE-5
Ray-O-Vac Corporation, Madison, Wisconsin - PTE-6
U.S. Department of Energy, Washington, D.C. (including its contractor Sandia Laboratories, Albuquerque, New Mexico) - PTE-7
National Aeronautics and Space Administration, Washington, D.C. - PTE-8
The Boeing Company, Seattle, Washington - PTE-9
Jet Propulsion Laboratory, Pasadena, California - PTE-10
MODICON, Incorporated, North Andover, Massachusetts, (Formerly Gould, Inc.) - PTE-11
Electrochem Industries, Inc., Clarence, New York - PTE-12
EG&G Environmental Equipment, Herndon, Virginia - PTE-13
Sonatech, Incorporated, Goleta, California - PTE-14
Altus Corporation, Palo Alto, California - PTE-15
Plainview Electronics, Corporation, Plainview, New York - PTE-16
Hazeltine Corporation, Braintree, Massachusetts - PTE-17
Magnavox Government & Industrial Electronics Co., Ft. Wayne, Indiana - PTE-18
Geophysical Research Corporation, Tulsa, Oklahoma - PTE-19
Northrop Corporation, Hawthrone, California - PTE-20
GN Lithium Batteries, Koege, Denmark (U.S. Agent RBI, Inc., Washington, D.C.) - PTE-21
NL Industries, Houston, Texas - PTE-22
In-Situ, Incorporated, Laramie, Wyoming - PTE-23
Technical Oil Tool Corporation, Norway, Oklahoma - PTE-24
DME Corporation, Pompano Beach, Florida - PTE-25
Gearhart Industries, Incorporated, Fort Worth, Texas - PTE-26
Moli Energy Limited, Burnaby, BC, Canada - PTE-27
McDonnell Douglas Corporation, St. Louis, Missouri - PTE-28
Sippican Ocean Systems, Incorporated, Marian, Massachusetts - PTE-29
Martin Marietta Corporation, Denver, Colorado - PTE-30
TNR Technical, Incorporated, Farmingdale, New York - PTE-31
General Motors Corporation, Warren, Michigan - PTE-32
General Electric Company, Philadelphia, Pennsylvania - PTE-33
ENMET Corporation, Ann Arbor, Michigan - PTE-34
Tadiran, Ltd. Industries, Incorporated, Renvot, Israel (U.S. Agent - Tadiran Electronic Industries, Woodland Hills, California) - PTE-35
Bren-Tronics, Incorporated, Commack, New York, PTE-36
Allen-Bradley Company, Milwaukee, Wisconsin - PTE-37
Panasonic Industrial Company, Secaucus, New Jersey - PTE-38
Matsushita Battery Industrial Company, Osoka, Japan, (U.S. Agent - Panasonic Industrial Company) PTE-39
Leigh Instruments, Ltd., Ontario, Canada (U.S. Agent - NAECO Assoc. Secaucus, New Jersey) - PTE-40
Sparton Corporation, Jackson, Michigan - PTE-41
Halliburton Services, Duncan, Oklahoma - PTE-42

General Dynamics, Fort Worth, Texas - PTE-43
Ballard Technologies Corporation, North Vancouver, Canada (U.S. Agent - Dr. Lynn Marcoux, Tustin, California) - PTE-44
Flow Research Corporation, Houston, Texas - PTE-45
Battery Engineering, Incorporated, Hyde Park, Massachusetts - PTE-46
Exploration Logging, Incorporated, Sacramento, California - PTE-47
Flopetrol Johnston, (Division of Schlumberger), Houston, Texas - PTE-48
Datasonic's, Incorporated, Cataumet, Massachusetts - PTE-49
Crompton Parkinson, Ltd., (U.S. Agent - Crompton Instruments, Inc., Chicago, Illinois) - PTE-50
ACR Electronics, Incorporated, Hollywood, Florida - PTE-51
Syntron, Incorporated, Houston, Texas - PTE-52
Macrodyne, Incorporated, Schenectady, New York - PTE-53
XCELATRON, Incorporated, Chimacum, Washington - PTE-54
Tadiran Electronic Industries, Woodland Hills, California - PTE-55
Beckman Instruments, Incorporated, Fullerton, California - PTE-56
Aluminum Company of America, Pittsburgh, Pennsylvania - PTE-57
Smith International, Houston, Texas - PTE-58
ITT Barton Instruments Co., City of Industry, California - PTE-59
Eveready Battery Co., Inc., Rocky River, Ohio - PTE-60
Telonics, Incorporated, Mesa, Arizona - PTE-61
Toshiba Battery Co., Ltd. (U.S. Agent - Marks, Murase and White, New York) - PTE-62
Schlumberger Well Service, Rosharon, Texas - PTE-63
EIC Laboratories, Incorporated, Norwood, Massachusetts - PTE-64
Clifton Precision Systems Division, Springfield, Pennsylvania - PTE-65
ENDECO, Incorporated, Marion, Massachusetts - PTE-66
Hughes Electronic Products Corp., Livonia, Michigan - PTE-67
Priebe Electronics, Redmond, Washington - PTE-68
Engineered Assemblies Corp., Clifton, New Jersey - PTE-69
Tracor Applied Sciences, Incorporated, Rockville, Maryland - PTE-70
Terra Tek Geoscience Services, Salt Lake City, Utah - PTE-71
FABRIKA Ni-cd Baterija "TREPCA" Gnjilane, Yugoslavia (U.S. Agent - Metalchemical Commercial Corp., New York, New York - PTE-72
American Meter Company, Philadelphia, Pennsylvania - PTE-73
Eastman Christensen, Salt Lake City, Utah - PTE-74
Teledyne Systems Co., Northridge, California - PTE-75
Interstate Electronics Corp., Anaheim, California - PTE-76
Wilson Greatbatch Ltd., Clarence, New York - PTE-77
W.R. Grace & Company, Columbia, Maryland - PTE-78
ECO Energy Conversion, Somerville, Massachusetts - PTE-79
Siemens Corporate Research & Support, Incorporated, Jamaica, New York - PTE-80
Siemens, Ag., Munchen, West Germany (U.S. Agent - Siemens Corporate Research & Support, Inc., Jamaica, NY) - PTE-81
DYMEC, Incorporated, Winchester, Massachusetts - PTE-82
Battery Assemblies, Incorporated, Bohemia, New York - PTE-83
Battery Pak, Incorporated, Spring, Texas - PTE-84
Datachecker Systems, Santa Clara, California - PTE-85
Synergistic Batteries, Incorporated, Marietta, Georgia - PTE-86
Wildlife Materials, Incorporated, Carbondale, Illinois - PTE-87
Penwood, Incorporated, Fort Worth, Texas - PTE-88

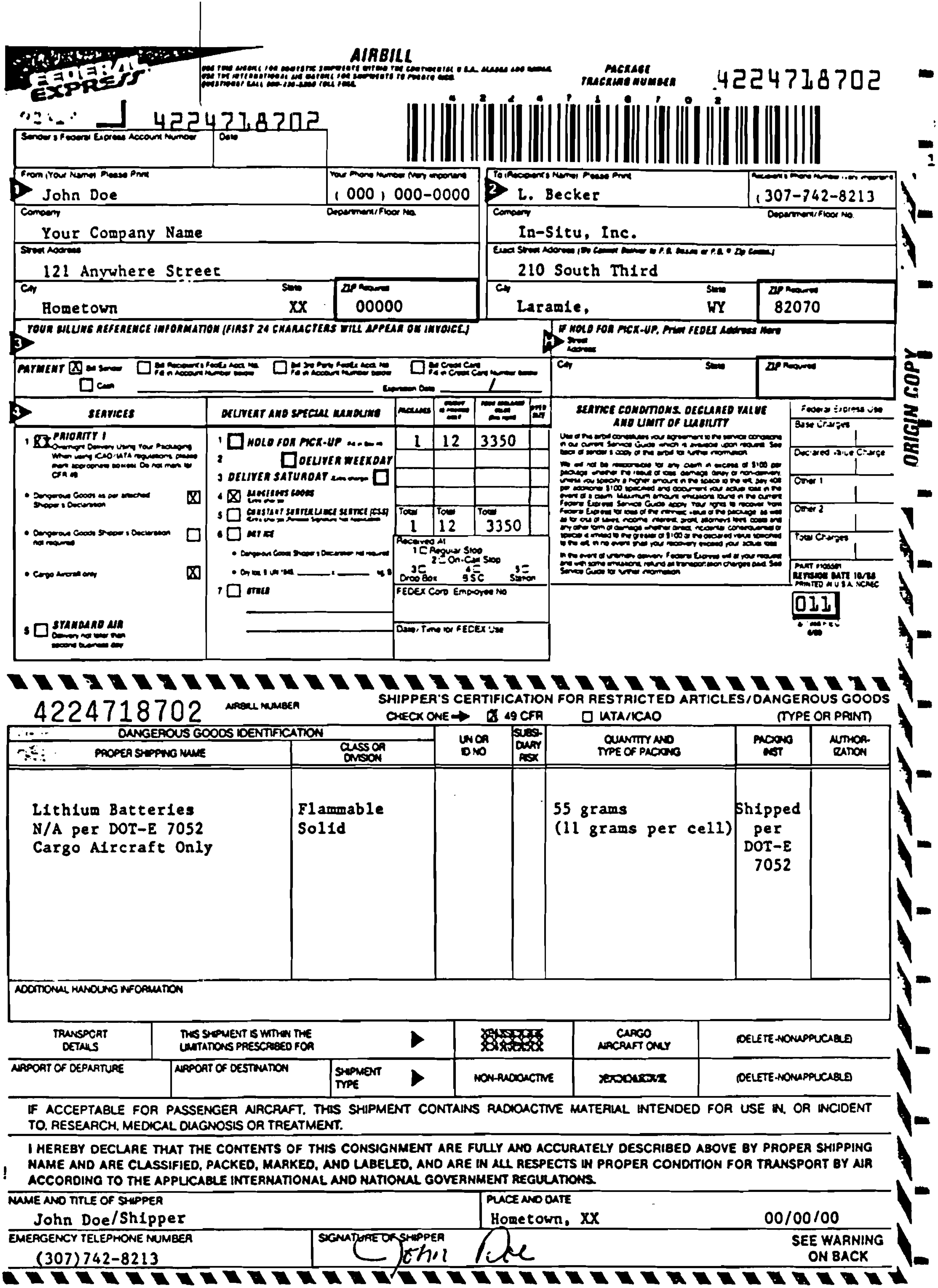
Lockheed Aeronautical Systems Company, Burbank, California - PTE-89
Tauber Electronics, Incorporated, San Diego, California - PTE-90
Adcour, Incorporated, Sharon, Massachusetts - PTE-91
Mil-Con Electronics Corporation, San Antonia, Texas - PTE-92
EnScan, Incorporated, Eden Prairie, Minnesota - PTE-93
Acme Aerospace Products Group, Salt Lake City, Utah - PTE-94
Hoppecke Battery Company, Hoppecke, West Germany (U.S. Agent - Acme Aerospace Products Group, Salt Lake City, Utah) - PTE-95
Motorola, Incorporated, Fort Lauderdale, Florida - PTE-96
Singer Dalmo Victor Division, Belmont, California - PTE-97
Whittaker Yardney Power Systems, Waltham, Massachusetts - PTE-98
Maxell Corporation of America, Fairlawn, New Jersey - PTE-99
Hitachi-Maxell, Ltd., Osaka, Japan - PTE-100
Beta Phase, Inc., Menlo Park, California - PTE-101
3M, St. Paul, Minnesota - PTE-102
Hydril Production Technology Division, Houston, Texas - PTE-103
Wimpol, Incorporated, Houston, Texas - PTE-104
DigiCourse, Incorporated, Haraban, Connecticut - PTE-105
Aquatronics, Portownsend, WA - PTE-106
Wood Group Wireline Products, Inc. Fort Worth, TX - PTE-107
GE Aerospace, Philadelphia, PA - PTE-108
GE Reuter Stokes, Twinsburg, OH - PTE-109
DC - Battery Products, St. Paul, MN - PTE-110
Trimble Navigation, Ltd., Sunnyvale, CA - PTE-111
Tracor Aerospace, Inc., Austin, TX - PTE-112
TDW Pipeline Surveys (Div. of TDW Service, Inc.), Tulsa, OK - PTE-113
Delta Environmental Consultants, Inc., Tampa, FL - PTE-114
The Bob Fournet Company, Lafayette, LA - PTE-115
K-Con International, Salt Lake City, UT - PTE-116
Mercury Instruments, Inc., Cincinnati, OH - PTE-117
Honeywell, Inc., Defense Avionics Systems Div., Albuquerque, NM - PTE-118
SAIC Technology, San Diego, CA - PTE-119
Ocean Technology, Inc., Burbank, CA - PTE-120
SAB/NIFE, Inc., Greenville, NC - PTE-121
Medtronic, Inc., Brooklyn Center, MN - PTE-122
Valvcon Corporation, Nelford, NH - PTE-123
Geomar International, Inc., Missouri City, TX - PTE-124
Oceanstar Systems, Inc., Cataumet, MA - PTE-125
Perfco Wireline, Inc., Houma, LA - PTE-126
Telecommunication Device, Inc., Downers Grove, IL - PTE-127
Fairchild Industries, Inc., Germantown, MD - PTE-128

