NORTHROP GRUMMAN

Transmittal

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Subject/Title: RevisedVapor Intrusion Work Plan Addendum #3
Former TRW Microwave Site, 825 Stewart Dr., Sunnyvale, California

CC: Joshua Nandi, Northrop Grumman Systems Corporation
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Northrop Grumman Systems Corporation is submitting the above-referenced Vapor Intrusion Work Plan Addendum #3 to the United States Environmental Protection Agency:

	For your review and comment
	For your information and file
X	For your approval
	For your signature

Total number of copies sent: 1

Remarks:

The work plan has been edited to incorporate comments received from USEPA.

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AECOM

REVISED WORK PLAN ADDENDUM #3 FOR VAPOR INTRUSION EVALUATION SAMPLING AND ANALYSIS

FORMER TRW MICROWAVE SITE
825 STEWART DRIVE
SUNNYVALE, CALIFORNIA

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February 2023

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Quality information

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1.0 INTRODUCTION

This third work plan addendum (Vapor Intrusion [VI] Work Plan Addendum #3 [VI Work Plan #3]) for the Vapor Intrusion Evaluation Sampling and Analysis Work Plan (AECOM, 2013; VI Work Plan) for Vapor Intrusion Evaluation Sampling and Analysis has been prepared by AECOM on behalf of Northrop Grumman Systems Corporation (Northrop Grumman) for the former TRW Microwave Site (the Site) located at 825 Stewart Drive in Sunnyvale, California (Figure 1). At the time the 2013 VI Work Plan was prepared, the building had been unoccupied and without mechanical ventilation since 2001. An addendum to the VI Work Plan (AECOM 2015a; VI Work Plan Addendum) was prepared after: 1) source area soil removal, 2) removal of potential VI pathways and 3) installation of a passive soil vapor collection (SVC) system under the Site building. A second addendum to the work plan (AECOM 2015b, VI Work Plan Addendum #2) was prepared after completion of significant tenant improvements by the building tenant.

1.1 Project Objective

The objective of this VI Work Plan #3 is to provide updated building layout information and sampling locations for evaluating the VI pathway under current Site conditions. The results of this sampling effort will be used to assess the VI pathway under current Site conditions.

1.2 Work Plan Addendum Organization

This VI Work Plan #3 is organized as follows:

- Section 1. Introduction – presents the project objective and organization for VI Work Plan #3.
- Section 2: Updated Site Background and Conceptual Site Model – summarizes Site activities conducted after the previous VI sampling event and the resulting updated conceptual Site model and proposed sampling location rationale.
- Section 3: Sampling and Analysis Plan – presents the updated sampling locations proposed based on changed Site conditions.
- Section 4: Quality Assurance Project Plan (QAPP) – presents updates to the QAPP included in the previous VI Work Plan Addendum.
- Section 5: Health and Safety Plan (HASP) – presents the HASP to be used for implementing this VI Work Plan #3.
- Section 6: Data Validation, Evaluation, and Reporting – presents how the data will be evaluated and reported.
- Section 7: Schedule – presents the proposed schedule for implementation of this VI Work Plan #3.
- Section 8: References – lists the documents cited in this VI Work Plan #3.

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2.0 UPDATED SITE BACKGROUND AND CONCEPTUAL SITE MODEL

This section provides updated background information for the Site including the results of the December 2015 VI evaluation sampling activities at the Site.

Based on results of groundwater sampling conducted in October 2021 at the Site, chemicals of concern (COCs) in the groundwater that could potentially impact indoor air include chlorinated volatile organic compounds (VOCs): trichloroethene, tetrachloroethene, and their degradation products (primarily cis-1,2-dicholoroethene and vinyl chloride).

2.1 Previous Vapor Intrusion Evaluation Sampling

VI sampling (i.e., indoor air, outdoor air, and sub-slab vapor sample collection) prior to installation of the SVC system is discussed in the Vapor Intrusion Evaluation Report (January 2014 VI Report; AECOM, 2014a). Results of VI sampling performed in May 2015 (after the SVC system was installed) are discussed in detail in the Vapor Intrusion Evaluation Report (June 2015 VI Report; AECOM, 2015b). The results of the May 2015 sampling indicated that there was no VI-related chemical that presented a cancer risk equal to or above a 1×10^{-6} exposure level and the hazard index (non-cancer risk) was less than 1 under the industrial exposure scenario. These May 2015 results were below the state and federal industrial screening levels (used as project action levels [PALs]) and indicated no risk to human health under the industrial exposure scenario. Results of VI sampling performed in December 2015 following tenant renovations are discussed in detail in the Vapor Intrusion Evaluation Report (AECOM, 2016). The results of the December 2015 were similar to the results from the May 2015 sampling event, indicating that no cumulative VI-related chemical presented a cancer risk equal to or above a 1×10^{-6} exposure level and the hazard index (non-cancer risk) was less than 1 under the industrial exposure scenario.

2.2 Conceptual Site Model

As discussed in the June 2015 VI Report, at the request of the property owner and as a conservative, proactive measure, Northrop Grumman installed a passive SVC system in August and September 2014. The passive SVC system was installed beneath the concrete floor of the entire building in accordance with the Passive Sub-Slab Vapor Collection System Installation Work Plan (AECOM, 2014b). The purpose of the passive SVC system is to passively collect vapors below the building slab and vent them to the atmosphere as a protective measure against VI.

The conceptual Site model remains predominantly unchanged since the previous December 2015 sampling event, with the exception of some changes to the internal building configuration. The heating, ventilating, and air conditioning (HVAC) air handling zones remain unchanged. Figures 2 [Proposed Sub-Slab and Indoor Air Sampling Locations (First Floor)] and 3 [Proposed Indoor Air Sampling Locations (Second Floor)] show the updated first and second floor layouts of the Site building, respectively.

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3.0 PROPOSED SCOPE OF WORK AND RATIONALE FOR SAMPLING LOCATIONS

Sampling activities proposed and discussed in this VI WP #3 include: 1) pre-building surveys, 2) sub-slab sample collection using SUMMA™ canisters, 3) indoor and outdoor air sample collection using both SUMMA™ canisters (over a 10-hour sampling duration) and Radiello® (passive) samplers (over a 7-day sampling duration), and 4) field parameter data collection including total organic vapor photo-ionization detector (PID) measurements, differential pressure measurements, indoor air temperature, and meteorological conditions such as wind, temperature, and air pressure (to be collected throughout the various sampling activities).

3.1 Pre-Sampling Building Survey

A pre-sampling building survey will be conducted approximately one week in advance of the sampling event. The Site will be visited to assess changed Site conditions following tenant improvements to potentially refine indoor air sampling locations. The visit will include identifying, photographing, and removing any potential VOC sources from inside the building. Potential VOC sources will be identified using a photo-ionization detector (PID). Additionally, since the existing sub-slab probes have not been sampled as of December 2015, the integrity of the sub-slab probes will be checked during the pre-sampling building survey and probes will be reinstalled if necessary. If new sub-slab probes are reinstalled, they will be located within five feet of the abandoned sub-slab sample location. The new sub-slab probes will be installed after the pre-sampling building survey is completed.

3.2 Sub-Slab Sampling Locations Rationale

The proposed sub-slab sample locations are situated within the vicinity of the indoor air sample locations or situated to provide additional coverage of the building. Sub-slab sampling locations, shown on Figure 2, include the previously sampled locations: SS-2, SS-5, SS-7, and SS-10. These sample locations are proposed again for this sampling event. A duplicate sample will be collected at SS-5. An additional probe is proposed and will be installed on the first floor of the building to the north and east of the former source area, SS-12, shown on Figure 2.

3.3 Indoor Air Sampling Locations Rationale

In general, proposed indoor air samples are collected in the vicinity of potential VI conduits (i.e., floor drain) or in areas that are representative of a typical workspace (i.e., cubicle, enclosed office area, etc.) (Department of Toxic Substances Control [DTSC] 2011). The building contains four discrete HVAC zones on the first floor, as indicated by the color outlines on Figure 2. One set of indoor air samples will be collected using SUMMA™ canisters from the following indoor air sampling locations. A total of ten samples (nine samples and one duplicate sample) will be located within the three main areas of the building. Proposed indoor air sampling locations are shown on Figures 2 (first floor) and 3 (second floor). A minimum of one indoor air sample will be collected in each HVAC zone as well as in the vicinity of the elevator shaft I the lobby as follows:

- HVAC Zone 1 (first floor)

    - A room over the former source area (IA-1]).
- In the central large area near the existing sub-slab point SS-7 (IA-2), a duplicate sample will be collected at IA-2.
    - A room adjacent to the existing sub-slab point SS-5 (IA-6).
    - Next to a floor drain located within a restroom (IA-9).
- HVAC Zone 2 (first floor)
    - In an area representative of HVAC Zone 2 (IA-7).
- HVAC Zone 3 (first floor)
    - In an area representative of HVAC Zone 3 (IA-8).
- HVAC Zone 4 (first floor)
    - In the smaller northern portion of the building, adjacent to existing sub-slab point SS-1 (IA-3)
- Lobby
    - An area near the elevator (IA-4) on first floor.
    - Near the elevator (IA-5) on second floor.

Revised and/or additional indoor air sampling locations may be proposed based on findings of a pre-sampling building survey.

3.4 Outdoor Air Sampling Location

One outdoor air sample and one duplicate outdoor air sample will be collected using SUMMA™ canisters. Similar to the previous sampling events, the samples will be collected on the roof of the building near the intake of the HVAC system so that the samples will be representative of the air that will enter the building when the HVAC system is in operation.

3.5 Radiello® Passive Indoor and Outdoor Air Sampling Locations

A second set of indoor and outdoor air data will be collected using Radiello® (passive) samplers to provide an understanding of concentrations over a longer sampling duration. Radiello® (passive) samplers will placed in up to four indoor air locations: IA-2, IA-3, IA-4, and IA-7 and will include one duplicate at IA-2. Radiello® (passive) samplers will be in place for seven days. One Radiello® (passive) sampler (and one duplicate sample) will also be placed outside near the HVAC system for seven days.

3.6 Field Parameter Data Collection

Field parameter data will be collected throughout the various sampling event activities. The following field measurements will be recorded: temperature (indoors and outside); total VOCs detected using a PID; and meteorological conditions during sample collection.

In addition, continuous pressure differential measurements (sub-slab pressure relative to the indoor air pressure referred to as cross-slab) will be collected. The cross-slab differential pressure readings will be collected to document conditions with the HVAC system in operation. The cross-

slab pressure differential measurements will be continuously recorded every 5 minutes over a 7-day period using a digital manometer (Omniguard™ 4 manufactured by Engineering Solutions Inc or equivalent). Digital manometers will be situated at three sub-slab sample locations: SS-2, SS-7, and SS-10 (if possible based on building operations). The differential pressure equipment will undergo quality assurance and quality control steps and calibrated in agreement with the standard operating procedure (SOP) provided in Appendix B.

4.0 SAMPLING AND ANALYSIS PLAN

The general procedures listed in the VI Work Plan Addendum (2013) for both sub-slab and indoor and outdoor air sampling will be followed during implementation of this VI Work Plan #3.

Unlike the previous sampling events described in the VI Work Plan Addendum, indoor air samples will be collected with the HVAC system on-line. Based on conversations with the building tenant, the HVAC system is not able to be put off-line due to ongoing building operations. The indoor air samples will be collected over a 10-hour period using the same methods previously stated in the VI Work Plan (2013).

In addition to the sampling and monitoring performed during previous events, continuous cross-slab differential pressure readings will be collected.