APPENDIX II

Honeywell Inc.'s application dated June 2, 1987.
Saft America, Inc.'s (Formerly Duracell Int'l, Inc.,) application dated January 17, 1989.
Eagle-Picher Industries, Inc.'s application dated September 15, 1987.
GTE Government Systems Corporation's application October 8, 1987.
U.S. Department of Defense's application dated September 4, 1987.
Ray-O-Vac Corporation's application dated November 30, 1987.
U.S. Department of Energy's application dated November 30, 1987.
National Aeronautics and Space Administration's application dated September 4, 1987.
The Boeing Company's application dated September 14, 1987.
Jet Propulsion Laboratory's application dated October 12, 1987.
MODICON, Inc.'s, (Formerly Gould, Inc.,) applications dated April 22, 1988 and supplement dated July 6, 1988.
Electrochem Industries, Incorporated's application dated November 2, 1987.
EG&G Environmental Equipment's application August 19, 1987.
Sonatech, Incorporated's application dated October 14, 1987.
Altus Corporation's application dated November 5, 1987.
Plainview Electronics Corporation's application dated September 2, 1987.
Hazeltine Corporation's application dated October 28, 1987.
Magnavox Government & Industrial Electronics Co's application dated September 29, 1987.
Geophysical Research Corporation's application dated August 27, 1987.
Northrop Corporation's application dated October 8, 1987.
GN Lithium Batteries (Formerly A/S Hellesens - Hellesens Battery Engineering, Inc.) application dated October 12, 1987.
NL Industries'application dated October 17, 1987.
In-Situ, Incorporated's application dated October 7, 1987.
Technical Oil Tool Corporation's application dated February 18, 1988.
DME Corporation's application dated October 29, 1987.
Gearhart Industries, Incorporated's application dated October 7, 1987.
Moli Energy Limited's application dated October 5, 1987.
McDonnell Douglas Corporation's application dated October 23, 1987.
Sippican Ocean Systems, Incorporated's application dated October 26, 1987.
Martin Marietta Corporation's application dated September 2, 1987.
TNR Technical, Inc.'s application dated October 5, 1987.
General Motors Corp's application dated January 21, 1988.
General Electric Company's application dated March 9, 1988.
ENMET Corporation's application dated September 9, 1987.
Tadiran, Ltd's Industries, Inc., application dated December 14, 1987.
Bren-Tronics, Inc.'s application dated October 26, 1987.
Allen-Bradley Company's applications dated February 17, 1988.
Panasonic Industries Company's application dated December 15, 1987.
Matsushita Battery Industrial Co., application dated December 15, 1987.
Lehigh Instruments, Ltd's application dated September 16, 1987.
Sparton Corporation's application dated October 6, 1987.
Halliburton Services' application dated August 11, 1987.
General Dynamics' application dated September 28, 1987.
Ballard Technologies Corporation's application dated November 25, 1987.
Flow Research Corporation's application dated October 26, 1987.

Battery Engineering, Inc.'s application dated October 5, 1987.
Exploration Logging, Inc.'s application dated December 21, 1987.
Flopetrol Johnston's (Division of Schlumberger) application dated October 26, 1987.
Datasonic's, Inc.'s application dated December 23, 1987.
Crompton Parkinson, Ltd's (U.S. Agent - Crompton Instruments, Inc.) application dated December 12, 1987.
ACR Electronics, Inc.'s application dated November 6, 1987.
Syntron, Inc.'s application dated December 15, 1987.
Macrodyne, Inc.'s application dated October 27, 1987.
XCELATRON, Inc.'s application dated November 24, 1987.
Tadiran Electronic Industries' application dated December 14, 1987.
Beckman Instruments, Inc.'s application dated October 13, 1987.
Aluminum Company of America's application dated December 14, 1987.
Smith International application dated September 23, 1987.
ITT Barton Instruments Company's application dated October 14, 1987.
Eveready Battery Co., Inc.'s application dated February 18, 1988.
Telonics, Inc.'s application dated September 15, 1987.
Toshiba Battery Co., Ltd's application dated October 30, 1987.
Schlumberger Well Service's dated September 29, 1987 and September 26, 1988.
EIC Laboratories, Inc.'s dated January 15, 1988.
Clifton Precision Systems Division's application dated March 29, 1988.
ENDECO, Inc.'s application dated November 4, 1987.
Hughes Electronics Products Corp's application dated October 9, 1987.
Priebe Electronics' application dated February 23, 1988.
Engineered Assemblies Corporation's application dated January 25, 1988.
Tracor Applied Sciences, Inc.'s application dated March 25, 1988.
Terra Tek Systems' application dated February 22, 1988.
FABRIKA Ni-cd Baterija "TREPCA'S" application dated December 9, 1987.
American Meter Company's application dated October 9, 1987.
Eastman Christensen's application dated October 8, 1987.
Teledyne Systems Company's application dated October 14, 1987.
Interstate Electronics Corp's application dated October 16, 1987.
Wilson Greatbatch Ltd's application dated November 2, 1987.
W.R. Grace & Company's application dated April 26, 1988.
ECO Energy Conversion's application dated November 18, 1987.
Siemens Corporate Research & Support, Inc.'s application dated November 20, 1987.
Siemens, AG's application dated November 10, 1987.
DYMEC, Inc.'s application dated September 9, 1987.
Battery Assemblies, Inc.'s application dated October 14, 1987.
Battery Pak, Incorporated's application dated November 11, 1987.
Datacbecker System's application dated November 12, 1987.
Synergistic Batteries, Inc.'s application dated November 16, 1987.
Wildlife Materials, Inc.'s application dated November 19, 1987.
Penwood, Inc.'s application dated December 9, 1987.
Lockheed Aeronautical Systems Co.'s application dated March 25, 1988.
Tauber Electronics, Inc.'s application dated March 25, 1988.
Adcour, Inc.'s application dated March 31, 1988.
Mil-Com Electronics Corp's application dated January 18, 1988.
EnScan, Incorporated's, application dated January 19, 1988.
Acme Aerospace Products Group's application dated March 2, 1988.

Hoppecke Battery Company's application dated March 2, 1988.
Motorola, Incorporated's application dated March 11, 1988.
Singer Dalmo Victor Division's application dated April 12, 1988.
Whittaker Yardney Power Systems' application dated July 22, 1988.
Maxell Corporation of America's application dated August 2, 1988.
Hatachi-Maxell, Ltd. (U.S. Agent - Maxell Corporation of America) - application dated August 3, 1988.
Beta Phase, Incorporated's, application dated July 22, 1988.
3M's application dated July 28, 1988.
Hydril Production Technology Division's application dated August 2, 1988.
Wimpol, Incorporated's application dated August 26, 1988.
DigiCourse, Incorporated's application dated May 4, 1988.
Aquatronics' application dated October 21, 1988.
Wood Group Wireline Products, Inc.'s application dated October 27, 1988.
G. E. Aerospace's application dated November 2, 1988.
GE Reuter Stokes' application dated October 14, 1988.
DC Battery Products' application dated October 3, 1988.
Trimble Navigation, Ltd's. application dated September 22, 1988.
Tracor Aerospace, Inc.'s application dated October 24, 1988.
TDW Pipeline Surveys Div., of TDW Services, Inc.'s application dated November 11, 1988.
Delta Environmental Consultants, Inc.'s application dated December 6, 1988.
The Bob Fournet Company's application dated December 14, 1988.
R-Con International's applications dated November 15, 1988 and January 31, 1989.
Mercury Instruments, Inc's applications dated February 2 and 17, 1989.
Honeywell, Inc., - Defense Avionics Systems Div.'s applications dated September 2, 1988 and February 7, 1989.
SAIC Technology's application dated February 15, 1989.
Ocean Technology, Inc.'s application dated October 28, 1988 and supplemental letter dated April 19, 1989.
SAB/NIFE, Inc's application dated February 7, 1989.
Medtronic, Inc.'s application dated February 27, 1989.
Valvcon Corporation's application dated February 28, 1989.
Geomar Internations, Inc.'s application dated March 8, 1989.
Oceanstar Systems Inc.'s application dated March 15, 1989.
Perfco Wireline, Inc.'s application dated March 20, 1989.
Telecommunication Devices, Inc.'s application dated March 20, 1989.
Fairchild Industries, Inc.'s application dated April 19, 1989.



FEDERAL EXPRESS

AIRBILL

PACKAGE TRACKING NUMBER 4224718702

4224718702

Sender's Federal Express Account Number	Date
From (Your Name) Please Print: John Doe	Your Phone Number (Very Important): (000) 000-0000
Company: Your Company Name	Department/Floor No.
Street Address: 121 Anywhere Street	
City: Hometown State: XX	ZIP Required: 00000

To (Recipient's Name) Please Print: L. Becker	Recipient's Phone Number: (307-742-8213
Company: In-Situ, Inc.	Department/Floor No.
Exact Street Address: 210 South Third	
City: Laramie, State: WY	ZIP Required: 82070

YOUR BILLING REFERENCE INFORMATION (FIRST 24 CHARACTERS WILL APPEAR ON INVOICE.)

IF HOLD FOR PICK-UP, Print FEDEX Address Here
Street Address
City State ZIP Required

PAYMENT ☒ Bill Sender ☐ Bill Recipient's FedEx Acct. No. Fill in Account Number below ☐ Bill 3rd Party FedEx Acct. No. Fill in Account Number below ☐ Bill Credit Card Fill in Credit Card Number below
☐ Cash
Expiration Date /

SERVICES

1 ☒ PRIORITY 1 Overnight Delivery Using Your Packaging. When using ICAO/IATA regulations, please mark appropriate boxes. Do not mark for CFR 49
- Dangerous Goods as per attached Shipper's Declaration ☒
- Dangerous Goods Shipper's Declaration not required ☐
- Cargo Aircraft only ☒

5 ☐ STANDARD AIR Delivery not later than second business day

DELIVERY AND SPECIAL HANDLING

1 ☐ HOLD FOR PICK-UP
2 ☐ DELIVER WEEKDAY
3 DELIVER SATURDAY ☐
4 ☒ DANGEROUS GOODS
5 ☐ CONSTANT SURVEILLANCE SERVICE (CSS)
6 ☐ DRY ICE
- Dangerous Goods Shipper's Declaration not required
7 ☐ OTHER

PACKAGES	WEIGHT	YOUR DECLARED VALUE	
1	12	3350	
Total 1	Total 12	Total 3350	

Received At
1 ☐ Regular Stop
2 ☐ On-Call Stop
3 ☐ Drop Box 4 ☐ BSC 5 ☐ Station

FEDEX Corp. Employee No.

Date/Time for FEDEX Use

SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY

Use of this airbill constitutes your agreement to the service conditions in our current Service Guide which is available upon request. See back of sender's copy of this airbill for further information.

We will not be responsible for any claim in excess of $100 per package whether the result of loss, damage, delay or non-delivery, unless you specify a higher amount in the space to the left, pay 40¢ per additional $100 specified and document your actual loss in the event of a claim. Maximum amount limitations found in the current Federal Express Service Guide apply. Your rights to recover from Federal Express for loss of the intrinsic value of the package, as well as for loss of sales, income, interest, profit, attorney's fees, costs and any other form of damage whether direct, incidental, consequential or special is limited to the greater of $100 or the declared value specified to the left. In no event shall your recovery exceed your actual loss.

In the event of untimely delivery, Federal Express will at your request and with some limitations, refund all transportation charges paid. See Service Guide for further information.

Federal Express Use	
Base Charges	
Declared Value Charge	
Other 1	
Other 2	
Total Charges	

PART #105501
REVISION DATE 10/86
PRINTED IN U.S.A. NCNEC

011

ORIGIN COPY

4224718702 AIRBILL NUMBER

SHIPPER'S CERTIFICATION FOR RESTRICTED ARTICLES/DANGEROUS GOODS

CHECK ONE ☒ 49 CFR ☐ IATA/ICAO (TYPE OR PRINT)

DANGEROUS GOODS IDENTIFICATION: PROPER SHIPPING NAME	CLASS OR DIVISION	UN OR ID NO	SUBSIDIARY RISK	QUANTITY AND TYPE OF PACKING	PACKING INST	AUTHORIZATION
Lithium Batteries N/A per DOT-E 7052 Cargo Aircraft Only	Flammable Solid			55 grams (11 grams per cell)	Shipped per DOT-E 7052	

ADDITIONAL HANDLING INFORMATION

TRANSPORT DETAILS		THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR ▶	[illegible]	CARGO AIRCRAFT ONLY	(DELETE-NONAPPLICABLE)
AIRPORT OF DEPARTURE	AIRPORT OF DESTINATION	SHIPMENT TYPE ▶	NON-RADIOACTIVE	[illegible]	(DELETE-NONAPPLICABLE)

IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS OR TREATMENT.

I HEREBY DECLARE THAT THE CONTENTS OF THIS CONSIGNMENT ARE FULLY AND ACCURATELY DESCRIBED ABOVE BY PROPER SHIPPING NAME AND ARE CLASSIFIED, PACKED, MARKED, AND LABELED, AND ARE IN ALL RESPECTS IN PROPER CONDITION FOR TRANSPORT BY AIR ACCORDING TO THE APPLICABLE INTERNATIONAL AND NATIONAL GOVERNMENT REGULATIONS.

NAME AND TITLE OF SHIPPER: John Doe/Shipper
PLACE AND DATE: Hometown, XX 00/00/00
EMERGENCY TELEPHONE NUMBER: (307)742-8213
SIGNATURE OF SHIPPER: John Doe
SEE WARNING ON BACK

Figure 2. Federal Express Airbill & Shipper's Certification

Figure 3. Carton Labels (Sheet 1 of 2)

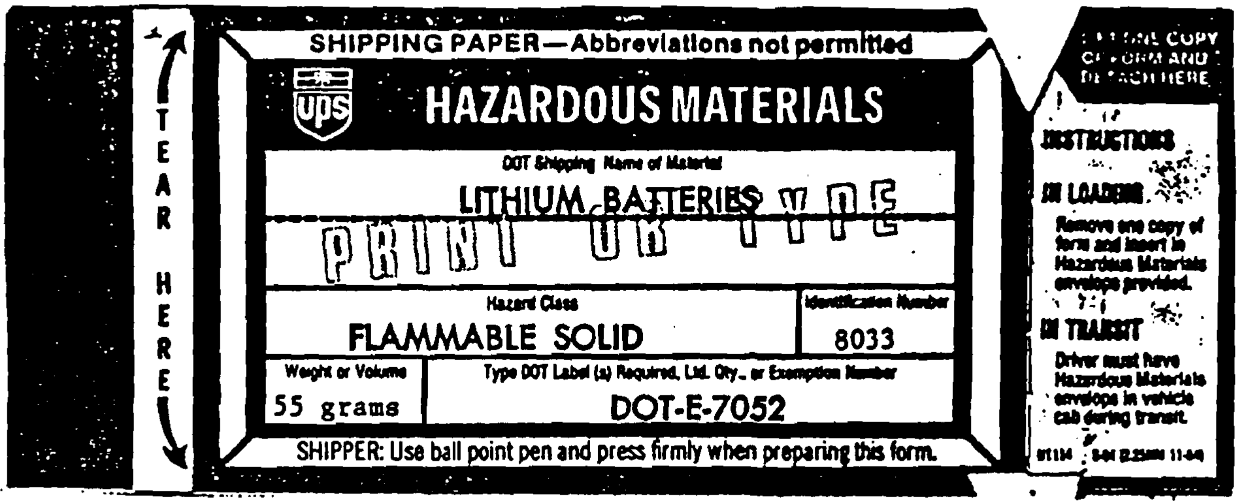
DELICATE
INSTRUMENTS

HANDLE WITH
GREAT CARE

L-85

© LABELMASTER, CHICAGO, ILL. 60646

Figure 3. Carton Labels (Sheet 2 of 2)



TEAR HERE

SHIPPING PAPER—Abbreviations not permitted

HAZARDOUS MATERIALS

DOT Shipping Name of Material	LITHIUM BATTERIES
	PRINT OR TYPE
Hazard Class	FLAMMABLE SOLID
Identification Number	8033
Weight or Volume	55 grams
Type DOT Label (s) Required, Ltd. Qty., or Exemption Number	DOT-E-7052

SHIPPER: Use ball point pen and press firmly when preparing this form.

[illegible] ONE COPY OF FORM AND DETACH HERE

INSTRUCTIONS

IN LOADING

Remove one copy of form and insert in Hazardous Materials envelope provided.

IN TRANSIT

Driver must have Hazardous Materials envelope in vehicle cab during transit.

[illegible]

ATTACH TO OUTSIDE OF CARTON

Figure 4. UPS Five-Part Form

APPENDIX A

SPECIFICATIONS

General

Dimensions	7W x 11L x 9D inches
Weight	12 pounds
Operating and storage temperature	-40°C to +70°C (-40°F to +158°F)

Transducer Input(s)

Type	4 to 20 mA, 2 or 3 wire
Source voltage	+20 to +28 VDC, pulsed
Source current	100 mA max
Source pulse width	50 msec typical
Input resistance	150 ohms typical
Accuracy	+/- .5% of full scale
Resolution (standard)	+/- .015% of full scale
Resolution (optional)	+/- .002% of full scale
Stability	+/- .005% of full scale per °C

Data Sampling

Data point capacity	Expandable to 16,000
Linear sampling rate	Programmable 1 minute to 100 hours
Logarithmic sampling rate	0.2 sec from 0 to 2 sec 1 sec from 2 to 20 sec 5 sec from 20 to 120 sec 30 sec from 2 to 10 min 2 min from 10 to 100 min 10 min from 100 to 1000 min 100 min from 1000 to 10,000 min 500 min from 10,000 min (programmable 1 min to 100 hr after 10 min)

Battery

Type	Lithium inorganic
Expected life	Greater than 100,000 data points

External Power Input

Input voltage	+12 VDC to +18 VDC
Input current	20 mA typical, 350 mA peak

Alarm Contacts

Contact voltage	30 VDC or 30 VAC max
Contact current	1 ampere max

RS232C Interface

Output voltage swing	+/- 4 VDC min, +/- 5 VDC typical
Handshake input voltage	+/- 15 VDC max, +/- 3 VDC min
Baud rate	Selectable 300 to 2400 baud
Character length	Selectable 7 or 8 bits
Parity	Selectable ODD, EVEN or NONE
End of line sequence	Selectable CR or CR/LF
Hardware handshake	CTS

APPENDIX B

RS232 INTERFACE CONNECTIONS

Pin Number	Signal Name	Direction
A	Chassis ground	-
B	Signal ground	-
C	Data Set Ready (DSR)	Input
D	Clear to Send (CTS)	Input
E	Request to Send (RTS)	Output
F	Transmit Data (TD)	Output

Signal directions are referenced to the SE1000B. The RTS output goes high when the SE1000B requests to output data (pressing the DATA key) and remains high until output is complete. The DSR input must be high and remain high for the SE1000B to recognize that an external device is connected. Cables to equipment that do not supply the DSR signal should tie DSR to the SE1000B's RTS output.

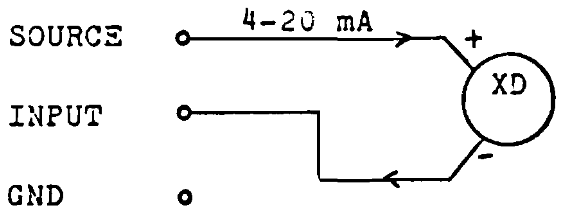
The CTS input is used for handshaking, high indicates receiving device ready, low indicates not ready. If CTS remains low (not ready) longer than about 3 seconds, the SE1000B will abort the data output.

APPENDIX C

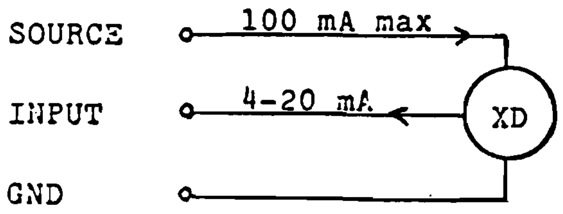
TRANSDUCER CONNECTIONS

Pin Number	Signal Name	Direction
A2, B2	INPUT	Input
A3, B3	SOURCE	Output
A4, B4	Signal Ground	-

Standard 2-wire configuration



Optional 3-wire configuration



APPENDIX D

ALARM CONNECTIONS

Pin Number	Contact Name
A1, B1	High alarm normally closed
B2	High alarm normally open
B3	High alarm common
A2	Low alarm normally closed
A3	Low alarm normally open
A4, B4	Low alarm common

APPENDIX E

EXTERNAL POWER CONNECTIONS

Pin Number	Signal Name
A1, B1	Input (+)
A4, B4	Ground (-)

The SE1000B is protected against voltages of the wrong polarity. DC voltages above 18 volts and any AC voltages will permanently damage the SE1000B's power supply. The internal power supply has voltage sensing circuitry to determine proper operation of the external supply or battery. Typically the initial external voltage must exceed 12 +/- .5 volts before the SE1000B will switch over to external power. The unit will automatically switch back to its internal battery if the external supply drops below 12 +/- .5 volts.

MINIRAM PERSONAL MONITOR
MODEL PDM-3
OPERATIONS MANUAL

MIE
213 Burlington Road
Bedford, Massachusetts 01730
Telephone: 617-275-5444

Monitoring Instruments for the Environment, Inc.

ONE YEAR LIMITED WARRANTY

MIE warrants to the original Purchaser that the apparatus to be delivered hereunder will be of the kind designated or specified and free of defects in workmanship or material. MIE makes no other express warranty, and disclaims any implied warranty of merchantability or fitness for purpose.

If the apparatus fails to conform to the above warranty, and notice is received by MIE from Purchaser within one year from the date of shipment, MIE will, as its option, either repair the defective part or parts or make available a repaired or replacement part. This warranty extends to all parts and labor involved in the required repair to the extent that said repair was not caused by negligence in operation of the apparatus by the Purchaser. MIE will perform the repair at its plant with all shipping and insurance costs paid by the Purchaser or, upon, mutual consent of the parties, at a site designated by the Purchaser except, in the latter circumstances, the Purchaser wil be responsible to reimburse MIE for all costs associated with travel, per diem, and travel time of those MIE individual(s) deemed appropriate to effectuate the repair.

Repair or replacement of the apparatus in the manner and for the time period specified above, is the Purchaser's exclusive remedy and will satisfy all liabilities of MIE to Purchaser arising out of the supply or use of the apparatus, whether based on contract, warranty, negligence or otherwise. In no event will MIE be liable for any incidental or consequential loss or damage from any failure of the apparatus to conform to the contract of sale.