4.1 Planned Sequence of Sampling Activities

The planned sequence of events is estimated as follows (subject to change based on field conditions):

Activity 1: Site Visit and Sub-Slab Vapor Probe Installation

a. Identify and remove potential indoor source materials, evaluate indoor air sample locations, verify building construction/condition
b. Verify integrity of sub-slab probes

Activity 2: Sub-Slab Vapor Probe Installation (may be performed concurrently with site visit)

a. Install SS-12
b. Replace existing sub-slab vapor probes (as needed)

Activity 3: Differential Pressure Measurement and Long-Term Sampling (72-hours after Site Visit)

a. Begin cross-slab differential pressure monitoring at sub-slab locations SS-2, SS-7, and SS-10.
b. Deploy long-term passive indoor air sampling equipment at IA-2, IA-3, IA-4, and IA-7
c. Deploy long-term passive outdoor air sampling equipment near HVAC intake

Activity 4: 10-hour Sampling Event (one week after Activity 3)

a. Begin 10-hour indoor air sampling at all indoor air sample locations
b. Begin 10-hour outdoor air sampling near HVAC intake
c. Stop and remove differential pressure monitoring equipment from sub-slab ports
d. Perform sub-slab sampling at all locations
e. Site clean-up, sample processing/packaging/shipping

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4.2 Standard Operating Procedures

This VI Work Plan #3 is subject to SOPs for the activities to be performed (e.g., soil gas probe installation and sampling, indoor and outdoor air sampling, and differential pressure monitoring) as detailed in the VI Work Plan (AECOM, 2013). Pre-sampling activities, sampling procedures, sample handling/custody/shipping, and analysis are detailed in Section 3.0 of the VI Work Plan (AECOM, 2013). For ease of reference, these procedures are summarized in the sections below. This VI Work Plan #3 is also performed in agreement with the Quality Assurance Project Plan located in Appendix A of the VI Work Plan (AECOM, 2013). Any variances from these procedures are detailed herein. The SOPs for Radiello® passive samplers and continuous differential pressure monitoring are included in Appendices A and, B.

4.2.1 Pre-Sampling Activities

As desired and if required, Northrop Grumman will visit the Site with the United States Environmental Protection Agency (USEPA) to review and get approval of final sampling locations included in this work plan. The Health and Safety Plan will be updated in advance to any field work activities being performed. Approval for building access is required from Northrop Grumman and building tenant. In addition, the field work schedule and building access coordination will be discussed with Northrop Grumman, USEPA, and subcontractor in advance of field work activities.

Approximately one week prior to sampling, AECOM will conduct a pre-sampling survey during which the following measurements will be recorded: temperature (indoors and outside); pressure differential measurements (readings taken throughout the building and at each sample location inside the Site building relative to the outside air pressure); total VOCs detected using a PID; and outside weather conditions during sample collection. These readings will be recorded on the form prior to and at the conclusion of the sampling described below. Any potential indoor source materials will be removed in advance of sample collection. Note that samples will not be collected within 48 hours of a significant rain event (1/2 inch of rainfall or greater).

4.2.2 Indoor and Outdoor Air Sampling (SUMMA™)

Indoor and outdoor air samples will be collected over a 10-hour period using individually certified clean SUMMA™ canisters supplied by the analytical laboratory, Eurofins Air Toxics, LLC in Folsom, California. Indoor and outdoor air samples will be analyzed for VOCs using USEPA Method TO-15 modified for selective ion monitoring (SIM) mode.

A second building survey will be completed on the day of sampling. This survey will include real-time screening level measurement of total organic vapors inside the building using a low-level photoionization detector (PID) with a reporting limit of 1 part per billion (ppb). Atmospheric pressure and temperature measurements will be taken inside and outside of the building prior to and after indoor air sampling. Indoor air samples will be collected over a 10-hour period. Each SUMMA™ canister will be placed at a height of approximately 3 to 5 feet above the floor level (i.e., the breathing zone). Sampling locations will be photographed and documented in the report. Duplicate samples will be collected using a tee into co-located SUMMA™ canisters. All windows and doors in the facility will be closed prior to initiating sampling and remain closed throughout the period of sampling. If the initial vacuum gauge on a SUMMA™ canister reads less than 26 inches of mercury (Hg), the canister will be replaced prior to sample collection; if the final vacuum gauge reads greater than 20 inches of Hg, the sample will be rejected. Vacuum pressures will be monitored throughout the 10-hour sampling period to identify potential problems with flow

regulators. Sample start and end times as well as start and end vacuum gauge readings will be included on the sample label and on field forms.

4.2.3 Indoor and Outdoor Sampling (Radiello®)

Indoor and outdoor air samples will be collected over a seven-day period using passive Radiello® supplied by the analytical laboratory, Eurofins Air Toxics, LLC in Folsom, California. Indoor and outdoor air samples will be analyzed for VOCs using USEPA Modified Method TO-17.

Samples will be placed at least 72 hours after the building survey which will include real-time screening level measurement of total organic vapors inside the building using a low-level photoionization detector (PID) with a reporting limit of 1 ppb. Atmospheric pressure and temperature measurements will be collected over the seven-day period. Each Radiello® canister will be placed at a height of approximately 3 to 5 feet above the floor level (i.e., the breathing zone). Sampling locations will be photographed and documented in the report. Duplicate samples will be placed adjacent to the parent sample. Sample start and end times as well as start and end vacuum gauge readings will be included on the sample label and on field forms.

It is likely the laboratory will not be able to report for all chemicals (*i.e.*, vinyl chloride) using Radiello® samplers. Detections of chemicals reported in the indoor air (SUMMA™) or sub-slab results will be used to evaluate potential human health risks.

4.2.4 Sub-Slab Sampling

As discussed in Section 2.4, existing sub-slab monitoring probes will be leak tested to verify the integrity of the sampling point. Where required, sub-slab vapor monitoring wells will be installed using a hand-held hammer drill. A 1-inch diameter borehole will be drilled to a depth of 3 inches below the concrete foundation of the building. A pilot borehole will be completed to determine the thickness of the building foundation if needed. A 0.5-inch-long plastic air diffuser (vapor implant) attached to ¼-inch Nylaflow® tubing will be inserted into the bottom of the borehole and will be connected to ¼-inch stainless steel, Nylaflow®, or Teflon™ tubing and inserted into the bottom of the borehole so that the top of screen is 1-inch below the building foundation. Filter pack sand (#3) will be placed around and extending 1-inch above the implant (approximately level with the building foundation), followed by 2- to 3-inches of bentonite, minimally hydrated to ensure proper sealing, and topped by a quick-set cement to the surface. The well will be completed with the terminal end of the ¼-inch stainless steel tubing connected to a threaded fitting in a compression cap that is flush with the building floor. A 5/8-inch diameter borehole will be drilled to a depth of 3 inches below the concrete slab of the building. A 1-inch-long plastic air diffuser (sub-slab vapor probe [implant]), attached to 1/8-inch or 1/4-inch Nylaflow® or Teflon™ tubing, will be inserted through the slab into the bottom of the borehole so that the top of screen is 1-inch below the bottom of the building slab. The upper end of the tubing will extend up through the slab with enough length to allow connection to the Summa canister sampling train. Filter pack sand will be placed around and extend 1-inch above the implant (approximately level with the bottom of the slab), followed by 2-inches of bentonite, minimally hydrated to ensure proper sealing, and topped by a quick-set cement to the surface.

Prior to sampling, all sub-slab probes will be leak tested to verify that each well is properly installed, and that indoor air is not drawn into the well thus diluting VOC concentrations in the samples. Leak testing will be conducted prior to sampling of the probe and no sooner than 2 hours after installation to allow time for the cement to cure and subsurface conditions to equilibrate prior to sampling.

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The leak tests will involve the use of helium as a tracer compound introduced into the atmosphere, under a shroud, immediately surrounding the well. Tracer gas testing with the helium shroud will be used during purging and sample collection while maintaining approximately 20% helium within the shroud. A PID is used to field screen for VOCs; followed by measurement of helium in the well vapor. A calibrated syringe will be used to purge vapor from the well. Purging will be minimized to the extent possible to ensure that the sample collected is representative of the sub-slab location. Detection of helium (using the helium tester) at 5 percent (%) of the concentration measured in under the shroud surrounding the well head will trigger an investigation into the potential cause of the leakage. If a potential cause is identified, corrective action will be taken to eliminate the leak before conducting a second leak test to confirm the initial result. If the tracer compound is not detected at a concentration in excess of failure criteria, the vapor well will be considered properly sealed.

If the well again fails the leak test, then a replacement well will be installed at least 5 ft away from the original well. The tubing and implant will be removed from the original well, and the borehole will be backfilled with concrete and finished flush with the building floor.

Prior to sampling, a shut-in test is performed to check for leaks in the above-ground sample train (e.g., fittings, lines, and valves located above-ground). The objective is to ensure that leaks in the sample train are detected. Valves to the probe and sample container are shut and the lines will be evacuated inducing a measured vacuum of about 100 inches of water. Once all the external valves to the sampling line are shut, the vacuum is observed for at least a minute. The vacuum gauge should remain steady, indicating no leakage at any of the fittings. If there is an observable loss of vacuum (indicating leakage), the fittings are adjusted until the line can hold a vacuum.

Sub-slab samples will be collected using 1 liter batch certified SUMMA™ canisters supplied by the analytical laboratory, Eurofins Air Toxics, LLC in Folsom, California. A default of three purge volumes will be used to remove ambient air from the sub-slab vapor probe and tubing to ensure that representative sub-slab vapor samples are collected. Sub-slab samples will be analyzed for VOCs and helium using USEPA Method TO-15 (in full scan mode) and Modified ASTM D-1946, respectively

The helium shroud procedure will continue to be used during sub-slab sample collection. Samples will be collected from the sub-slab probes immediately after purging using a 1-Liter SUMMA™ canister fitted with a flow regulator that limits the flow rate to less than 200 milliliters per minute. A tee will be used to collect a duplicate sample into co-located SUMMA™ canisters. Sample start and end times as well as start and end vacuum gauge readings will be included on the sample label and on field forms.

5.0 QUALITY ASSURANCE PROJECT PLAN

The QAPP included in Appendix A of the VI Work Plan Addendum will be used for implementation of this VI Work Plan #3 with the following updates:

- PALs: PALs for the sampling described in this VI Work Plan #3 will use the industrial indoor air screening levels from the DTSC Office of Human and Ecological Risk (HERO) Note 3, last updated in May 2022 or, if unavailable, the United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) for industrial exposure to indoor air, last updated in November 2022. Screening levels for indoor air are based on a target cancer risk of 1E-06 or a target noncancer hazard of 1. These screening criteria are shown in Table 1, which replaces Table A-2 from the original QAPP. Laboratory reporting limits are shown in Table 2, which meet the PALs.

- Number and Location of Samples: Sampling locations and rationale for the work described in this VI Work Plan #3 are discussed in Sections 2.4 through 2.6. The number of field duplicates (two indoor air [one SUMMA™ and one Radiello®], two outdoor air [one SUMMA™ and one Radiello®], and one sub-slab) remains unchanged. The number and types of samples are provided in Table 3.

6.0 HEALTH AND SAFETY PLAN

The HASP [discussed in Section 5.0, Appendix A of the VI Work Plan (2013)] previously prepared for the Site will be updated and used.

7.0 DATA VALIDATION, EVALUATION, AND REPORTING

Data reporting will follow the procedures listed in Sections 6.1 and 6.3, respectively, of the VI Work Plan (2013). Data will be evaluated using the procedures listed in Section 6.2 of the VI Work Plan; however, the comparison criteria will be updated to reflect updated screening levels issued in 2022, as discussed in Section 4.0. Data validation and usability will be performed in agreement with Section A.5 of the VI Work Plan (AECOM, 2013). The validation process includes evaluation against criteria for laboratory blanks, evaluating against accuracy criteria including holding times and laboratory control samples, evaluating against precision criteria by assessing the relative percent difference for field and laboratory duplicates, and confirming that data qualifiers are appropriately assigned. Duplicate results will use the maximum detected concentration in the analysis if samples are considered representative. Results reporting one detect and one non-detect will use the detected result in the analysis. Sampling results and their evaluation will be presented in a technical report to USEPA within 30 days of receipt of results from the laboratory. Laboratory methods quality objectives are provided in Table 4.

All conclusions made from implementing this VI Work Plan #3 are contingent upon the property owner ensuring that the integrity of the concrete slab will not be compromised after the sampling has been conducted (e.g., additional building improvements). If the concrete slab is compromised after implementation of this VI Work Plan #3, the VI sampling and reporting (as described above) will need to be repeated to document current conditions unless sub-slab concentrations are below screening levels.

After data collection and evaluation is completed, reviewed, and approved by USEPA, the sub-slab ports will be decommissioned, upon consultation and approval by USEPA.

8.0 SCHEDULE

Following USEPA approval of this VI Work Plan #3, preparation for field activities, including coordination with the analytical laboratory and the property owner will begin. Pending availability of all relevant parties and appropriate weather conditions, sampling is expected to be scheduled in March 2023. A building survey will be conducted in advance of the sampling event. Data compilation and evaluation will follow sample collection and analysis and a draft version of the report will be submitted for regulatory review. AECOM plans to submit the draft report to the USEPA within 30 days of receipt of laboratory analytical results.