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1.0 DESCRIPTION

1.1 Sensing Method

The MINIRAM (for Miniature Real-time Aerosol Monitor) Model PDM-3 is an ultra-compact personal-size airborne particulate monitor whose operating principle is based on the detection of scattered electromagnetic radiation in the near infrared. The MINIRAM uses a pulsed GaAlAs light emitting source, which generates a narrow-band emission (half-power width of 80 nm) centered at 880 nm. This source is operated at an average output power of about 2 mW. The radiation scattered by airborne particles is sensed over an angular range of approximately 45° to 95° from the forward direction by means of a silicon-photovoltaic hydrid detector with internal low-noise preamplifier. An optical interference-type filter is incorporated to screen out any light whose wavelength differs from that of the pulsed source.

The MINIRAM is a light scattering aerosol monitor of the nephelometric type, i.e., the instrument continuously senses the combined scattering from the population of particles present within its sensing volume (approximately 1 cm^3) whose dimensions are large compared with the average separation between the individual airborne particles.

1.2 Open Sensing Chamber Sampling Method

Air surrounding the MINIRAM passes freely through the open aerosol sensing chamber as a result of air transport caused by convection, circulation, ventilation, and personnel motion. The MINIRAM requires no pump for its operation, and the scattering sensing parameters have been designed for preferential response to the particle size range of 0.1 to 10 micrometers, ensuring high correlation with standard gravimetric measurements of both the respirable and thoracic deposition fractions. Optional flow accessories are available for applications requiring specific inertial particle precollection, extractive sampling, concurrent filter collection, etc.

It should be noted that one of the advantages of direct light scattering aerosol sensing is that the rate at which air passes through the sensor does not influence the indicated concentration because the detection is performed directly on every parcel of air traversing the fixed sensing volume.

Therefore, flow velocity through a real-time sensor such as the MINIRAM influences only the response time. So, it should not surprise the first-time user when, upon pressing the MEAS key of the MINIRAM, no pump noise is heard, and this silence will be accompanied by a readout message of "GO" on the liquid-crystal display indicating that the MINIRAM has, indeed, been activated.

1.3 MINIRAM Electronics

The MIE MINIRAM is a very advanced aerosol monitor which incorporates a custom-designed single-chip CMOS microprocessor whose functions are to: process the signal from the light scattering detection circuit, control the measurement sequence program, compute concentration averages, keep record of elapsed time, perform automatic zero correction, control auto-ranging, drive the liquid-crystal-display, store average concentration values as well as timing and identification information, sense battery and overload conditions, sequence playback of stored information, and provide alarm signals.

The MINIRAM derives its power from a set of internal rechargeable Ni-Cd batteries which can provide continuous monitoring operation for over 8 1/2 hours, or retain stored information for up to approximately 6 months. The battery set is packaged as a separable module which allows easy field replacement when recharging is not feasible. The MINIRAM can be run without time limit from an A.C. line using the charger provided with the instrument.

The MINIRAM has two output connectors. One provides a continuous, real-time analog signal output proportional to the aerosol concentration. This signal can be used for continuous recording (e.g., on a strip chart recorder), telemetry, or control purposes, etc. The other connector provides, during the measurement mode, either an ASCII digital output which is updated every 10 seconds, or a switched output for alarm purposes (depending on the user-selected function). Stored information playback can be accomplished either by means of the MINIRAM's own display or through the digital output jack. During the normal monitoring operation, the liquid-crystal-display indicates the aerosol concentration in the units of milligrams per cubic meter, and the displayed reading is updated every 10 seconds. When operating in the measurement or monitoring mode, other functions can be displayed momentarily, i.e., as long as a corresponding touch switch is pressed. All external controls are performed by pressing one or more of 8 sealed touch switches on the MINIRAM panel.

1.4 Modes of Use and Application

The MINIRAM measures the concentration of any airborne particles, both solid and liquid, and the display indicates this level in the units of milligrams per cubic meter, based on its factory calibration, against a filter-gravimetric reference, using a standard test dust (Arizona road dust). Th MINIRAM can be used to measure the concentration of all forms of aerosol: dusts, fumes, smokes, fogs, etc.

Its small size and weight, and concentration averaging features permit its use as a personal exposure monitor, attached to a belt, shoulder strap, hard hat, etc. Alternatively, it can be used as an area monitor for both indoor and ambient air situations. Test chamber monitoring, visibility measurements, cloud detection (e.g., radio/drop sonde), aerosol dispersion studies, etc. are additional applications of the MINIRAM.

2.0 WHEN YOUR RECEIVE THE MINIRAM ...

Follow these steps when first receiving your MINIRAM:

2.1 Remove the instrument from shipping case.

2.2 Observe display. It should be blank indicating that the MINIRAM is in the minimum power mode.

2.3 Plug charger into A.C. line (standard charger is for 120V, 60 Hz; optional version available for 220V, 50 Hz).

2.4 Connect charger plug into corresponding MINIRAM receptacle.

2.5 Leave charger connected to MINIRAM for a minimum of 8 hours before using instrument without the charger.

2.6 You can operate the MINIRAM immediately after the charger has been connected. Follow operating instructions described in the next section of this manual.

3.0 OPERATING INSTRUCTIONS

Refer to Figure 1 for the location of control switches, display, and connector jacks. Refer to Figure 2 for the display timing sequences.

3.1 Initial Condition

Assuming that the batteries of the MINIRAM have been recharged (see section 2.0), the display may indicate one of the following conditions:

- Blank display: Means the MINIRAM had not been in the measurement mode for 48 hours or more, and is in the minimum power off mode.

- "OFF" display: MINIRAM has been in the off mode for less than 48 hours.

- Concentration display that changes or "blinks" once every 10 seconds: the MINIRAM is in the measurement mode.

3.2 To start Measurement Cycle

- If the MINIRAM shows a blanked display (see above), press OFF and wait until the display reads "OFF" (approximately 5 seconds after pressing OFF), before pressing MEAS to initiate measurement cycle.
- If the MINIRAM shows "OFF" (see above), press MEAS directly to initiate measurement cycle (there is no need to press OFF first, in this case).

The functions performed by pressing each MINIRAM touch switch are as follows:

3.3 MEAS

To start the monitoring operation of the MINIRAM, Press MEAS (see automatic timing sequence of Figure 2). The first readout displayed is either "GO" (or "CGO" if TIME is also pressed, section 3.4), followed by the last concentration reading or ".00". Approximately 36 seconds after pressing MEAS the first new 10-second-averaged concentration reading is displayed. All subsequent readings are concentration values in milligrams per cubic meter, updated every 10 seconds. Figure 3 shows a typical digital printout of a sequence of 10-second measurements (second data block).

The MINIRAM will now run in the measurement mode for 500 minutes (8 hours and 20 minutes), after which it will stop, displaying the OFF reading, retaining in storage the concentration average and elapsed time information. Once the MEAS mode has been entered this sequence can only be interrupted by pressing OFF; pressing ZERO, TWA, SA, TIME or ID# only affects the display during the time these keys are pressed, without affecting the measurement cycle. Pressing PBK during this cycle has no effect.

The instrument normally operates in the .00 to 9.99 mg/m^3 range. Whenever a 10-second concentration exceeds 9.99 mg/m^3 the MINIRAM display automatically switches to the .0 to 99.9 mg/m^3 range and remains in that range as long a the measured 10-second concentration exceeds 9.99 mg/m^3, otherwise the MINIRAM reverts to its lower range display.

3.4 MEAS and TIME

If both MEAS and TIME are pressed at the same time (press TIME first and while depressing it actuate MEAS) the MINIRAM will display "CGO" (for Continuous "GO"), and will then operate as above (i.e., pressing MEAS only), except that after the first 8.3 hour run it will restart automatically and continue to measure for an indefinite number of 8.3 hour runs, (with the battery charger) until the OFF key is pressed, or until the batteries are exhausted. Concentration averages and timing information for the last seven 8.3 hour runs will remain in storage at any given time.

3.5 OFF

When this key is pressed the MINIRAM will discontinue whatever mode is underway displaying "GCA"* followed by the display segments check ("8.8.8-") and finally "OFF" (see timing diagram of Figure 2). The MINIRAM will then remain in this reduced power condition (displaying "OFF") for a minimum of 10 minutes or a maximum of 48 hours or until the MEAS key is pressed to resume the measurement cycle.

If OFF is pressed during a measurement run the display will read "OFF" for 48 hours (unless another key is pressed during that period), after which the display will be blanked. Thereafter, if OFF is pressed the MINIRAM will display the "OFF" reading for only 10 minutes, after which the display will be blanked again unless another key is pressed during that period.

Every time the OFF key is pressed, during a measurement cycle, the MINIRAM will store the concentration average and elapsed monitoring time up to the time of that OFF command. The duration of the off period (up to 48 hours), i.e., between two consecutive measurement cycles, is also stored for each of up to 7 cycles.

If the MINIRAM is not reactivated (i.e., pressing MEAS) within 48 hours of the OFF Command, it automatically switches to a minimum power level, with blanked display; however, all data remains stored in memory for up to approximately 6 months without battery recharging (indefinitely, with charger).

<u>OFF must be keyed before any other operating mode can be entered</u>: setting ID#, zero referencing, playing back stored data, or changing the program code. Display functions, however, can be activated during the measurement mode.

---

*"GCA" is displayed and printed out by the PDM-3 although the instrument is manufactured by MIE, Inc.

3.6 TIME

During the measurement mode, if TIME is pressed the display will show the elapsed time, in minutes, to three significant figures, from the start of the last measurement run. The MINIRAM will automatically return to concentration display after the TIME key is released.

3.7 TWA

This key stands for Time-Weighted-Average. During the measurement mode, if TWA is pressed the display will indicate the average concentration in milligrams/m^3 up to that instant, from the start of the last run. This average is computed by the MINIRAM applying the equation:

$$\text{TWA} = \frac{1}{t} \int_{o}^{t} Cdt$$

where t is the elapsed run time and C is the instantaneous concentration at time t. The value of TWA is updated every 10 seconds. After releasing the TWA key the MINIRAM display returns to the 10-second concentration display.

3.8 SA

This key stands for Shift-Average. During the measurement mode, pressing SA will provide a display of the aerosol concentration, up to that moment, averaged over an 8-hour shift period. This average is computed by the MINIRAM applying the equation:

$$\text{TWA} = \frac{1}{480\ \text{Min.}} \int_{o}^{t} Cdt$$

The shift-average value corresponds to the exposure from the start of the measurement cycle. Thus, for example, if the MINIRAM has been measuring for 3 hours, and the time-weighted average over that period has been 6 mg/m^3

(TWA reading), the shift average value at that time, (SA reading) would be 2 mg/m^3, which is equivalent to an 8-hour exposure at an average concentration of 2 mg/m^3.

The value of SA is updated every 10 seconds. When releasing the SA key the MINIRAM display returns to the 10-second concentration display.

3.9 PBK

With the MINIRAM in the off mode (i.e., not in the measurement mode), the stored information can be played back by pressing PBK. If the PBK key is initially pressed the display will indicate "P" for one second. If PBK continues to be pressed for more than 1 second, then the stored data is automatically played back through the MINIRAM display: First, the identification number is displayed with the ID indicator bar on; next the shift or run number (7 through 1, i.e., starting with the last run) is shown (with the OVR indicator bar on as identification); followed by the sampling (i.e., measurement) time in minutes, for that run; followed by the off-time between the last and next run (in tens of minutes); finally, the average in mg/m^3.* This sequence is repeated seven times. An average reading of 9.99 indicates that a significant overload condition occurred during that run. The total time required for the complete automatic playback on the MINIRAM display is approximately 70 seconds.