9.0 REFERENCES

AECOM, 2013. Vapor Intrusion Evaluation Sampling and Analysis Work Plan, Former TRW Microwave Facility, Sunnyvale, California. October 29.

AECOM, 2014a. Vapor Intrusion Evaluation Report, Former TRW Microwave Facility, 825 Stewart Drive Sunnyvale, California. February 28.

AECOM, 2014b. Passive Sub-Slab Vapor Collection System Installation Work Plan, Former TRW Microwave Facility, 825 Stewart Drive, Sunnyvale, California. August 13.

AECOM, 2015a. Work Plan Addendum for Vapor Intrusion Evaluation, Former TRW Microwave Site, Sunnyvale, California. March 26.

AECOM, 2015b. Work Plan Addendum #2 for Vapor Intrusion Evaluation Sampling and Analysis, Former TRW Microwave Facility, 825 Stewart Drive, Sunnyvale, California. December.

AECOM, 2015c. Vapor Intrusion Evaluation Report, Former TRW Microwave Site, Sunnyvale, California. June 30.

Department of Toxic Substances Control (DTSC). 2011. Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance). October.

DTSC Office of Human and Ecological Risk (HERO). 2022. Human Health Risk Assessment Note Number 3. June 2020 Revised May.

USEPA, 2022. Regional Screening Levels. November. (Accessed from https://www.epa.gov/risk/regional-screening-levels-rsls in January 2023).

TABLES

TABLE 1. UPDATED SCREENING CRITERIA COMPARISON

Analyte	Previous PALs ($\mu g/m^3$)	USEPA Regional Screening Levels - Industrial [a] Indoor Air ($\mu g/m^3$)	USEPA Regional Screening Levels - Industrial [a] Soil Gas ($\mu g/m^3$)	DTSC HERO Note 3 - Industrial [b] Indoor Air ($\mu g/m^3$)	DTSC HERO Note 3 - Industrial [b] Soil Gas ($\mu g/m^3$)
1,1-dichloroethane (1,1-DCA)	7.7	7.7	260	NE	NE
1,1-dichloroethene (1,1-DCE)	880	880	29330	NE	NE
1,2-dichlorobenzene	880	880	29330	NE	NE
1,1,1-trichloroethane (1,1,1-TCA)	22,000	22,000	733330	NE	NE
chlorobenzene	220	220	7330	NE	NE
chloroform	0.53	0.53	20	NE	NE
cis-1,2-dichloroethene	260	180	6000	35	1170
trans-1,2-dichloroethene	260	180	6000	350	11670
tetrachloroethene (PCE)	47	47	1570	2	70
trichloroethene (TCE) [c]	3.0	3.0	100	NE	NE
Freon 11 (trichlorofluoromethane)	3,100	NE	NE	5,300	176,670
Freon 12 (dichlorodifluoromethane)	440	440	14670	NE	NE
Freon 113	130,000	22,000	733330	NE	NE
vinyl chloride	2.8	2.8	90	0.16	10

Notes:

[a] USEPA Regional Screening Levels for Industrial Exposure (RSLs; USEPA, 2022).

[b] DTSC HERO Note 3 Screening Levels for Industrial Exposure (HERO, 2022).

[c] USEPA will be notified immediately if indoor air results are above the accelerated response value of 7 $\mu g/m^3$ for commercial/industrial exposures, and confirmation sampling will be conducted.

$\mu g/m^3$	micrograms per cubic meter
DTSC	Department of Toxic Substances Control
HERO	DTSC Human and Ecological Risk Office
NE	not established
PALs	project action levels

TABLE 2. LABORATORY REPORTING LIMITS

Analyte	Estimated Sample Reporting Limit (1L Summa) ($\mu g/m^3$)	Estimated Sample Reporting Limit (6L Summa) ($\mu g/m^3$)	Estimated Sample Reporting Limit (Radiello) ($\mu g/m^3$)
1,1-dichloroethane (1,1-DCA)	4.4	0.14	0.1575
1,1-dichloroethene (1,1-DCE)	4.4	0.07	0.5221
1,2-dichlorobenzene	6.6	0.89	0.1710
1,1,1-trichloroethane (1,1,1-TCA)	5.9	0.1925	0.16
chlorobenzene	5.0	0.68	0.1459
chloroform	5.3	0.73	0.1323
cis-1,2-dichloroethene	4.4	0.13825	0.16
trans-1,2-dichloroethene	4.4	0.7	0.3307
tetrachloroethene (PCE)	7.4	0.245	0.1681
trichloroethene (TCE)	5.90	0.1925	0.1438
Freon 11 (trichlorofluoromethane)	6.1	0.83	--
Freon 12 (dichlorodifluoromethane)	5.50	0.173075	--
Freon 113	8.3	1.1	--
vinyl chloride	2.8	0.0455	--

Notes:

$\mu g/m^3$	micrograms per cubic meter
ppbv	part per billion volume
RL	reporting limit
TO-15 (SIM)	toxic organics-15 select ion monitoring
1L	1 liter
6L	6 liter
--	not available/applicable

TABLE 3. NUMBER AND TYPES OF SAMPLES

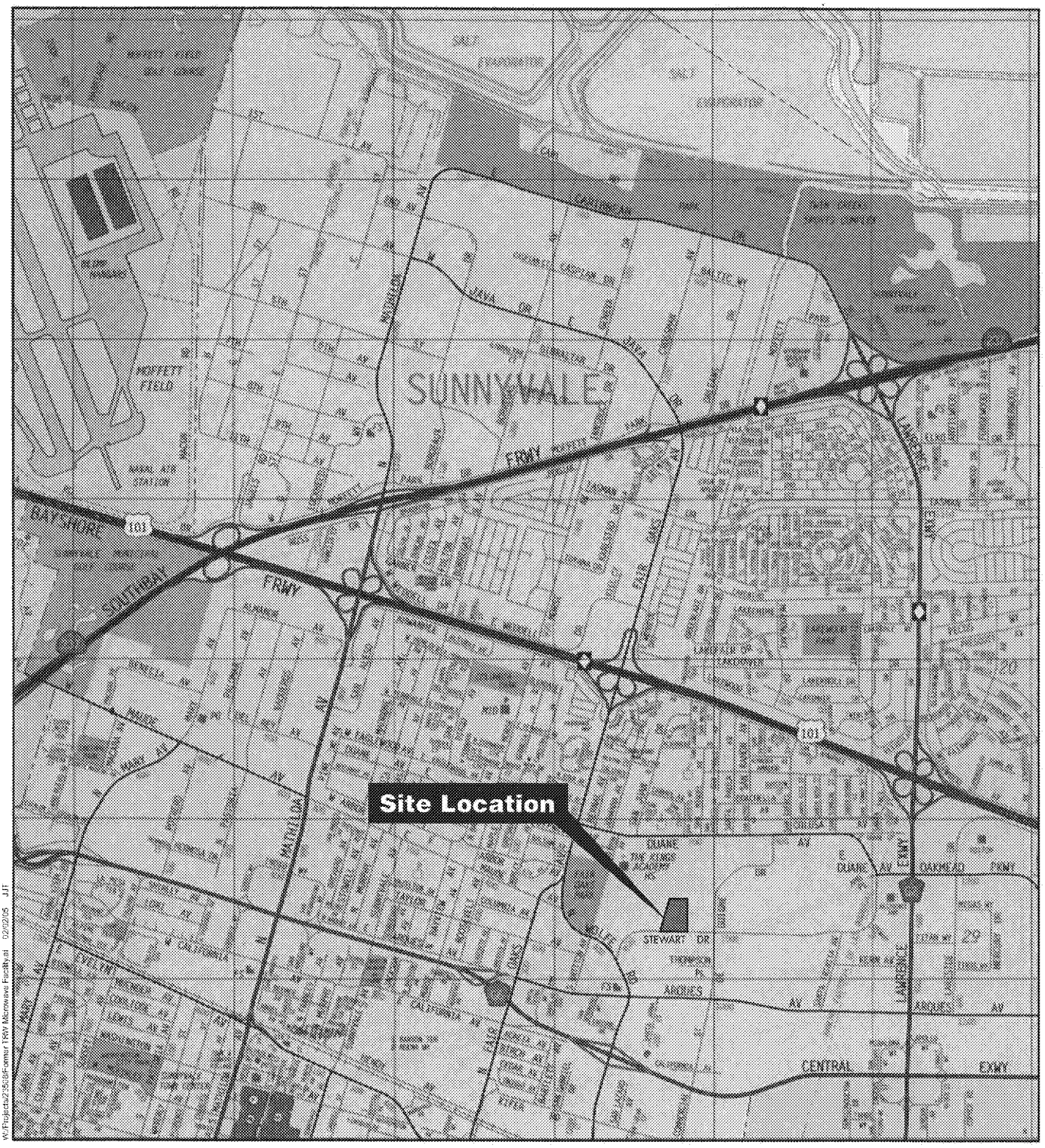
			Number of Samples		
Type of Sample	**Sampling Duration**	**Analytical Method**	**Primary**	**Trip Blank**	**Duplicate**
Indoor/Outdoor Air	7 days	Radiello® 130 TO-17	5	1	2
Indoor Air	10-hour	TO-15 SIM	9		1
Outdoor Air	10-hour	TO-15 SIM	1		1
Sub-Slab Soil Gas	Grab	TO-15 Scan	5		1

TABLE 4. METHOD QUALITY OBJECTIVES

Method	Media Certification	Holding Time	Preservation	Field Blank	Field Duplicate	Continuing Calibration Verification	Laboratory Method Blank	Laboratory Control Sample	Internal Standards	Surrogates
TO-15 SIM	Individual < RL	30 Days	Ambient (10-35°C)	As needed <MDL	1 per 10 samples ≤ 25 RPD	≤ 30 percent difference	< MDL	≤ 25 percent	60-140 percent recovery	70-130 percent recovery
TO-15 Scan	Batch < RL	30 Days	Ambient (10-35°C)	As needed <MDL	1 per 10 samples ≤ 25 RPD	≤ 30 percent difference	< MDL	≤ 25 percent	60-140 percent recovery	70-130 percent recovery
TO-17 for Radiello-130	< RL	2 years	Ambient	As needed < RL	As needed (no set criteria)	≤ 30 percent difference	< RL	≤ 25 percent	50-200 percent recovery	70-130 percent recovery

Notes:
MDL - method detection limit
RPD - relative percent difference

FIGURES



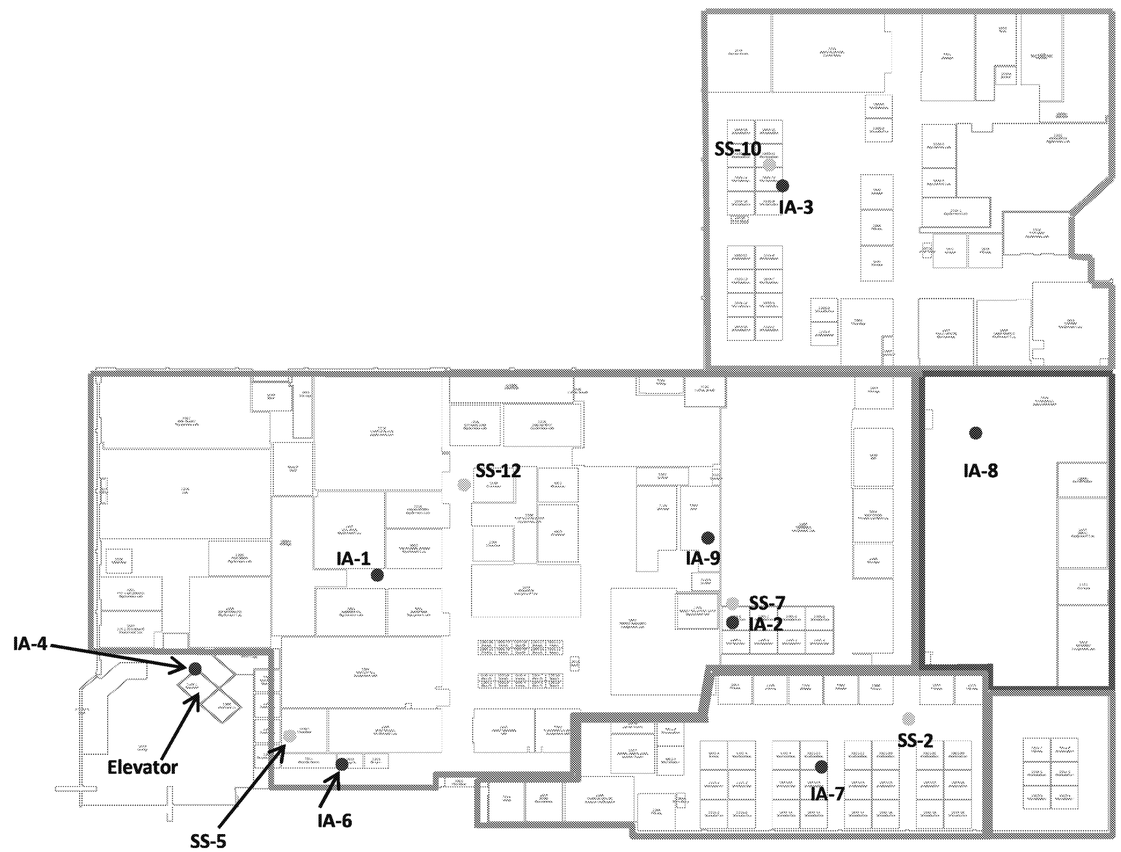
NORTH

0 1/2

MILE

NORTHROP GRUMMAN

Figure 1
Site Location Map
Former TRW Microwave Facility
825 Stewart Drive
Sunnyvale, California



Legend:

- ● PROPOSED INDOOR AIR SAMPLE
- ● PROPOSED SUB-SLAB SAMPLE
- HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) ZONE 1
- HVAC ZONE 2
- HVAC ZONE 3
- HVAC ZONE 4

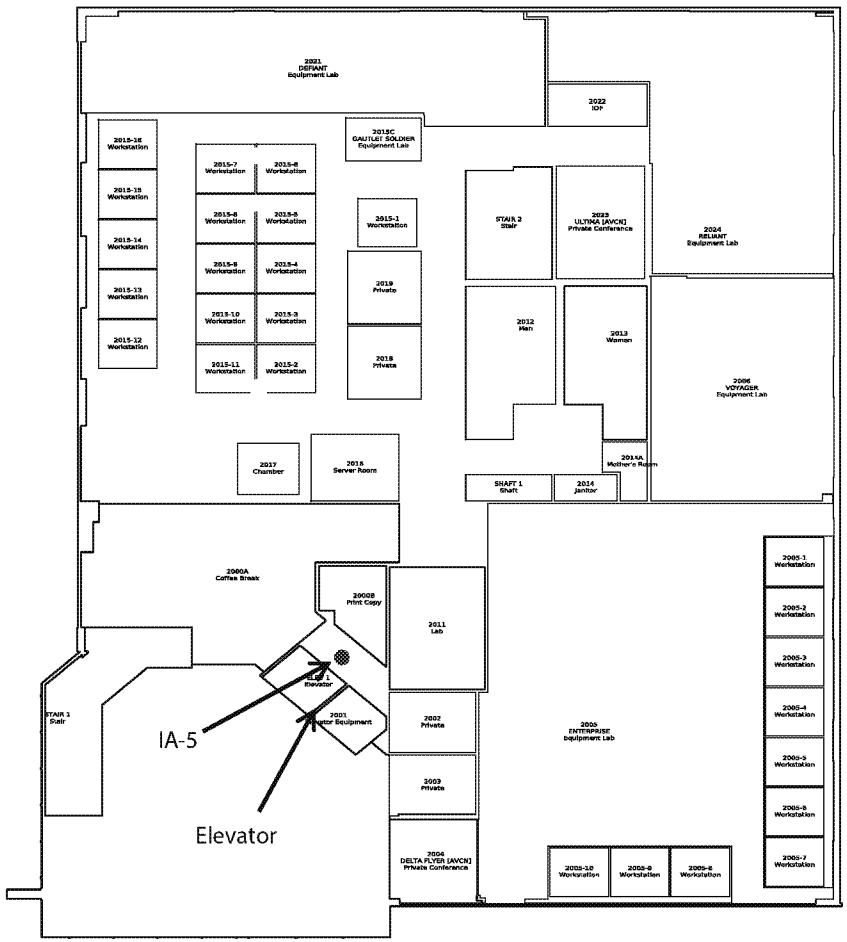
NOT TO SCALE

N

Former TRW Microwave Site

Proposed Sub-Slab and Indoor Air Sampling Locations (First Floor)

Date 02-16	AECOM	Figure 2
Project No. 60443776		



NOT TO SCALE

Legend:

● INDOOR AIR SAMPLE

Former TRW Microwave Site

Proposed Indoor Air Sampling Location
(Second Floor)

Date 10-22	AECOM	Figure
Project No. 60680270		3

APPENDIX A

RADIELLO® PASSIVE SAMPLER
STANDARD OPERATING PROCEDURES

Edition 01/2019

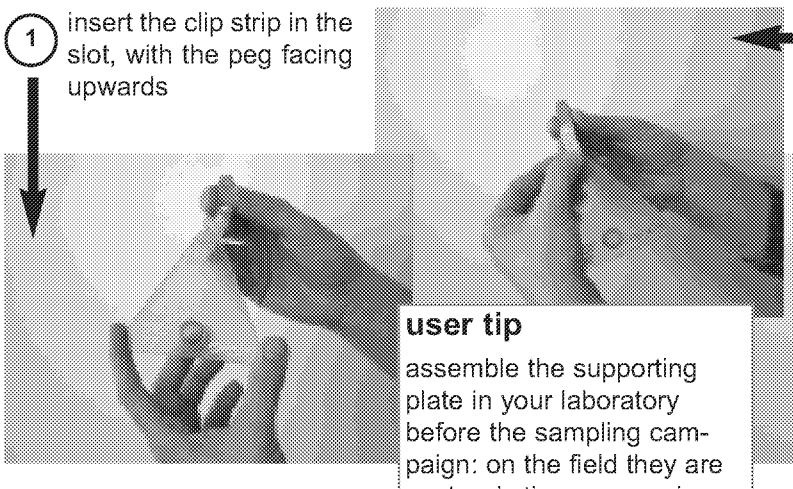
how to use *radiello*

assembling the supporting plate

before sampling

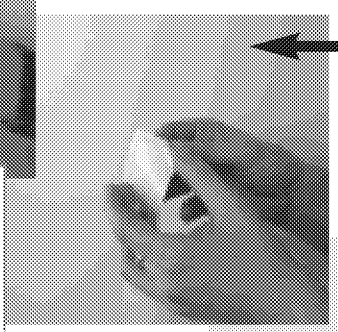
Before using ***radiello***, you have to assemble the supporting plate with the clip, necessary to suspend it, and the adhesive label pocket.

1 insert the clip strip in the slot, with the peg facing upwards



2 ply the strip and insert the peg into the hole

3 peel off the transparent pocket



user tip

assemble the supporting plate in your laboratory before the sampling campaign: on the field they are uselessly time-consuming.

4 and stick it onto the plate in a central position;

if you prefer, the pocket can be applied to the rear of the plate, but BE CAREFUL, always with the label insertion slot on the side (otherwise, if it starts raining the label can get wet)

on-field

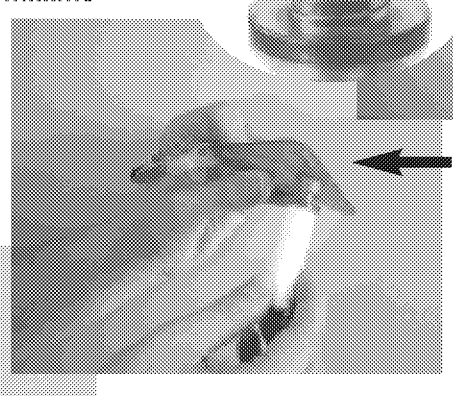
to start the sampling

1 open the plastic bag, draw the cartridge out from the tube and put it in the diffusive body. ***Keep the glass or the plastic tube and stopper in the original plastic bag.***

The lower part of the diffusive body holds a seat for the central positioning of the cartridge. **A correctly centered cartridge should not stick out even by half a millimeter. If it is not so, the cartridge is not correctly positioned and is out of axis.**

As a consequence, when the diffusive body is screwed onto the supporting plate the cartridge is bent, the geometry of the sampler is disturbed and the results obtained become unreliable.

To place the cartridge centrally you need only to tap on the diffusive body.

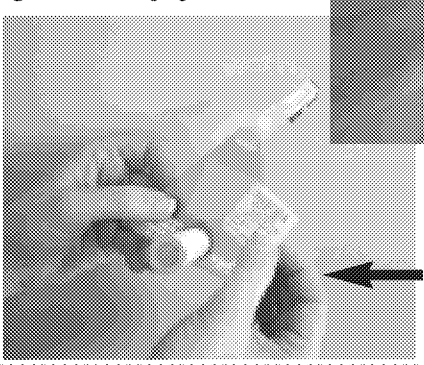


2 keeping the diffusive body in a vertical position, screw it onto the supporting plate.

BE CAREFUL: do not hold the diffusive body horizontally when you screw it onto the plate, otherwise the cartridge could come out from its seat and stick out.

user tip

Do not touch the cartridge with your fingers if possible, particularly if it is impregnated with reactive



3 Insert a label in the pocket without peeling it off. Keep note of the date and time and expose ***radiello***. Sampling has started.

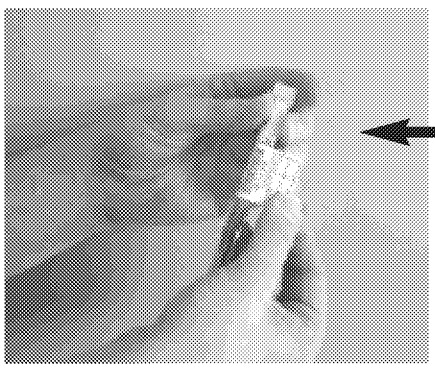
Istituti Clinici Scientifici Maugeri

ISTITUTI CLINICI SCIENTIFICI MAUGERI S.p.A. - SB
Centro di Ricerche Ambientali - via Atene, 9 - 35010 VIGONZA (PD)
tel. 0498 064 511 fax 0498 064 555 e.mail cra.padova@icsmaugeri.it

user tip

even if you can write date and time of the sampling start and end on the adhesive label, we suggest you to keep note of these parameters also separately: after a week exposure with bad weather conditions, your writings could become illegible!

DO NOT USE MARKING PENS to write on the label: they contain solvents that are sampled by ***radiello***!



after the sampling

Keep note of the date and time of the end of exposure.

4 Place the cartridge into the tube, peel off the label and stick it onto the tube such that the barcode is parallel to the axis of the tube.

If you have performed the sampling of different polluting compounds at the same time, ***BE CAREFUL NOT TO MIX UP THE TUBES***: place the exposed cartridge in its original tube, identified by the code printed on the plastic bag.

IMPORTANT

Always stick the label such that the barcode is parallel to the axis of the tube: any other position will compromise the barcode automated reading by the optic reading device.

maintenance

When exposed outdoors or in a workplace environment, the diffusive body may get dirty from airborne dust. Fine particles (PM_{10}) are especially harmful to yellow diffusive bodies since they can obstruct the pores. When the diffusive bodies are dirty you can wash them as follows.

Immerse the diffusive bodies in a beaker with a soapy solution (e.g. dish detergent) and sonicate them for 20 minutes. As the diffusive bodies float, you may make them sink by putting a smaller beaker on them, with water inside enough to dip it a few centimeters.

Rinse the diffusive bodies with plenty of water and then deionized water; let them finally dry in the air.

IMPORTANT: NEVER USE SOLVENTS TO CLEAN THE DIFFUSIVE BODIES!!!

After four or five washings, diffusive bodies need replacing: repeatedly adsorbed dust may have penetrated the pores such deeply to be undisturbed by washing.