If PBK is pressed for less than one second "PA" will be displayed, and the stored data will be fed out through the digital output jack of the MINIRAM for printout, magnetic storage, telemetry, etc. A printout consists of 8 lines of data. Figure 3 shows a typical stored data printout (see data block labeled "Playback of Stored Data"). The first 7 lines show the data for the last 7 measurement periods, and the last line shows the identification number (I), the programmable selection code (F), and the zero value for that data block (Z). In addition a check sum is printed out on a 9th line for

---

*Either the TWA or the SA values, depending on selected user-programmable code (see Section 4.2).

modem/computer data transfer purposes. The first 7 data lines are subdivided into 4 columns. The first column identifies the measurement period (starting with the last or 7th); the next column lists the corresponding duration of each measurement period, in minutes; the third column lists the off time between consecutive measurement periods, in minutes divided by 10; and the last column lists the average concentration values for each period in mg/m^3.*

Either time-weighted, or shift average values can be printed, depending on the selected programmable code (see section 4.2). The example shown on Figure 3 (F-0012) indicates that the TWA values are listed. Although the printout heading will indicate "PDM-2 LISTING" (as shown in Figure 3), this format applies equally to the MINIRAM model PDM-3.

The speed of the digital transfer to a printer or other digital device can be user selected through the programmable selection code (see section 4.2). For a 300 baud rate the transfer time for the stored data block is approximately 45 seconds. See sections 10.0 and 11.0 for instructions on how to connect the MINIRAM to a printer or other digital recording/processing device.

3.10 ZERO

The interior walls of the MINIRAM sampling chamber reflect a small amount of the light from the infrared source into the detector. This background level is referred to as the "zero value", and is automatically subtracted from all aerosol concentration readings during the measurement mode. The result is that the displayed readings depend only on the actual dust concentration present within the sensing chamber.

The zero value varies from instrument to instrument as well as with different sensing chambers. It will increase somewhat as the chamber inner walls and windows become contaminated with dust. A zero update should be performed after cleaning the sensing chamber (see section 12.0).

---

*Either the TWA or the SA values, depending on selected user-programmable code (see Section 4.2).

Pressing ZERO during a measurement period provides momentary display of the stored zero concentration value used by the MINIRAM to correct all digital concentration readings (the analog output signal is not zero-corrected). To update the ZERO value the MINIRAM must be in its off condition (press OFF in case of doubt). Then, press ZERO and wait until the display again indicates "OFF".

The average of 4 consecutive 10-second zero level measurements will then be stored by the MINIRAM as the new ZERO reference value. (See timing diagram in Figure 2 and digital printout obtained during a typical zero check on Figure 3). When operating the MINIRAM in high particle concentration environments (5 mg/m^3) the zero value update should be performed approximately every 8 hours. At aerosol concentrations below approximately 1 mg/m^3 this update may only be required once a week, or even less frequently. The zero update should be performed either within a clean-air environment (ideally, a clean room or clean-bench) for dust measurements in the concentration range below 0.5 mg/m^3, approximately, or by flowing clean air through the sensing chamber of the MINIRAM (e.g., by means of an optional clean-air adaptor, MIE model PDM-1FZ Zero Check Module) (see section 17.2) for use at dust concentrations above 0.5 mg/m^3, approximately. Air conditioned offices (without smokers) usually have concentrations below approximately 0.05 mg/m^3 and can thus be used for zeroing purposes. When measurements are performed under essentially clean air conditions, e.g., in the same environment where the zero check was performed, the MINIRAM readings will indicate 0.00 mg/m^3 with small random fluctuations around that value. Positive values (e.g., 0.02) will thus be indicated on the LCD display. Negative values (e.g., -0.02) are suppressed and are also indicated as 0.00. The digital output, however, does include such negative values and these will be printed out by a digital printer (see sections 10.0 and 11.0)

3.11 ID#

Pressing ID# during a measurement period provides momentary display of the identification number stored within the MINIRAM memory.

The ID# key, in combination with other keys, is used for several additional programming functions described in the next section (4.0).

4.0 PROGRAMMABLE FUNCTIONS

4.1 ID# Selection

In order to change the instrument identification number the MINIRAM must first be in the off mode (i.e., press OFF). Then press the ID# key, and the presently stored number (between 1 and 999) will be displayed, as well as the ID indicator bar. To increment the identification number press the ▲ key (same key as TWA), and to decrement the number press the ▼ key (same key as SA). Any number between 1 and 999 can thus be selected and will remain in storage until the batteries are disconnected, or if the MINIRAM is not recharged over a 6-month period.

Pressing the OFF key after the above identification number selection will remove the MINIRAM from the ID# selection routine and lock-in that number until a new number is selected. A complete ID# lock-out (i.e., a routine to preclude panel-control change of that number) can be accomplished by a separate programmable code selection (see section 4.2).

4.2 Programmable Selection Code

The programmable code allows the user to panel-select several alternate functions and operating modes.

The program codes to select specific alternate operating modes are:

1	selects the alarm instead of ASCII digital output
2	selects the ID# lock-out
4	selects the TWA instead of the SA to be stored for playback
8	selects a 1-second pause after each printer carriage return (for slow printers)
32	selects 110 baud digital output rate instead of 300 baud
64	selects 600 baud digital output rate instead of 300 baud

These numbers are entered as a sum, e.g., to implement ID# lock out, TWA storage, and 1-second carriage return delay, the code number would be 14 (2+4+8).

To enter the desired code (e.g., 14) follow these steps:

- Press OFF key and wait until "OFF" is displayed.
- Press ID# key and set program code to desired number (e.g., 14) by means of the ▲ and ▼ keys.
- Press TIME key (this will show previously entered code).
- Press ID# key again to lock in the new program code which will then be displayed.
- The preceding steps will cause the ID# to become equal to the programmable selection code. To restore the desired ID# (without affecting the selected code number which is now locked in), use the ▲ and ▼ keys again to select the ID# for the instrument as described in section 4.1.
- Press OFF to exit the ID# selection routine.
- To look at the programmed code number, at any time, start from the off condition; press ID#, then press TIME ("F" will then be displayed momentarily), after which the code number will be displayed. Press OFF to exit the code number routine.

If no specific alternate code is entered the MINIRAM will operate in its standard mode (equivalent to code 12) consisting of the following:

- ASCII digital output
- Panel-selectable ID number (preset to 999)
- Time-Weighted Average (TWA) values in memory storage
- 7-bit ASCII resolution
- 300 baud digital output
- Printer carriage return followed by a 1 second delay

4.3 ID# Lock-out

If the ID# lock-out code has been selected (i.e., a 2 as part of the sum, as described in section 4.2) then both the ID# and the programmable code can only be displayed (and printed out), but neither of the two can then be changed by means of the panel keys. In this case, in order to change the ID# if the lock-out code has been selected, or too alter the programmable code, the battery must be unplugged momentarily. Disconnecting the battery, however, causes the MINIRAM to lose all stored data, and cancels all alternate program codes which may then be restored following the procedure described in section 4.2.

4.4 Alarm Level Adjustment

If the selected program code includes a 1, the MINIRAM will not provide an ASCII digital output but instead a switched output (at the digital output connector) which will close every time the measured 10-second concentration value exceeds a presettable threshold concentration level. If a 1 has been included in the code, then the ID# divided by 10 becomes the alarm level in milligrams/m^3. This level can be adjusted following the ID# selection procedure of section 4.1, that is using the ▲ and ▼ keys to increment or decrement the number. For example, if an alarm level of 12.5 mg/m^3 is desired (and starting from the off mode), press ID#, adjust displayed number to 125 with the ▲ and ▼ keys, and press OFF. This number (e.g., 125) then becomes the ID# as well. It is not possible to enter a separate alarm level and ID# number.

5.0 OVERLOAD AND ERROR CODE INDICATORS

5.1 Bar Displays

There are three bar indicators on the MINIRAM display, identified as OVR, ID, and BAT. If the OVR bar is displayed at any time during operation in the measurement mode the MINIRAM detection circuit has been overloaded. A momentary overload can be caused by the insertion of an object into the sensing chamber, sudden exposure to sunlight, etc. If the cause of overload is eliminated, the OVR bar will disappear during the next 10-second display period, unless the overload persists for more than a total of 1 1/2 minutes over an 8 1/3 hour measurement cycle.

The ID bar display is activated only for display identification purposes and not for error conditions.

The BAT bar is displayed when the battery voltage becomes insufficient, indicating that the charger should be plugged into the MINIRAM.

5.2 Error Codes

The MINIRAM will display and output (at the digital output jack) error code numbers along with the corresponding overload indicator bars on the LCD readout. These codes will appear only if the problem persists for more than about 30 seconds.

The error code numbers are as follows:

.0.1: low battery condition

.0.2: RAM (digital processing)

.0.3: A/D (signal) overload

If an overload condition persists for more than approximately 1 1/2 minutes the selected concentration average value (SA or TWA) automatically registers 9.99 and that number will be indicated (or digitally transmitted) upon data playback, signifying an invalid measurement cycle. The OVR bar will then remain on for the rest of that run.

6.0 SENSING CHAMBER REMOVAL AND INSERTION

During normal operation of the MINIRAM the removable sensing chamber (see Figure 1) must be properly inserted, i.e., pushed all the way into the MINIRAM towards the display/control panel end of the instrument. When this chamber is properly positioned the surface on the opposite end from the display/control panel will be approximately flush with the body of the MINIRAM.

To remove the sensing chamber, gently push it away from the display/control panel end, using both thumbs, sliding it out of its channel. This will expose the shouldered metal button with its small spring-loaded plunger, and the two lenses (illumination and detection lenses). Touching of these lenses should be avoided to prevent their soiling. Lens tissue should be used if cleaning of these lenses becomes necessary. Also, the inside surface of the removable sensing chamber is coated with a special anti-reflectant paint and these surfaces should not be touched, if at all possible. (Newer models have a special finish which is not touch-sensitive).

The removable sensing chamber has two small glass windows which should be kept clean (see section 12.0 on routine maintenance).

The sensing chamber is partially closed at one of its open ends. This end is inserted first when sliding the chamber back into the MINIRAM channel. A small shouldered slot is provided on the underside of the removable sensing chamber for the metal button that serves to retain the chamber.

To reinsert the sensing chamber simply slide it back into position making sure that the chamber is moved parallel to the MINIRAM body. Ensure complete insertion, as mentioned above.

7.0 BATTERY PACK REPLACEMENT

The battery pack of the MINIRAM (MIE Part No. PDM-3B) constitutes an intrinsically safe sealed module that can be removed and replaced. To do so, remove the four central screws from the back of the MINIRAM case (not the two corner screws), and gently lift the battery pack up and out, and gently pull apart the battery connector freeing the battery pack. Reverse order of steps when installing another pack.

CAUTION: All stored data will be lost when disconnecting battery.

After reconnecting battery pack, the ID resets to 999 and an automatic zero reference check is performed by the MINIRAM.

Separate battery packs can be used whenever a.c. line power is unavailable to recharge the pack within the MINIRAM. These spare parts can be recharged independently from the MINIRAM by plugging the charger into the charge receptacle which is an integral part of the battery pack (see figure 1).

8.0 CALIBRATION ADJUSTMENT

Although every MINIRAM has been factory-calibrated using a representative dust (see section 1.4), the user may wish to change the calibration constant of the instrument for a specific type of aerosol. Such a calibration should be performed by obtaining a concurrent filter collection (e.g., by means of a personal filter sampler), sampling from the same environment within which the MINIRAM is placed. The average concentration obtained by the MINIRAM (i.e. TWA reading) at the end of the test should be compared with the filter-gravimetric-determined concentration. The ratio of the two concentration values can then be used to correct the MINIRAM calibration. The comparison run should be replicated several times (to minimize errors) to obtain an average ratio.

To change the MINIRAM calibration proceed as follows:

8.1 Place MINIRAM in a clean environment (e.g. air conditioned office).

8.2 Remove battery pack (follow procedure of section 7.0).

8.3 Disconnect battery connector (remember that all stored data will thus be lost/erased from MINIRAM memory).

8.4 While leaving battery pack lying next to MINIRAM, re-connect the two units (i.e. plug in connector).

8.5 Immediately observe MINIRAM display. It will be performing a slow segment-by-segment display checkout. As soon as it displays ".00", press OFF, thus interrupting the initial automatic zero check (see section 7.0). Wait until the display indicates "OFF" and then press MEAS and wait approximately 36 seconds.