The following table shows the advised washing schedule:

PM_{10} concentration ($\mu g \cdot m^{-3}$)	<30	40	>50
Washing after days of exposure	45	30	15

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APPENDIX B

DIFFERENTIAL PRESSURE MONITORING
STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE: SUB-SLAB/INDOOR AIR DIFFERENTIAL PRESSURE MONITORING FOR VAPOR INTRUSION

1.0 BACKGROUND

Vapor intrusion (VI) is the migration of volatile organic compounds (VOCs) from the subsurface into the indoor air of overlying buildings (United States Environmental Protection Agency [USEPA] 2015). These contaminant vapors can migrate through several transport mechanisms, including diffusion in the unsaturated zone, diffusion in shallow groundwater, horizontal and vertical migration via preferential pathways (e.g., utility corridors, pipelines, cracked clay), and advective/convective transport in the soil (Interstate Technology Regulatory Council 2007; Department of Defense 2009, USEPA 2015; California Department of Toxic Substances Control and California Water Resources Control Boards 2020). Advective and convective transport is generally most active beneath or directly adjacent to buildings, where there can be a negative pressure differential (dP) between the building and the surrounding soil that tends to pull soil gas upwards towards the building (often referred to as building or stack effects). This pressure differential (dP) can occur from one or more natural and human-caused factors such as:

- Seasons of the year;
- Wind speed;
- Difference between indoor and outdoor temperatures;
- Barometric trends;
- Difference between sub-slab and indoor air pressure (cross-slab dP]) or between indoor air and outdoor air pressure;
- Building conditions (e.g., foundation type and status, age, size);
- Operation of heating, ventilating and air conditioning (HVAC) and/or exhaust fans in bathrooms and kitchens; and
- Use of fireplaces and other combustion sources.

The combination of these factors results in a net convective flow of soil gas from the subsurface migrating into the building interior. The DP parameter is a useful indicator and dP measurements can be used as a complementary line of evidence as they can be used to evaluate the potential for convective flow of soil gas and the potential for VI into a building.

2.0 PURPOSE AND SCOPE

This standard operating procedure (SOP) describes procedures to provide data for understanding pressure differences between building interior and beneath the building foundation slab (sub-slab), which is referred to the " cross-slab" dP in this SOP).

The measurement of cross-slab dP can easily be determined via a sub-slab probe. Therefore, a sub-slab probes shall be installed at the locations proposed for dP monitoring. The dP recorder (Omniguard™4 or equivalent) will be set to record the maximum and minimum differential pressure at five-minute intervals.

3.0 EQUIPMENT AND MATERIALS

- DP recorder (Omniguard™4 or equivalent) (do not use battery-operated recorder)

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- Photoionization detector (PID)
- Temperature probe (TSI 9565 or equivalent)
- Teflon (1/4 or 1/8 inch outer diameter) tubing and larger diameter flexible tubing
- Fittings and ferrules and sampling union to connect the Omniguard™4 to the sub-slab vapor probe
- Tools such as wrenches for adjusting fittings and ferrules and tube cutter
- Extension cords for connection to an outlet
- Safety cones to identify dP recorder locations and electrical cords
- Signs to indicate " Sampling/Monitoring is in Progress"
- Indelible ink pens (utilize ball point, solvent-based markers or Sharpie pens shall not be used at any time)
- Project field logbook for recording field observations
- Sampling and Analysis Plan
- Health and Safety Plan (HASP)

4.0 FIELD PROCEDURES

4.1.1 Differential Pressure Monitoring Procedures

Set up the dP recorder in accordance with the Omniguard™4 Manual (dP manual) provided in Attachment 1. Refer to Sections 3 and 4 of the dP manual for detailed instructions and information. An illustration and description of the controls (e.g., ports and keys including menu, printer, and alarm) are provided on pages 16 and 17 of the dP manual.

Below are quick setup notes for the Omniguard™4 (provided on pages 6 through 8 and the last page of the dP manual).

1. Before a computer can communicate with an Omniguard™4, download and install the Omniguard™4 Communication software from website: www.engsolinc.com. Detailed instructions for installation and operation of the software are included with the download.
2. Attach Teflon tubing to sub-slab probe and attach other end of tubing to inlet port #2 (reference point). Inlet port #1 does not require tubing as it will remain open to indoor air. If other flexible tubing is used in conjunction with Teflon tubing, ensure there is a tight seat between both sets of tubing.
3. Plug the unit into a nearby electrical outlet, use extension cords if needed. Turn the unit on and select the MENU button to select the setting list. Enter and save information for the following parameters: DATE and TIME, UNITS (Pascal [Pa]), ALARM SETPOINTS (using a range of + 62 Pa to -62 Pa), LOG RATE (every 5 minutes), ALARM RATE (every 5 seconds), and CONTRACTOR NAME (AECOM).
4. Press START JOB button to begin the pressure readings (i.e., new job). Enter a name for the new job and press SAVE to save the job name. The previous job will end and a summary of it will print.
5. Check Alarm 1 and 2 setpoints (displayed in the monitor screen window), adjust if needed.

It will be necessary to periodically check the dP recorder to ensure the unit's power has not been interrupted or tampered with. The unit will need to be manually restarted if a power outage occurs within the building. If the unit is set up for multiple days but cannot be monitored in person, the audible alarm can be disabled by pressing the ALARM SILENCE button. The paper printer can be disabled by

pressing the PRINTER ON/OFF button, all pressure readings are logged to memory regardless of printer settings.

After dP monitoring is complete, transfer the job log to the computer following the steps below (refer to pages 22 and 23 of the dP manual).

1. If not completed during the initial setup, download and install the Omniguard™4 Communication software from website: www.engsolinc.com.
2. Use the USB cable included with the Omniguard™4, plug the cable into the appropriate connector on the unit and the other end to the appropriate computer port.
3. Select RECEIVE CURRENT JOB LOG or RECEIVE ALL JOB LOGS under JOB LOGS in the unit's window menu.
4. When uploading is complete the job log will be displayed in the box on the left side of the window. For the paper print job, refer to pages 14 and 15 of the dP manual.
5. Select the SAVE CURRENT REPORT as a .txt file. This file can be opened in Notepad program and then copied into Excel.

4.1.2 Weather Conditions

Information regarding several environmental factors shall be obtained during the dP monitoring event and documented since they may affect the results of the dP monitoring and sub-slab sampling event. These factors include:

- Indoor and outdoor air temperatures (field equipment and local meteorological station);
- Wind speed and direction, and humidity (local meteorological station);
- Degree of cloud cover (observed); and
- Barometric pressure and trend (local meteorological station).

5.0 HEALTH AND SAFETY

- Field personnel shall adhere to the site-specific HASP.
- Follow all operating procedures as indicated in the instruction manuals for field equipment and materials.
- Ensure outlet(s) in the building are available for use, extension cords may be necessary. Inspect any extensions cords and outlets that will be used for dP monitoring to avoid shocks/power shortages.
- Ensure the Omniguard™4 and extension cords are placed in safe areas of the building.
- Minimize lengths of extension cords and tubing to avoid trip hazard.
- Place safety cones and signs in vicinity of dP recorder, tubing, and extension cords to inform others of their presence. Use tape to hold tubing and extension cords in place.

6.0 QUALITY CONTROL

- Periodically check the Omniguard™4 to ensure electricity to the unit has not been interrupted or the unit has not been tampered with.
- Minimize tubing length to avoid loss of accuracy.
- The Omniguard™4 does not require calibration between jobs (nor is it recommended). However, it can be calibrated using the ZERO CALIBRATE menu item, Zero calibration can

only be done when the pressure tubing is not attached to the unit. Calibration verification should be conducted by the factory on an annual basis. Refer to page 21 of the dP manual for details on zero calibration.

7.0 DOCUMENTION/RECORDS

The field crew shall document each DP monitoring event in a bound logbook or appropriate field forms/log sheets. The following information will be recorded:

- Project name and number
- Date and time
- Name(s) of sampling personnel
- Site location
- DP monitoring location (dP monitoring data will be logged/recorded as described in Section 4.1.1)
- Weather conditions
- Miscellaneous observations
- Analytical equipment utilized (e.g., Omniguard™4, PID)
- Equipment calibration records (provided with equipment)

The original field records will be placed in the project files immediately upon completion of fieldwork.

8.0 REFERENCES

California Department of Toxic Substances Control and California Water Resources Control Boards. 2020. Supplemental Guidance: Screening and Evaluating Vapor Intrusion. Draft for Public Comments. February.

Department of Defense, United States. 2009. DoD Vapor Intrusion Handbook. Washington D.C. January.

Interstate Technology & Regulatory Council. 20007. Vapor Intrusion Pathway: A Practical Guideline. Prepared by the Interstate Technology & Regulatory Council, Vapor Intrusion Team. January.

United States Environmental Protection Agency. 2015. OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air. Office of Solid Waste and Emergency Response. Publication 9200.2-154. June.

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Attachment 1
Omniguard 4 Differential Pressure Recorder Owner's Manual

OMNIGUARD™ 4

DIFFERENTIAL PRESSURE RECORDER

Owner's Manual

ENGINEERING SOLUTIONS INC

ED_013917_00000027-00034

OMNIGUARD 4

Differential Pressure Recorder

Serial #:

_____

The serial number is located inside the case lid.

Dealer Name and Address:

_____

Name

_____

Address

_____

City, State, Zip

_____

Phone

Date of Purchase: _____

_____

Registered to:

_____

Name

_____

Address

_____

City, State, Zip

_____

Phone

ENGINEERING SOLUTIONS INC

6000 Southcenter Blvd, Suite 70
Seattle, Washington 98188-2439
(206) 241-9395 • (206) 241-9411 fax
www.engsolinc.com

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Omniguard ™ 4

Differential Pressure Recorder

Introduction

Unpacking

The *Omniguard 4* is shipped complete and ready to use. When unpacking the unit, please check for the following items:

- Roll of thermal paper (installed)
- 10 ft. inlet pressure tubing
- Owner's Manual
- Registration Card

Save the shipping box and packing material, in the event the unit must be shipped to another location or for service. If you are missing any items shown on the packing list, or if you have any questions regarding your *Omniguard 4*, please call your dealer or Engineering Solutions at (206) 241-9395.

Please remember to fill out and return the Registration Card.

Owner's Manual Overview

This manual covers the setup and operation of the *Omniguard 4*. It uses several different fonts and other special characters to make various unit functions and types of reporting easy to identify. Below is an example of each:

- Text printed on the display screen is shown as: ALARM 1
- Thermal printer text is shown as: **NORMAL OP**
- Keys and connectors on the front panel are shown as: **ALARM SILENCE**

Features

- Real-time differential monitoring of vacuum and/or pressure level
- Extremely simple to setup and use, with on screen help available via a **HELP** key
- Log and track by Jobs. Stores multiple jobs, each with unique job name and starting/ending dates
- Contractor name appears in all Job Logs
- Programmable high and low alarm settings
- Windowed case lid allows viewing pressure reading and status from across the room, operates with lid closed to prevent damage to unit from water and other construction debris
- Large easy-to-read graphic LCD display with backlight shows current pressure reading, operation status and alarm setpoints

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- Multiple display modes, allows easy viewing of pressure reading from a distance, modes toggled by **DISPLAY** key
- 30+ days internal memory stores pressure readings and alarm occurrences with a date/time-stamp, complete record of operation available for printing and transfer to computer
- Built-in hanging clip gets unit off the ground and away from possible damage, allows easy viewing of monitoring status
- Totally self-contained unit, all necessary parts store securely inside the lid
- Temperature compensation circuitry eliminates the need for off-site calibration
- Pressure readings displayed in Inches WC, Millimeters WC or Pascals
- USB and Serial ports support PC communication for transferring job logs to a computer
- Audible and visual alarm systems with Alarm Silence function
- Operating temperature range 30°- 130°F
- 1 Year Warranty

Accessories

- Remote high intensity strobe light with 95db alarm & 25 ft. cable
- Telephone autodialer for off-site alarm notification
- External modem supports remote off-site monitoring and log tranfers to office computer
- Battery pack for portable operation
- NIST traceable certification
- 220VAC, 50Hz power supply operation
- Alternate operating pressure ranges

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Section 1: Basic Care

The *Omniguard 4* is built and engineered to provide you with dependable performance for years to come. Following these basic guidelines will insure that you get maximum use from your unit. Once the unit is set up, field operation is easy. Complete reports are virtually automatic, providing the most accurate records of your job site conditions available.

- This unit is designed to measure differential pressure only from +0.250" to -0.250" WC (optional pressure ranges are available).

  Caution: Never apply pressure to the inlet port by mouth or with any other strong pressure device. ***High pressure will permanently damage the sensor.***

- Use only *Omniguard* thermal printer paper.
- Always store the unit away from sources of excessive heat, dust and moisture.
- Never attempt to repair any of the internal components of the unit.
- Protect the unit from strong shocks or vibrations. Be sure the lid is securely closed whenever transporting the unit.
- Be sure to plug your *Omniguard 4* into a power supply that complies with the National Electrical Code. Keep all connections dry. As with any electrical device, this unit has the potential to cause an electrical shock hazard.
- If your unit must be shipped at any time to another location or for service, use the original packing material and shipping box for optimum protection during shipping.

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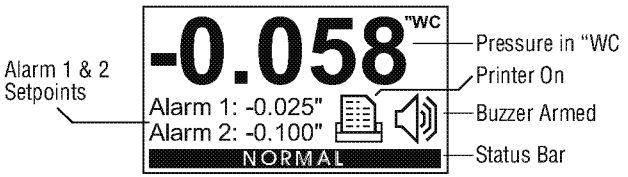
Section 2: Navigating The LCD Display

The *Omniguard 4* display features four screen types, shown below. Press the indicated key to move from screen to screen.

Monitor Screen

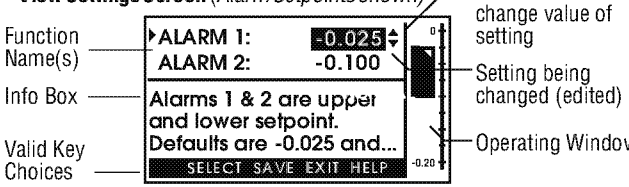


press **MENU**

Main Menu (*Help Menu uses same format*)

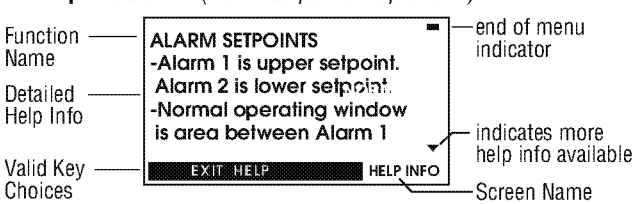
press **SELECT**

View Settings Screen (*Alarm Setpoints shown*)



press **HELP**

Help Info Screen (*Alarm Setpoints help shown*)



press **HELP** again to go to Help Menu Screen

press **EXIT** to return to previous screen or Monitor Screen

Section 3: Quick Setup & Usage

This section is a quick reference checklist for setting up your *Omniguard 4*.

1. Insert one end of pressure tubing inside the containment area. Connect the other end of tubing to **INLET #1**.
2. Locate a convenient place for *Omniguard 4* outside the containment. Plug power cord into a power outlet.
3. Turn the unit on. If the message Set Time & Date pops up, set the correct Time & Date. This happens if the internal battery is has died and the built-in clock lost its settings (don't worry, the battery is rechargable and lasts over 30 days between charges).
4. Press **PRINT JOB** for a printout of the previous job, if required. A report for the previous job can be printed at any time.
5. Press **START JOB** to begin a new job. Enter a name for the new job and then press **SAVE** to save the job name. The previous job will end and a summary of it will print.
6. Check Alarm 1 & 2 setpoints (displayed in the monitor screen window), adjust if needed.
7. Zero calibrating the unit before a new job is not required (nor recommended). If desired, calibrate unit using ZERO CALIBRATE menu item.

The status bar will indicate WAITING FOR PRESSURE and the **STATUS** LED will flash green until containment pressure reaches the operating window. Once this is reached, the status bar will display NORMAL and the **STATUS** LED will change to steady green indicating that the unit is now in its normal operational mode. Printing and logging of pressure readings begins once the normal operational mode is achieved.

During normal operation, the highest and lowest pressure readings will be printed and logged into memory with a time/date stamp **every 15 minutes** (the default Print/Log rate).

If the monitored pressure then goes **outside** the operating window, the unit will go into alarm mode. The buzzer will sound, the status bar will change to a flashing >>ALARM<< and the **STATUS** LED will flash red. The print and log rate of the pressure readings will increase to **every 15 seconds** (the default Print/Log Alarm rate).

Sample Session: Viewing/Changing Settings

1. From the Monitor Screen, press **MENU** to go to the Main Menu.
2. Use the ▲/▼ arrow keys to highlight ALARM SETPOINTS.
3. Press **SELECT** to go to the View Setting Screen and allow changes to the ALARM SETPOINTS.
4. The ALARM 1 setting can now be increased or decreased by using ▲/▼.

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5. Once the desired value has been reached, press ◀ / ▶ to highlight ALARM 2 setting.
6. Use ▲/▼ to adjust the value of the ALARM 2 setting.
7. Save the updated settings for both Alarm 1 & 2 by pressing **SAVE**. Saved settings are printed and logged into memory.

   or **EXIT** to return to Main Menu **without** saving.

   Note: Press **HELP** *at any time to view more detailed help information.*

Hanging the Omniguard 4

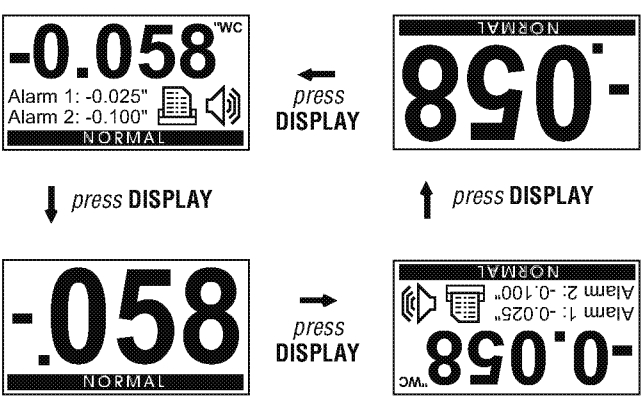
The *Omniguard 4* can be hung on a wall for easy viewing and to keep it off of the floor, away from possible damage. Hanging the *Omniguard 4* by the clip allows the cover to close, protecting the unit from water damage while allowing the LCD display and **STATUS** LED to be viewed through the window on the cover. The hose and AC cord should exit the case thru the foam slot, then the cover should be latched closed to protect the unit from water damage.

Use the **DISPLAY** key to flip the display orientation when hanging the unit by its handle (see below).

Display Modes

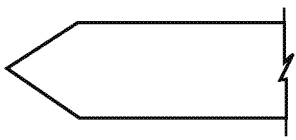
The **DISPLAY** key on the *Omniguard 4* is used to vary the display view and orientation to accomodate hanging the unit by its handle. The pressure reading can be enlarged to enhance viewing from across the room.

Press **DISPLAY** to toggle the views in the sequence shown below.

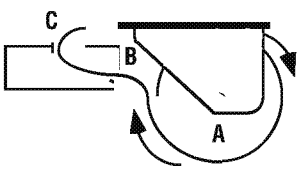


Loading the Thermal Printer Paper

Caution: Only *use Omniguard thermal printer paper! Thermal paper prints on only* ***one*** *side, the side away from the paper roll. If the roll is installed incorrectly the printer will be able to advance the paper but be unable to print on it.*

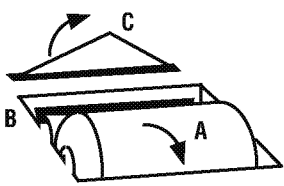


1. Cut the end of the paper to a tapered point.
2. Place the paper **A** into the tray so the paper unrolls from the bottom.



3. Insert tapered point into slot marked **B**, feed through until tapered point can be pulled from the top at **C**.

Do not use the **PAPER FEED** *key to advance the paper.*



4. From **C**, gently pull until the tapered portion is completely exposed.
5. Replace lid onto the paper housing and secure with the thumbscrew.

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Section 4: Detailed Operation

The *Omniguard 4* monitors and records the differential pressure between the **#1** inlet port and the **#2 (Reference)** inlet port.

In abatement applications the *Omniguard 4* should be located outside the containment area and not in any antechambers (i.e. shower or changing room). This allows a supervisor or hygienist to monitor pressure readings without entering the containment area.

Work Area Setup

The *Omniguard 4* should be placed on a solid (non-vibrating) surface, excessive vibrations disrupt accurate pressure measurement, hanging the unit on a wall is okay.

1. The intake end of the pressure tubing must be located a **minimum of 5 feet away from** any openings or HEPA fan/filter units. Choose a location away from excessive dust or moisture.
2. Cut a 1/2" slit in the polyethylene barrier and feed approximately 1 ft. of pressure tubing through it. Tape the tubing securely to the polyethylene.
3. Connect the free end of the tubing securely over the **#1** inlet port. Be careful not to turn the nozzle.
4. The maximum hose length is limited to 70 ft (for 3/16"ID hose). Lengths beyond 70 ft can degrade reading accuracy.
5. The Alarm 1 and Alarm 2 settings should be in negative units when used to monitor a negative containment area. For positive containment applications, use positive units (Inches WC, Millimeters WC or Pascals) for alarm setpoints.

> *NOTE: It is important that there be no kinks or sharp bends in any part of the tubing. Any blockage could inhibit accurate recording of the pressure in the containment area.*

Power-Up

To begin operating the *Omniguard 4*, plug the power cord into a standard wall outlet supplying 115VAC, 60Hz and press the **POWER ON/OFF** key. The first time a new unit is turned on the settings will be at default values.

Initial Power-Up -- the user is asked to set the unit's Date & Time and Alarm 1 & 2 setpoints because they are at the factory defaults. *This happens only until these settings are updated, usually only the first time the unit is used.*

Normal Power-Up Sequence -- If the unit was properly turned off after the previous usage, **POWER OFF** will print. Otherwise **POWER FAIL** will print, indicating that an AC power failure may have occurred. Either message will be followed by the date and time the unit was last powered off.

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A diagnostic test will automatically run and the unit will print the date, time and the current alarm setpoints. The unit will then immediately begin to monitor containment pressure.

Until the containment pressure has reached the operating window, the status bar will indicate WAITING FOR PRESSURE and the **STATUS** LED will flash green.

> *Note: Logging and printing of monitored pressure readings does **not** begin until the containment pressure has reached the operating window!*

You will need to customize the factory Alarm 1 and Alarm 2 setpoints for your application!

Once the containment pressure reaches the operating window (the area between the Alarm 1 and Alarm 2 setpoints) the unit's status bar changes from WAITING FOR PRESSURE to NORMAL and the **STATUS** LED changes to a steady green. **NORMAL OP** is then printed along with a time-stamp. The **STATUS** LED changes to orange to warn of an impending Alarm condition when the pressure is within 0.005"WC of the Alarm setpoints.

Contractor Name

The *Omniguard 4* can store the name of the Contractor that is using the unit. The Contractor name will appear in all Job logs and printed Reports. Only one name can be stored.

To set the Contractor Name --

1. Press **MENU** to view the Main Menu.
2. Highlight CONTRACTOR NAME using ▲/▼.
3. Press **SELECT** to view or change the setting.
4. Use the ▲/▼ keys to change the character. Upper and lowercase letters and numbers are all usable characters to enter.
5. Use the ◀ / ▶ keys to move to the next/previous character to set.
6. When the entire name has been entered, press **SAVE** to save the new name and return to the Main Menu.

Pressing the **EXIT** *key will return you to the Main Menu **without** saving the updated Contractor Name.*

Date & Time

The date and time settings are used as a reference time-stamp for all logged events.

To change the Date & Time --

1. Press **MENU** to view the Main Menu.
2. Highlight DATE & TIME using ▲/▼ and press **SELECT** to change the setting.

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3. Use ▲/▼ to change the month.
4. Press ◀ / ▶ to advance to the day, using ▲/▼ to change.
5. Repeat the procedure for the year.
6. Press ◀ / ▶ to advance to the time. Use ▲/▼ to set the hours and minutes, use the ◀ / ▶ keys to move from one to the other.

   Note: the unit operates on a 24 hour clock.

7. Press **SAVE** to save the updated settings and return to the Main Menu. Press **EXIT** to return without changing the settings.

Alarm Setpoint Selection

The normal operating window is the area between the Alarm 1 and Alarm 2 setpoints. These setpoints can be set anywhere within the operating range of the unit; +/- 0.250" WC in increments of 0.005"WC. The *Omniguard 4* can also operate in units of mmWC or Pascals. *(See Pressure Units.)*

Alarm 1: (default is -0.025"WC)

- upper setpoint of operating window

Alarm 2: (default is -0.100"WC)

- lower setpoint of operating window

The *Omniguard 4* can be used in both positive and negative pressure monitoring applications. The procedure for setting of Alarm setpoints is the same for both applications.