8.6 Observe 10-second readings (typically in the range of 1 to 3 mg/m^3) and record manually a few consecutive readings. Calculate the average of these values.

8.7 Identify small potentiometer screw (visible through an opening in the foil shield of the open MINIRAM) opposite the digital output jack. Adjust this potentiometer, using a fine screw driver, until the average MINIRAM reading is increased or decreased (with respect to the average obtained in 8.6) by the desired ratio (e.g. as determined by previous gravimetric comparison runs).

8.8 Shut off MINIRAM, reposition and secure battery pack, and re-zero instrument as usual. All subsequent concentration readings are now corrected by the desired ratio.

If an optional Reference Scatterer is available, insert in the MINIRAM instead of the normal sensing chamber and follow the same procedure (i.e., follow steps 8.1 through 8.8).

9.0 ANALOG RECORDER CONNECTION

The analog output of the MINIRAM is a negative voltage of 0 to 1.5 V. A high input impedance recorder (100K), or other signal processing device can be connected to that output. The 0 to -1.5V range corresponds approximately to 0 to 100 mg/m^3 as displayed by the MINIRAM.

This analog output (as opposed to the digital output and readings) is not zero-corrected, and thus a zero concentration results in a bias level of the order of several millivolts.

It is advisable to connect a capacitor in parallel with (i.e. across) the analog output (e.g. 100 microfarads or larger) in order to obtain a steady output signal. The internal time constant of the analog output of the MINIRAM is only 0.2 seconds which, in the absence of an external capacitor, results in excessive signal fluctuations.

Two miniature plugs are provided with the instrument to connect to the analog and/or digital output jacks (both can be used concurrently).

10.0 USE OF OPTIONAL MIE DIGITAL PRINTER

The MINIRAM can be connected to the MIE model DP-2-80C digital printer, an optional accessory designed for direct coupling to the MINIRAM. This printer can be used both to print out the continuous concentration data (updated every 10 seconds) in the normal measurement mode, and to print out the data stored in the MINIRAM memory as described in section 3.9.

An example of the printout formats when using the printer in combination with the MINIRAM is presented in figure 3. The DP-2-80C, a very compact impact dot matrix printer, is provided with a special interconnection cable to the MINIRAM digital output jack. When using the MINIRAM with this printer, the output data rate should be left at 300 baud (the normal MINIRAM default value), as described in section 4.2.

The following are specific operation procedures for use of the printer in combination with the MINIRAM. Other operating and maintenance information is contained in the instruction manual that accompanies the printer.

10.1 Printer Connection

A 20 mA current must flow through the DP-2-80C printer for it to operate. Plug its cable into the MINIRAM digital output receptacle and press OFF. Turn on the printer power switch (on its right side) and the two green lights on the front will be on if printing paper is in the unit. The ribbon cartridge should have been previously loaded. Refer to the printer User's Manual for details.

10.2 Printer Test

In order to test whether the DP-2-80C printer is operating correctly, hold down the LINE FEED button while turning the printer on. Once the printer is on, release the LINE FEED button and the printer will then print out all of its characters. To stop this operation press SELECT.

10.3 Printout of Stored Data

Plug printer connector into the MINIRAM digital output receptacle. Turn off printer power switch. Press OFF on MINIRAM and wait until it reads "OFF". Turn on printer power switch. Press PBK on MINIRAM for less than one second (see section 3.9) and the LCD display should then indicate "PA". The printer will then print out the stored data block.

10.4 Printout of Zero or of Measurement Data

Interconnect MINIRAM and printer as indicated before and switch on printer power. Press OFF on the MINIRAM. Press either ZERO or MEAS on MINIRAM (depending on which information should be printed out). Printer will print out zero data approximately 72 seconds after pressing ZERO on MINIRAM (see figure 2). The first line of measurement data will be printed out approximately 126 seconds after pressing MEAS, and thereafter every 100 seconds (each line contains ten 10-second measurements). The printer power can be turned off any time during the measurement cycle, and turned on again during a cycle to resume printing. The data line numbers (see figure 3) will then be the current ones as sequenced by the MINIRAM whose output is independent of the operations of the printer.

11.0 DIGITAL OUTPUT CONNECTIONS

A digital printer (other than MIE model DP-2-80C), data logger (MIE PDL-1), or modem may be coupled to the MINIRAM. The data output is in the form of 20 mA current loop, 300 baud (110 or 600 baud by alternate programming) asynchronous ASCII characters. The output load should be less than 50 ohms.

Figure 4 is a diagram showing the connections and components required for a 20 mA loop interconnection to a printer. A similar diagram is shown for standard RS232 interfacing with a printer (see Figure 5). These connections do not apply when using the DP-2-80C printer.

The MINIRAM does not send parity information, but does provide an ASCII check sum which is the sum of all ASCII characters, to insure data integrity.

To use the check sum the host computer must add the ASCII value of all digits, spaces, carriage returns, and line feeds except for the first two carriage returns and line feeds which are sent immediately after pressing the PBK switch. The last eight bits of this sum should then be expressed as a decimal number (0-255) and should agree with the decimal value of the MINIRAM check sum.

12.0 ROUTINE MAINTENANCE

When the MINIRAM is not being operated it should be placed in its shipping case which should then be closed. This will minimize the amount of particle contamination of the inner surfaces of the sensing chamber.

After prolonged operation within, and exposure to particlate-laden air, the interior walls and the two glass windows of the sensing chamber may have become contaminated with particles. Although repeated updating of the zero reference following the procedure of section 3.10 will correct errors resulting from such particle accumulations, eventually this contamination could affect the accuracy of the measurements as a result of excessive spurious scattering, and significant attenuation to the radiation passing through the glass windows of the sensing chamber.

An indication of excessive chamber contamination is provided by the zero level reading (section 3.10), which should not exceed 3 mg/m^3, approximately.

In order to clean a soiled sensing chamber remove that chamber as described in section 7.0 and wash it with soap and water, rinsing thoroughly to remove any residues from the glass windows and interior of the chamber. Do not use solvents of any type. Do not rub interior surfaces of the chamber (coated version). Allow the sensing chamber to dry completely and re-insert into the MINIRAM as indicated in section 7.0

13.0 PRECAUTIONS AND OPERATING POSITIONS

The interior of the MINIRAM sensing chamber should not be exposed to fluctuations of intense light; flashes of sunlight or bright daylight especially, are to be avoided. Such excessive variable illumination of the scattering detector can result in significant measurement errors that may persist over several 10-second display cycles. In order to operate the MINIRAM under those conditions it is advisable to use the Sunshield accessory (MIE model PDM-SNS, see section 17.5).

Another potential source of error is the presence of reflecting surfaces in close proximity to the sensing chamber openings. Such objects should be kept at least 2 cm (3/4 inch) from the chamber openings.

The removable sensing chamber should not be used as a carrying handle, especially not while operating the MINIRAM; holding this chamber may affect the measurements.

When using the MINIRAM for personal monitoring it should be positioned vertically, i.e., with the display/control panel facing upwards, by either clipping the MINIRAM to the belt, shoulder strap, etc.

In general, an approximate vertical position is to be preferred for any long-term monitoring purposes, in that this position minimizes potential particle deposition within the removable sensing chamber.

Other monitoring positions are:

a) horizontal, resting on belt clip

b) hand held (while ensuring that hand and fingers are away from edges of sensing chamber)

c) Using the optional MINIRAM table stand

d) Wall mounted using belt clip, or the four battery pack attachment screws on the back of the MINIRAM.

14.0 INTRINSIC SAFETY

The MINIRAM has been designed to satisfy the requirements for intrinsically safe operation in methane-air mixtures. The sealed battery pack incorporates a current-limiting resistor that limits the battery short circuit current to less than 14A. MSHA 2G-3532-0 approval has been granted to the PDM-3.

15.0 SPECIFICATIONS

- Measurement ranges: 0.01 to 10 mg/m^3 and 0.1 to 100 mg/m^3
- Precision and stability (for 10 sec. readings)*: ± 0.03 mg/m^3 (2-sigma)
- Precision and stability of time-averaged measurements*:
  ± 0.02 mg/m^3 (for 1 minute averaging)
  ± 0.006 mg/m^3 (for 10 minute averaging)
  ± 0.003 mg/m^3 (for 1 hour averaging)
  ± 0.001 mg/m^3 (for 8 hour averaging)
- Temperature coefficient: 0.005 mg/m^3 per °C (typical)
- Readout resolution: 0.02 mg/m^3 or 0.1 mg/m^3 depending on automatically selected range (3 digit LCD)
- Digital readout updating time: 10 seconds
- Analog output time constant: 0.2 seconds
- Total measurement period: 8 1/3 hours, or indefinite 8 1/3 hour cycles
- Particle size range of maximum response: 0.1 to 10 µm in diameter
- Measurement display: normally 10 second real time measurement; or momentarily: time-weighted average, or 8-hour equivalent shift average, or elapsed sample time (in minutes), or zero value, or identification number, or programmable code
- Data storage: seven concentration averages, sampling periods in minutes (3 significant figure resolution), off time (10 minute resolution), identification number, zero value, programmable code, and check sum
- Real time outputs: analog (0 to 1.5V full scale), and digital ASCII
- Memory playback: either by own LCD display, or by 110, 300 or 600 baud, ASCII digital output (20 mA current loop, or RS232 terminals may be connected with appropriate interface)
- Nominal battery voltage: 7.5V
- Average battery current drain: 40 mA

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*At constant temperature (typ. 25°C)

- Continuous operating time with full battery charge: 10 hours, approximately
- Operating temperature: 0° to 50°C (32 to 120°F) Storage: -20 to 60°C
- Outside dimensions: main body: 10 x 10 x 4 cm (4 x 4 x 2 inches); sensing chamber cover: 7.7 x 3.8 x 1.5 cm (3 x 1.5 x 0.6 inches)
- Weight: 0.45 kg. (16 oz.)

16.0 STANDARD ACCESSORIES

Accessories provided with each MINIRAM are detailed in the following subsections.

16.1 Battery Charger

The battery charger (MIE model PDM-1-157-1) serves the following functions: recharge or maintain the charge of the nickel-cadmium batteries within the MINIRAM, permit continuous a.c. power line operation, and provide power for the operation of pump of the optional MIE model PDM-1FZ Zero Check Module (see section 17.2). The charger cannot be used to power the MINIRAM without its batteries, however, it can be used to charge a separate or spare battery pack (MIE model PDM-3B, see section 7.0).

The standard battery charger is designed for a 120V/60 Hz input, however, it can be obtained for 220V/50 Hz if so specified.

16.2 Other Standard Accessories

Other accessories supplied with the MINIRAM are:

- Output connectors (can be used for the analog, and/or the digital output jacks);
- Shipping Case;
- Instruction Manual.

17.0 OPTIONAL ACCESSORIES

Several optional accessories are available from MIE for the MINIRAM, these are described in the following subsections.

17.1 Flow Adapter (MIE model PDM-1F)

The Flow Adapter when used in conjunction with the MINIRAM and any pump or external flow system, allows a sample to be drawn through the instrument sensing chamber. A personal monitoring pump at flow rates of 2 ℓ /minute or less may be used.

To attach the Flow Adapter to the MINIRAM loosen the two thumbscrews and pull the front sealing plate forward. Slide the Adapter over the MINIRAM sensing chamber as illustrated above; secure the Adapter to the MINIRAM by tightening the two allen-head screws through the hold down tabs. Tighten the thumbscrews to seal the two end plates to the MINIRAM sensing chamber.

Typically, this accessory would be used when extracting samples from aerosol chambers, detecting leaks from pressurized ducting, or for isokinetic sampling using probes.

Notes:

When using any of the optional accessories that are attached on and around the sensing chamber (models PDM-1F, -1FZ, -1FS, -1FR, and -SNS) to perform measurements at concentrations below 0.5 mg/m^3, it is advisable to zero check the MINIRAM with the accessory in place, making sure that its mounting and sealing screws are properly tightened.