Positive Pressure Application -- Clean room or HVAC system

example settings: **Alarm 1** @ +0.050" WC
Alarm 2 @ +0.025" WC

Negative Pressure Application -- Asbestos or lead abatement

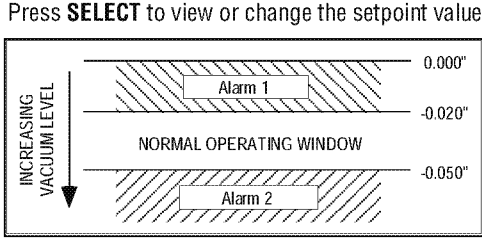
example settings: **Alarm 1** @ -0.020" WC
Alarm 2 @ -0.050" WC

Example of Setting Alarm Levels

This is an example of setting the alarm levels for negative containment area with an operating window of -0.020" to -0.050" WC.

To change the Alarm Setpoints --

1. Press **MENU** to view the Main Menu.
2. Highlight ALARM SETPOINTS using ▲/▼.
3. Press **SELECT** to view or change the setpoint values.



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4. Use ▲/▼ to set Alarm 1 to -0.020"WC. The value will change in 0.005" increments. The bar graph at the right of the screen indicates the relative operating window size within the operating pressure range of the unit.

5. Press ◀ / ▶ to highlight Alarm 2. Use ▲/▼ to set the value to -0.050"WC.

6. Press **SAVE** to save the updated settings and return to the Main Menu.

   Pressing the **EXIT** *key will return you to the Main Menu* ***without*** *saving the updated settings.*

Once the containment pressure reaches a value between -0.020" and -0.050" WC the unit will be in normal operational mode.

Then, if the containment pressure ...

... rises to -0.019" WC, **Alarm 1** will activate.
... falls to -0.051" WC, **Alarm 2** will activate.

Starting/Ending A Job

Before starting a new project you should start a new job. Using the **START JOB** key separates the new job from previous jobs in the log and reports and allows you to "name" the new job.It also ends the current job and causes a Job Summary Report for the job just ended to print.

START JOB will not erase any previous job logs, nor will it alter any other settings (such as the Alarm Setpoints). A report for the previous job can be printed at any time.

Note: It is a good idea to print a report of the previous job (using **PRINT JOB***) before pressing the* **START JOB** *key. A report for the previous job may also be printed at a later time by selecting* PRINT/VIEW JOB LOGS *from the main menu.*

To start a new Job --

1. Press the **START JOB** key.

2. Use the ◀ key to move to the cursor to the beginning of the line. Then use ▲/▼ keys to change the character. Upper and lowercase letters and numbers are all usable characters.

3. Use the ▶ key move to the next character to set.

4. When the entire name has been entered, press **SAVE** to save the new Job name. The previous job will end and a summary of it will print, followed by a **NEW JOB** message.

   Pressing the **EXIT** *key will return you to the Monitor Screen* ***without*** *starting a new job.*

When completed, the screen will display Ending Last Job. After a few moments the unit will automatically return to the Monitor Screen.

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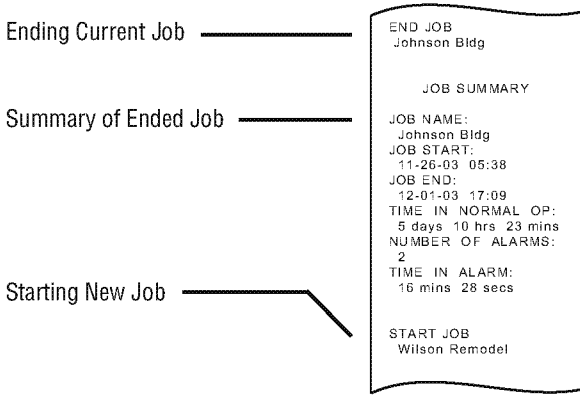
The memory has a capacity to store 128,000 characters of printed data. This represents 30+ days of normal operation and approximately 200 alarm messages. When the memory is full, the new data will begin to overwrite the oldest data.

Note: Overwritten data cannot be retrieved.

Example of Printout after **START JOB** *is pressed--*



Alarm Condition

Once the containment pressure reaches the operating window, the unit will be in normal operation and the alarms will be armed. Then if containment pressure falls **outside** the operating window, the following will occur:

1. Internal buzzer and **AUX ALARM** output will be activated and will remain active until **ALARM SILENCE** is pressed.
2. The status bar will change to >>ALARM<< and begin flashing. The **STATUS** LED will flash red.
3. Printer will indicate which alarm setpoint was exceeded. The print/log rate will increase to the preset alarm rate. Printouts will show the time followed by the current pressure reading.

When the containment pressure returns to within the normal operating window, the unit will log and print **NORMAL OP** with a time-stamp. The buzzer and **AUX ALARM** output will turn off. The **STATUS** LED will return to a steady green. If the alarm was silenced without rearming, it should be rearmed.

Alarm Silence, Disable and Rearming

The buzzer symbol on the Monitor Screen indicates whether the audible alarm and **AUX ALARM** output are armed or disabled. The alarm is always armed when the unit is first turned on. The alarm silence function and **AUX ALARM** output are controlled by the **ALARM SILENCE** key.

To disable or silence the buzzer--

Press **ALARM SILENCE** once and the alarm will be disabled. This will be indicated on the screen with an **X** marking through the buzzer symbol. If the alarm was sounding at the time of disabling it will become silent.

To rearm a silenced buzzer --

Press **ALARM SILENCE** and the buzzer symbol will be displayed without an **X** through it.

Armed Disabled or Silenced

Alarm Symbols

Turning Printer On/Off

The **PRINTER ON/OFF** key controls the printer power. All pressure readings are logged to memory regardless of printer setting.

Note: If a printer error is detected, the printer will automatically turn off and a JAM *message will appear above the printer symbol. Clear the jam and use the* **PRINTER ON/OFF** *key to turn the printer back on. Paper jams are logged with a time-stamp.*

On Off Jammed

Printer Symbols

Viewing/Printing Jobs & the Print Job Key

The *Omniguard 4* provides a printout of all recorded data, alarm messages and changes in operational settings. The current Job or any previous Job (or portions of those jobs) and the *Omniguard's* Configuration Report can be printed at anytime.

Print Job Key --

Pressing **PRINT JOB** will print a specific report for the current Job (preselected in the PRINT JOB KEY SETUP menu item). This makes it easy to print a particular portion of the current Job on a daily or other basis.

To view or print a Job Log --

1. Press **MENU** to view the Main Menu.
2. Highlight VIEW/PRINT JOB LOGS using ▲/▼ and press **SELECT**.
3. The selected Job Log will appear on the screen for viewing. Press the **PRINT JOB** key at any time while viewing the report and the Job Report will begin printing.

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Printing a log does not cause any data to be erased from memory. ***Cancel*** *printing by pressing any key.*

Example of Typical Job Printout

Typical startup sequence

Setting changes print for verification

Containment pressure reached operating window... Normal OP

Alarm Condition (Alarm 1 tripped)

Back into Normal Operation

New Date prints at midnight

Signoff header

```
POWER OFF
   11-21-03  19:48:39

CURRENT JOB
 Johnson Bldg

      OMNIGUARD 4
   11-26-03  08:02:20
ALARM 1 @  -0.025" WC
ALARM 2 @  -0.100" WC

NEW TIME
 05:38:00

NEW ALARM 2
 -0.090" WC

NORMAL OP  05:51:24
 TIME  HI "WC LO "WC
 06:06  -0.032  -0.028
 06:21  -0.031  -0.027
 06:36  -0.033  -0.028

ALARM 1 @-0.025" WC
 08:51:26   -0.012" WC
 08:51:41   -0.002" WC

NORMAL OP  08:51:55
 TIME  HI "WC LO "WC
 09:06  -0.032  -0.028
```

```
11-27-03
 TIME  HI "WC LO "WC
 00:06  -0.032  -0.028
```

```
      JOB REPORT
   11-27-03  08:33:24

JOB NAME:
  Johnson Bldg
-----------------------
CONTRACTOR:
  Acme Abatement
-----------------------
SUPERVISOR:

-----------------------
```

Example of Job Summary Printout

```
      JOB SUMMARY

JOB NAME:
 Johnson Bldg
JOB START:
 11-26-03  05:38
JOB END:
 12-01-03  17:09
TIME  IN  NORMAL  OP:
 5 days  10 hrs  23 mins
NUMBER  OF  ALARMS:
 2
TIME  IN  ALARM:
 16 mins  28 secs
```

Configuration Report

The *Omniguard 4* provides a report of all of the unit's current settings (Alarm Setpoints, Log Rates, etc.) and the current system information (memory status, unit serial number, etc.). This report can be viewed and printed at any time.

To view or print the Configuration Report --

1. Press **MENU** to view the Main Menu.
2. Highlight CONFIGURATION REPORT using ▲/▼ and press **SELECT**.
3. The Configuration Report will appear in its entirety on the screen for viewing. Press the **PRINT JOB** key and the Configuration Report will begin printing.

Printing a report does not cause any data to be erased from memory. ***Cancel*** *report printing by pressing any key.*

Description of Controls

Menu Keys

MENU - displays Main Menu or selects the highlighted item for review or editing

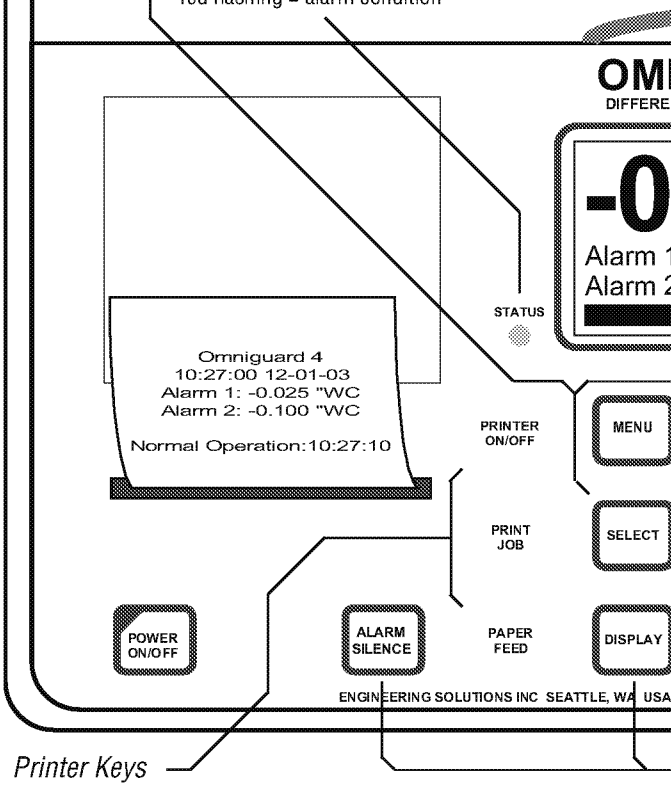
SELECT - press to view or change settings of the highlighted item from the Main Menu.

▲ / ▼ - scroll through menu selections or change settings. Step through settings by pressing ◀ / ▶.

SAVE - saves updated unit settings to memory after editing, then exits to the Main Menu.

EXIT - exits to previous screen; if editing, exits **without** saving any updated settings.

STATUS - LED indicator shows operating status:
green = normal operation
green flashing = waiting to reach operating pressure
orange = within 5 millinches of an alarm condition
red flashing = alarm condition



Printer Keys

PRINTER ON/OFF - turns the printer on and off. Printer status is indicated by the printer symbol at the Monitor Screen.

PRINT JOB - press to print a current Job Report. Actual report type is assigned to key in the Print Job Key Setup menu item. **Cancel** printing by pressing any key.

PAPER FEED - advances the printer paper.

POWER ON/OFF - turns unit on and off.

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Ports

#1 - inlet connector for pressure tubing from containment.