Use an external pump or pressurized air source (well filtered) to drive clean air through the sensing chamber to zero the MINIRAM with any of those accessories (except in the case of the Zero Check Module). To zero check the MINIRAM when using the Sunshield place instrument with the attached sunshield in a clean room environment (see Section 3.10).

17.2 Zero Check Module (MIE model PDM-1FZ)

The Zero Check Module can be used to zero the MINIRAM when a clean air environment is not available. The Zero Check Module should be used when concentrations in the range above 0.5 mg/m^3 are to be measured (see section 3.10).

In addition, this accessory can be used to draw a sample stream through the MINIRAM sensing chamber (in lieu of a separate pump) by disconnecting the small tube at the sensing chamber inlet fitting.

This accessory consists of a pump, filter and the necessary tubing to circulate clean filtered air through the MINIRAM. The pump may be powered by the MINIRAM battery charger (or a 5-10 VDC power supply). The battery within the MINIRAM cannot be used to operate the Zero Check Module.

To zero the MINIRAM, first attach the Zero Check Module following the same procedure described for attaching the basic Flow Adapter (see section 17.1). Connect the battery charger to the Zero Check Module and to an A.C. source. Allow at least one minute of operation to purge the sample chamber with clean air. Press the ZERO button on the MINIRAM and continue operating the Zero Check Module until the final average zero reading is displayed (see section 3.10).

17.3 Personal Sampler Adapter (MIE models PDM-1FS and PDM-2FS)

This accessory, when used with the MINIRAM and a personal monitoring pump, permits active sampling of respirable (cyclone preselected) particles through the instrument sensing chamber and collection on a filter. The aerosol sample is drawn through a 10 mm nylon cyclone (with a 50% cut point at 3.5 m when operated at 2 ℓ/minute), through the sensing chamber of the MINIRAM, and then collected on a filter located in the cassette/filter holder for subsequent gravimetric or other analysis.

The model PDM-1FS is for use with an MSA 37mm filter cassette no. 457193. The model PDM-2FS is compatible with a Millipore 37mm disk filter holder no. M000 037 A0.

To attach the Personal Sampler Adapter to the MINIRAM, follow the same procedure as described for attaching the basic Flow Adapter (see Section 17.1). Connect a length of tubing from the exhaust fitting on the filter holder to a personal sampling pump (not provided with the Adapter).

The use of the Personal Sampler Adapter permits concurrent MINIRAM readings and filter collection to facilitate calibration of the MINIRAM for a specific aerosol, or to determine both concentration and chemical composition of the aerosol.

17.4 Respirator Adapter (MIE model PDM-1FR)

The Respirator Adapter, when used in conjunction with the MINIRAM, provides a means of measuring aerosol concentrations inside a respirator. The external concentration can also be measured with the MINIRAM and thus the values obtained with the MINIRAM after connecting it to the respirator can be used to determine protection factors; consequently, quantitative fit checks are possible under field conditions.

WARNING: DO NOT USE THIS ACCESSORY IN A HAZARDOUS (TOXIC DUSTS, FUMES, GASES, ETC.) ENVIRONMENT, SINCE RESPIRATOR INTEGRITY CANNOT BE GUARANTEED BECAUSE OF THE POSSIBILITY OF LEAKS.

A tube should be attached from a tap on the respirator to the inlet (which is located on the smaller sealing plate) of the Respirator Adapter. When the respirator wearer exhales, a slight positive pressure develops inside the mask resulting in an air flow to the MINIRAM sample chamber, where the concentration is measured. This air then passes through a check valve as it exits the chamber. When the wearer inhales, the check valve closes to prevent exposure to ambient conditions. A back-up filter is also used after the check valve as an additional safety precaution in the event of check valve failure.

To attach the Respirator Adapter to the MINIRAM, follow the same procedure for attaching the basic Flow Adapter (see Section 17.1).

The use of the DP-2-80C in combination with the MINIRAM is described in Section 10.0. A separate instruction manual for the printer is supplied with that unit.

17.9 Reference Scatterer (MIE model PDM-RS)

The PDM-RS is a specially modified sensing chamber that includes a diffusing optical filter mounted within the sensing region of the MINIRAM. It is designed to scatter a controlled amount of light from the infrared source to the detector, providing a stable and repeatable reading on the MINIRAM display. The reference scatterer is inserted into the MINIRAM instead of the normal sensing chamber, and the readings are obtained operating in the MEAS mode. If the PDM-RS is ordered from MIE concurrently with a MINIRAM the reference scatterer will be factory marked with the calibration reading to be obtained when inserted into that particular MINIRAM whose serial number will also be shown on the PDM-RS tag. The readings displayed by the MINIRAM when inserting the PDM-RS should be within +5% of the value marked on that reference scatterer.* The readings obtained with the reference scatterer may show a small warm-up drift (i.e. gradual change) during the initial 5 to 10 minutes after pressing MEAS.

If the reference scatterer is ordered separately from the MINIRAM, the user will then determine the calibration reading obtained on the MINIRAM and mark it (together with the MINIRAM serial number) on the PDM-RS tag.

Because of small differences in the optical configuration of each reference scatterer, the readings obtained with a given reference scatterer are unique to a given MINIRAM. The response to a given population of airborne particles, however, is the same for all factory calibrated MINIRAMs, within approximately ± 5%.

17.10 Carrying Case (MIE model PDM-HC)

The PDM-HC is a convenient and compact hard shell carrying case designed to house a MINIRAM and a battery charger. The inside is foam padded for full

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*Prior to the use of the reference scatterer the MINIRAM should be zeroed with a clean standard sensing chamber as described in Section 3.10.

protection. The outside dimensions of the PDM-HC-1 are: length - 9 1/2 inches, depth - 7 inches, and height - 3 1/2 inches.

17.11 Cable (MIE model PDM-CB)

The PDM-CB cable is used to connect the digital output of the PDM-3 with the input of the 80 column digital printer MIE model DP-2-80C.

17.12 Portable Data Logger (model PDL-1)

This data logger can be used to record, average, peak detect, etc. concentration levels measured by the PDM-3. A separate instructional manual is provided for the PDL-1.

List of Figures

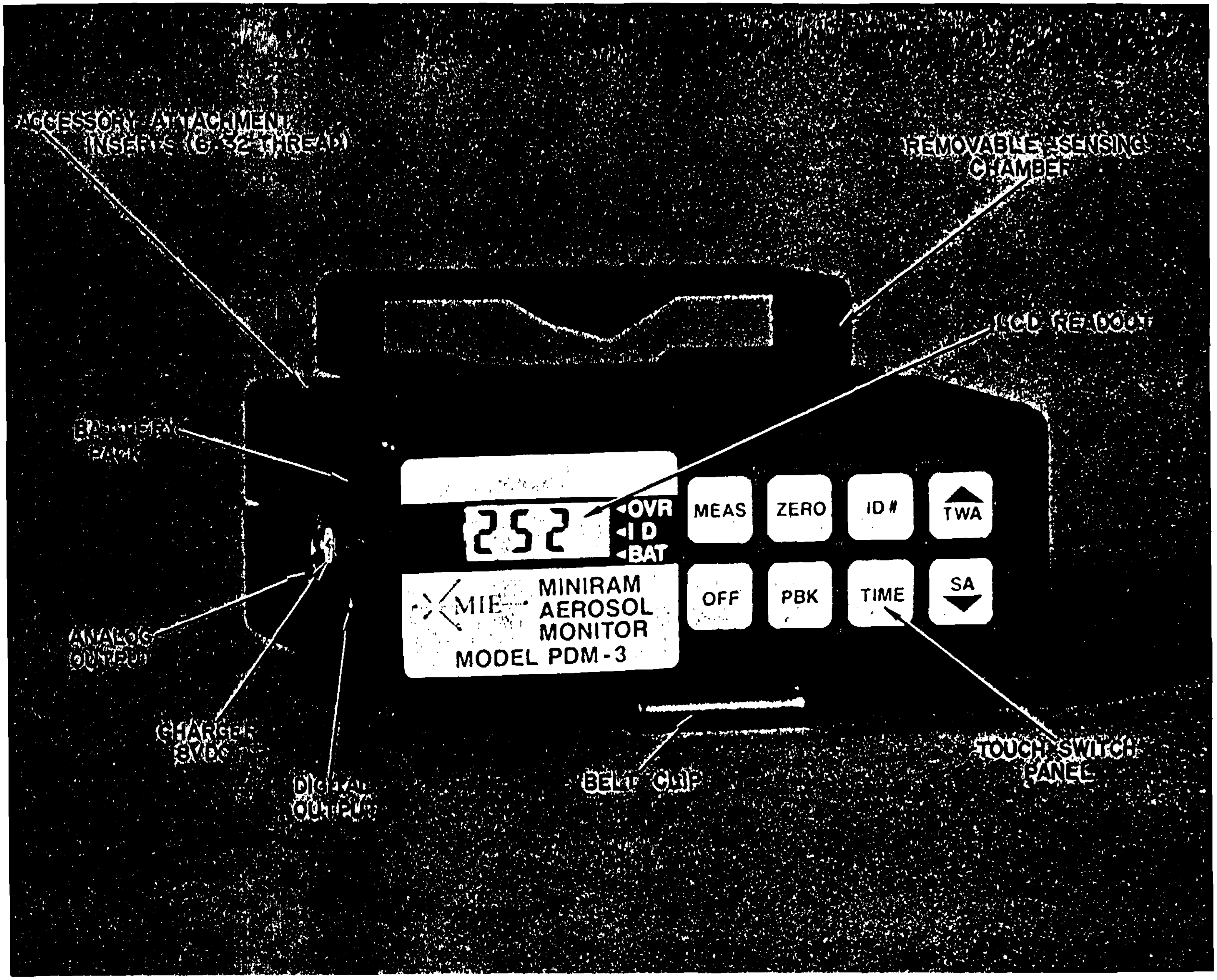


Figure 1. Main view of MINIRAM.

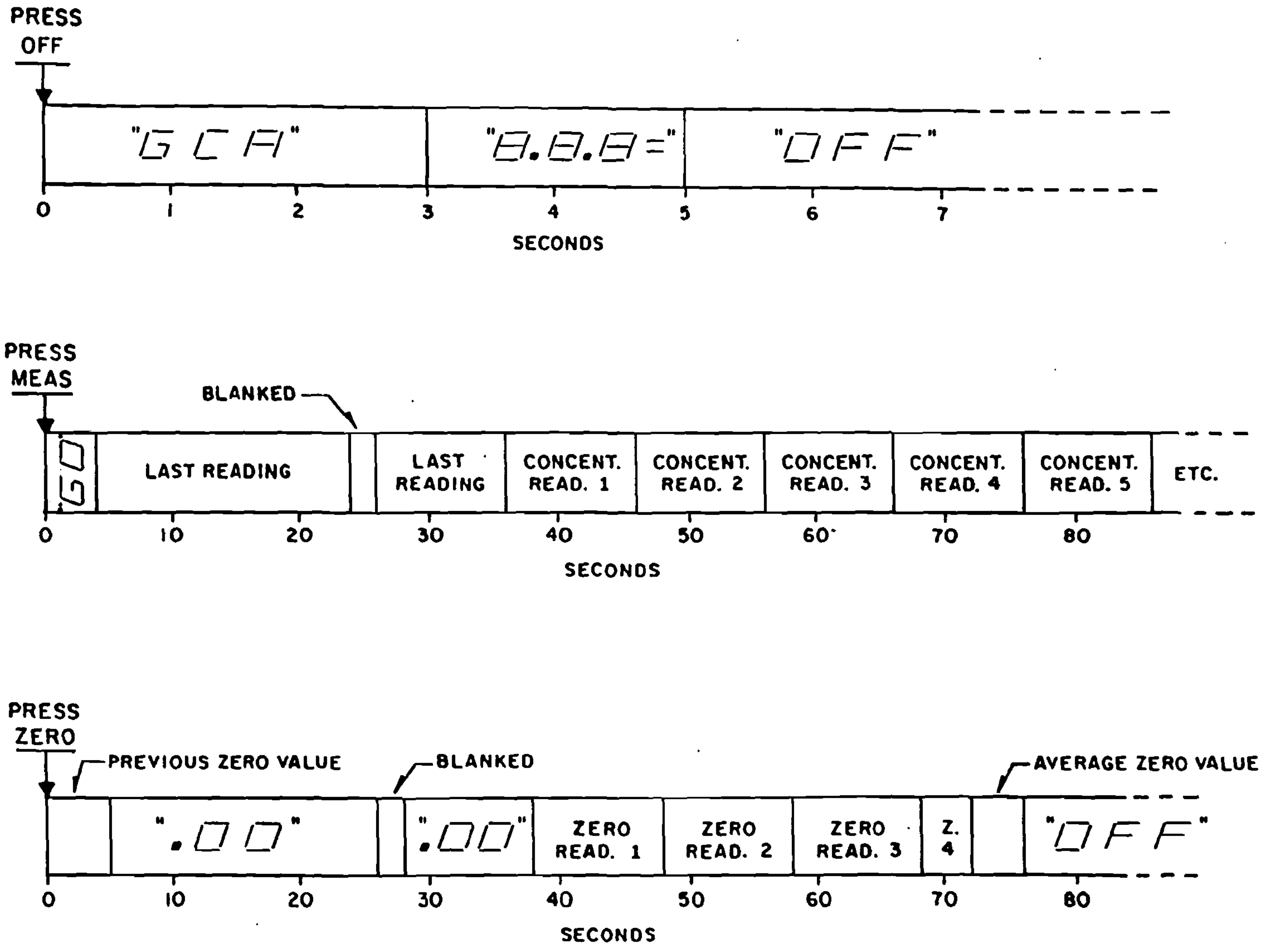
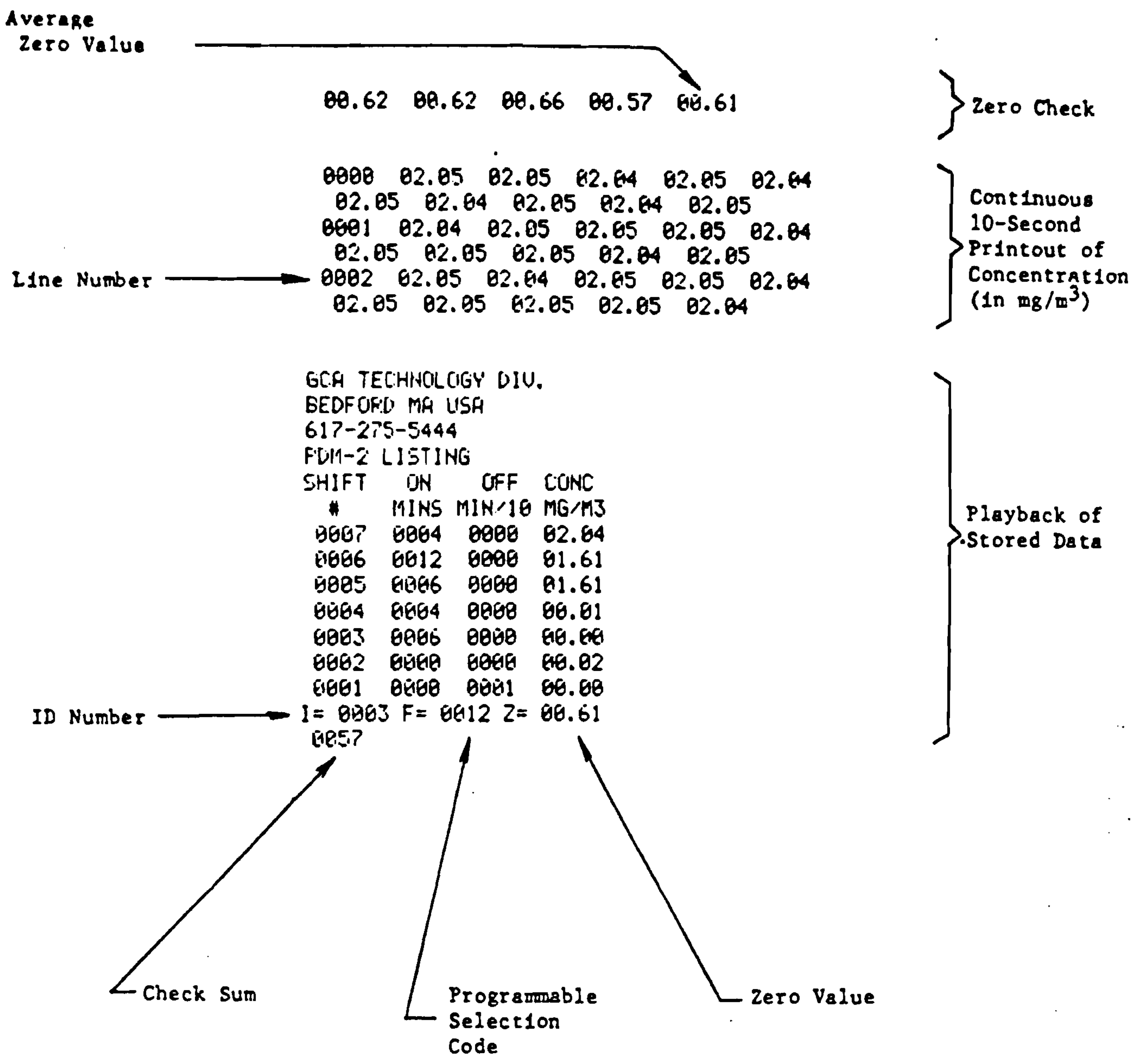


Figure 2. Timing diagram of MINIRAM model PDM-3 when pressing OFF, MEAS. or ZERO (typical times).



```
00.62  00.62  00.66  00.57  00.61

0000  02.05  02.05  02.04  02.05  02.04
 02.05  02.04  02.05  02.04  02.05
0001  02.04  02.05  02.05  02.05  02.04
 02.05  02.05  02.05  02.04  02.05
0002  02.05  02.04  02.05  02.05  02.04
 02.05  02.05  02.05  02.05  02.04

GCA TECHNOLOGY DIV.
BEDFORD MA USA
617-275-5444
PDM-2 LISTING
SHIFT   ON    OFF   CONC
  #    MINS MIN/10 MG/M3
 0007  0004  0000  02.04
 0006  0012  0000  01.61
 0005  0006  0000  01.61
 0004  0004  0000  00.01
 0003  0006  0000  00.00
 0002  0000  0000  00.02
 0001  0000  0001  00.00
I= 0003 F= 0012 Z= 00.61
 0057
```

Figure 3. Typical MINIRAM Model PDM-3 Digital Printout Format.

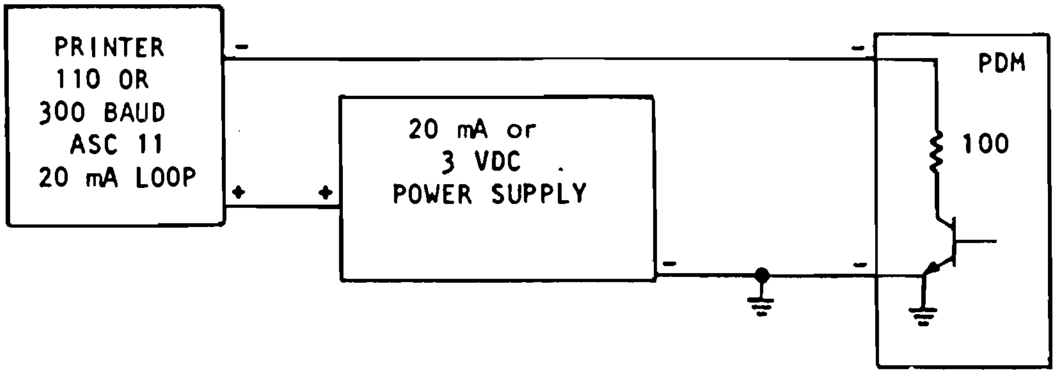


Figure 4. 20 mA loop connection.

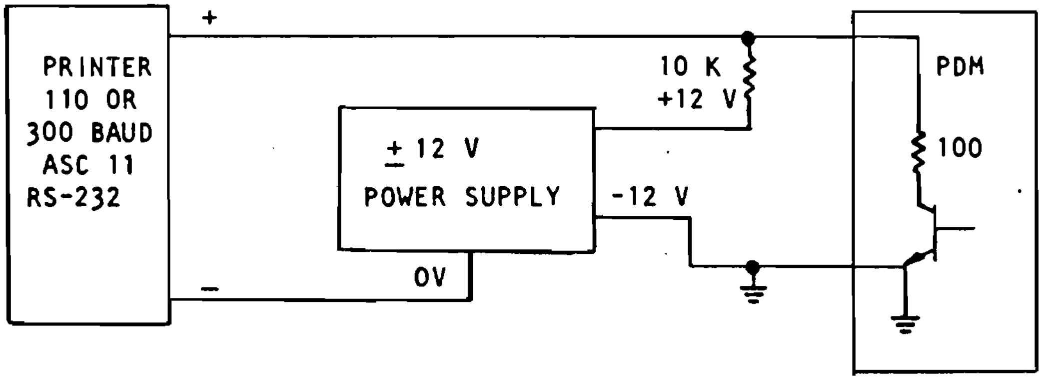
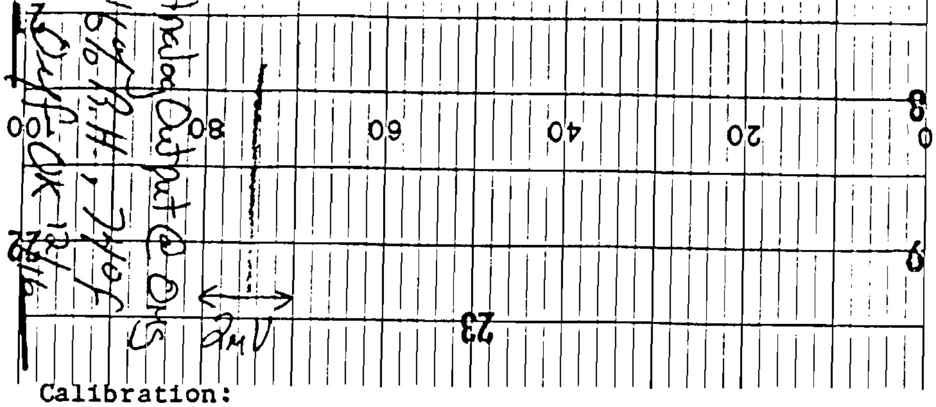


Figure 5. RS-232 connection.



MIE, Inc.
213 Burlington Road
Bedford, Massachusetts 01730
Telephone: 617-275-5444
Telex: 92-3339

S/N 4392

Check

Calibration:

1) Set dust box concentration for 2-6 $mg\text{-}m^{-3}$. ✓
2) Check seal of sample chamber and flow adapter. ✓
3) Record calibration zero: .88mg. ✓
4) Record 15 min. PDM average (TWA): 3.06mg. ✓
5) Record 15 min. Master average (ASA): 3.09mg. ✓
6) Confirm that PDM reads within ±.05 of RAM-1. ✓
7) Record analog output voltage: 55.08mV. ✓

Final Assembly:

1) Inspect sample chamber for excessive calibration dust. ✓
2) Inspect battery pack for fit with front bezel (flush to 1/16 in.). ✓
3) Record average zero readings with battery pack: .88mg. ✓
4) Install belt clip. ✓
5) Attach labels square to housings. ✓
6) Attach Sun Shield. ✓

Final Test:

1) Record clean room zero: .87mg. ✓
2) Record reading with Sun Shield only: 91.4mg. ✓
3) Test digital output. ✓
4) Test analog output, attach recorder sample. ✓
5) Life Test. ✓
6) Charge battery fully, approx. 8.5 VDC @ 8 hours. ✓
7) Turn off instrument. ✓
8) Record S/N above and record S/N and calibration data in log book. ✓

Technician F. J. Melia Date 16 Dec. 88

Rev. 9-28-88

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