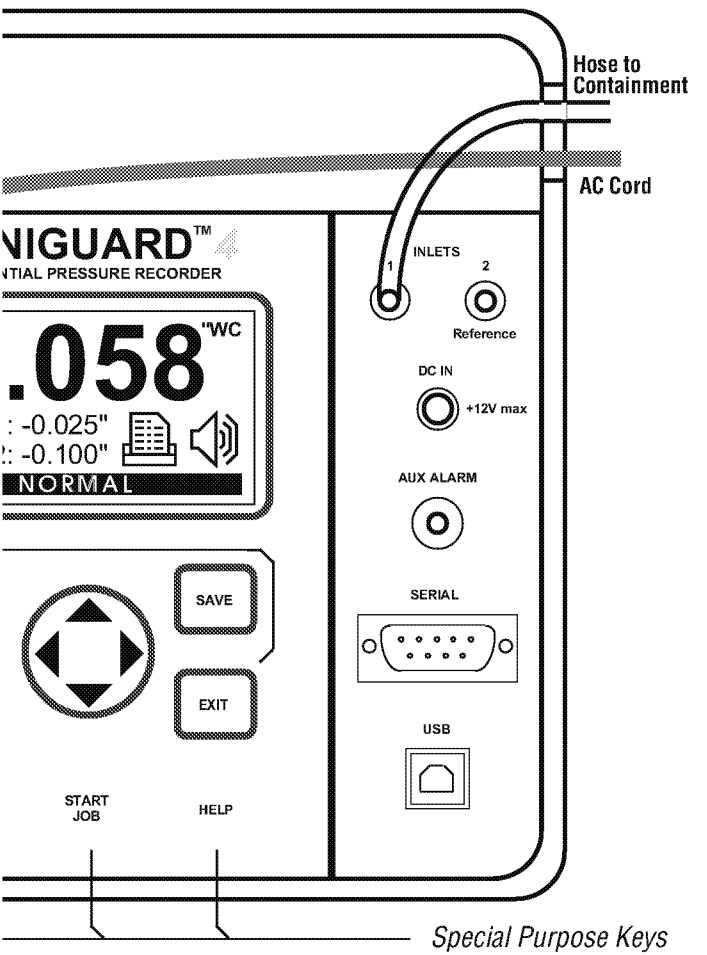
#2 - inlet connector for sensing ambient pressure from outside containment.

DC IN - connects to optional external battery.

AUX ALARM - SPDT relay output supports optional remote alarm or telephone autodialer.

SERIAL - connector for sending data to a PC or an external modem.

USB - connector for sending data to a PC.



Special Purpose Keys

ALARM SILENCE - silences the internal buzzer and **AUX ALARM** output when an Alarm Condition occurs. Audible Alarm status is indicated by the buzzer symbol at the Monitor Screen.

DISPLAY - toggles display thru 4 different screens: monitoring, pressure only, inverted monitoring & inverted pressure only.

START JOB - press to begin a new Job. Assign a name to the new Job. Ends previous Job and prints its Summary report.

HELP - provides information about the highlighted item or displays Help Menu to select a topic for which more information is available.

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Print/Log Rates

The printing and logging of pressure readings begins once the unit reaches normal operation (status bar indicates NORMAL). There are two user-definable rates at which printing/logging occurs.

Normal Rate: (default is 15 min.)

- setting choices are 5, 15, 30 minutes or OFF.
- rate at which the highest & lowest pressure readings are printed and logged to memory during normal operation
- when set to OFF, unit will only log & print alarm readings

Alarm Rate: (default is 15 sec.)

- setting choices are 15, 30, 60 or 120 seconds.
- rate at which pressure readings are printed and logged to memory during an alarm condition

To change the Print/Log Rate --

1. Press **MENU** to view the Main Menu.
2. Highlight PRINT/LOG RATES using ▲/▼ and press **SELECT** to change settings.
3. Use ▲/▼ to change the NORMAL RATE.
4. Press ◀ / ▶ to move from NORMAL RATE to ALARM RATE and repeat step 3 to change the ALARM RATE setting.
5. Press **SAVE** to save the updated settings and return to the Main Menu.

Pressing the **EXIT** *key will return you to the Main Menu* ***without*** *saving the updated settings.*

To conserve paper and log space, the Alarm Print/Log rate will reduce to 15 minutes if the unit stays in an alarm condition for more than 10 minutes. The pressure monitoring rate is not affected. The Alarm Print/Log rate will return to its original setting at the beginning of the next alarm.

Inlet Pressure Response Rate

This setting determines how quickly the unit will react to pressure changes. Reduce this setting if you are using the unit in conditions where air pressure fluctuates rapidly and can cause false alarms, such as in high wind.

Response Rate: (default rate is Medium)

- rate choices are Slow, Medium and Fast
- in windy conditions, set to Slow
- if quick response to small pressure changes is needed, set to Fast

To change the Response Rate --

1. Press **MENU** to view the Main Menu.

2. Highlight RESPONSE RATE using ▲/▼ and press **SELECT** to view or change the setting.
3. Use ▲/▼ to change the setting.
4. Press **SAVE** to save the updated setting and return to the Main Menu.

Pressing the **EXIT** *key will return you to the Main Menu* ***without*** *saving the updated settings.*

Display Contrast & Backlight

The contrast level and backlight setting on the LCD screen allows the user to adjust the display for optimal viewing in varied lighting conditions. The backlight automatically dims after 4 minutes to extend battery and backlight life. It can be reactivated by pressing any key.

Contrast: (default is 50%)
- range is 0% (min) to 100% (max)

Backlight: (default is ON)
- choices are ON or OFF

To change the Contrast or Backlight --

1. Press **MENU** to view the Main Menu.
2. Highlight DISPLAY from the Main Menu using ▲/▼ and press **SELECT** to change the settings.
3. Press ◀ / ▶ to choose CONTRAST or BACKLIGHT and use ▲/▼ to change the settings for each.
4. Press **SAVE** to save the updated settings and return to the Main Menu.

Pressing the **EXIT** *key will return you to the Main Menu* ***without*** *saving the updated settings.*

Pressure Units

The pressure units used by the *Omniguard 4* to display and record pressure readings are selectable.

Pressure Units: (default is Inches WC)
- choices are Inches WC ("WC), Millimeters WC (mmWC) or Pascals (Pa)

To select the desired pressure units --

1. Press **MENU** to view the Main Menu.
2. Highlight PRESSURE UNITS by using ▲/▼ and press **SELECT** to change the setting.
3. Use ▲/▼ to change the pressure units to the desired measurement.

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4. Press **SAVE** to save the updated settings and return to the Main Menu.

Pressing the **EXIT** *key will return you to the Main Menu* ***without*** *saving the updated settings.*

Passcode Protect

The passcode protect feature allows the site manager to assign a passcode that prevents unauthorized changes to the unit's settings. Once enabled, the four digit code must be entered to change any setting. Settings may be viewed without the passcode.

Passcode Protect: (default is OFF)

Passcode: (default passcode is 0 0 0 0)

- passcode can be set to ON or OFF
- master passcode is 7 7 7 7

To set and enable the Passcode --

1. Press **MENU** to view the Main Menu.
2. Highlight PASSCODE PROTECTION from the Main Menu using ▲/▼ and press **SELECT** to view or change the setting.
3. Press ▲/▼ to select the passcode On or Off.
5. Press ◀ / ▶ to move to the Passcode digits.
4. Set each digit of the passcode using ▲/▼.
5. Press ◀ / ▶ to move from one digit to the next.
6. Press **SAVE** to save the updated setting and return to the Main Menu.

Pressing the **EXIT** *key will return you to the Main Menu* ***without*** *saving the updated settings.*

> *Note: In the event that the passcode is lost or forgotten it can be reset and settings can be changed using the master passcode.*

Aux Alarm Setup

The **AUX ALARM** output can be used to activate either of two optional accessories; the Remote Auxillary Alarm or the Telephone Autodialer. The Aux Alarm Setup menu item is used to set which device type is attached to the **AUX ALARM** connector.

AUX MODE: (default is Remote Alarm)

- choices are Remote Alarm, Autodial 1 min, Autodial 5 min or Autodial 10 min

To select the Autodialer device --

1. Press **MENU** to view the Main Menu.
2. Highlight AUX ALARM SETUP using ▲/▼ and press **SELECT** to view or change the settings.

3. Press ▲/▼ to change the setting to the Autodialer mode. The 1, 5 and 10 minute options set the retrigger time (the amount of time the Autodialer must wait between multiple alarms before dialing out a second time).

4. Press **SAVE** to save the new setting and return to the Main Menu.

Pressing the **EXIT** *key will return you to the Main Menu* ***without*** *saving the updated settings.*

In an alarm condition, the **AUX ALARM** output will activate the Autodialer only once in a given time period (1,5 or 10 minutes). This prevents the autodialer from calling more than once if the alarm is tripping multiple times within a short period of time. After the 1, 5 or 10 minute period has elapsed, the autodialer will dial out again if the unit goes back into an alarm condition.

The autodialer may be disabled by pressing the **ALARM SILENCE** key. The **AUX ALARM** output will only rearm once the unit has returned to normal operation, this prevents the autodialer from continuously dialing during an alarm condition.

Zero Calibration

The *Omniguard 4* does not require calibration between jobs. Internal temperature compensation and other circuity provides unsurpassed accuracy over a 30°- 130° Fahrenheit range.

> *That's the reason for the clicking noise you hear the unit making. Its constantly compensating for zero offset drift. We* ***do*** *recommend annual calibration verification by the factory.*

To manually reset the zero point --

1. Disconnect the pressure tubing from the **#1** and **#2** inlets.

2. Press **MENU** to view the Main Menu.

3. Highlight ZERO CALIBRATE using ▲/▼ and press **SELECT** to choose zero calibration.

4. Press **SAVE** to calibrate and return to the Main Menu.

> *Pressing any other key will return you to the Monitor Screen* ***without*** *resetting zero.*

When completed, the screen will display DONE. After a few moments the unit will automatically return to the Monitor Screen.

> *Note: Allow the unit to warm up for 15 minutes prior to zero calibrating. This permits the pressure sensor to stabilize its readings. Zero calibration can only be done when the pressure tubing is* ***not attached to the unit****.*

Using Help

To access Help information on a highlighted topic --

- Press **HELP**. Detailed information about the unit's current status or the highlighted function will be displayed.

To access the Help Menu --

1. Press **HELP** twice.
2. Highlight the desired topic using ▲/▼.
3. Press **SELECT** to view the information available for that topic.

Communication

The *Omniguard 4* has built-in USB and Serial ports to connect to a PC or to an optional External Modem. The Windows® compatible Omniguard 4 Communication software must be installed in the PC and is available as a free download @ www.engsolinc.com.

The *Omniguard 4* can communicate with a PC three different ways...

1. Connect a USB cable directly to the PC.
2. Connect a Serial cable directly to the PC.
3. Connect via dialup to the PC. Requires an external modem (with a phone line connected to it). Configure the modem using the MODEM SETUP menu item.

Once connected, you can transfer the current Job Log or all Job Logs to the PC. You can also "remotely monitor" the *Omniguard 4*, observing pressure, status and log updates as they occur on the job site.

> *Before a PC can communicate with an Omniguard 4, you must first download and install the Omniguard 4 Communication software from our web site @ www.engsolinc.com. Detailed instructions for installation and operation of the software are included with the download.*

Transferring a Job Log to the PC

The Job Logs stored in the *Omniguard 4*'s memory can be transferred to an IBM compatible PC for permanent storage, statistical analysis and summary report generation. Job Logs transferred to a PC can be reviewed and reprinted any number of times.

To transfer a job log --

1. Install the Communication program into your computer.
2. Select either the USB cable (included with your *Omniguard 4*) or the optional Serial cable (available from your distributor). Plug the cable into the appropriate connector on the *Omniguard.*

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3. Plug the other end of the cable into the appropriate USB or Serial port on your PC.
4. Run the Communication program and follow the instructions shown on the computer screen.

Remote Monitoring & Modem Setup

Office personel using their modem equipped PC can call the phone number of the site and connect to the *Omniguard 4* through its optional External Modem.The modem plugs into the **SERIAL** port and requires a standard RJ11 phone plug and a working telephone line. Remote off-site monitoring of *Omniguard 4* is supported along with remote job log transfers.

> ***Caution**: Transferring Job Logs to the PC via modem may take up to 5 minutes (depending on the modem speed and the size of the Job Logs being transferred). The Omniguard 4 **is not** actively monitoring during the log transfer. Once the transfer is complete, the unit resumes monitoring the pressure.*

The external modem setup should be tested and its proper operation confirmed before leaving the job site. Before performing the modem test, use the Modem Setup menu item to configure the Omniguard 4 to work with the external modem you are using.

To configure and test the Modem setup --

1. Plug the modem cable into the **SERIAL** port and modem.
2. Plug the phone cable into the modem and a working telephone line RJ11 phone jack. Turn the modem on.
3. Press **MENU** to view the Main Menu.
4. Highlight MODEM SETUP using ▲/▼ and press **SELECT** to view or change the settings.
5. Press ▲/▼ to change the Init Command setting if necessary.
6. Press ◀ / ▶ to move to Dialing Prefix and change if necessary. The Dialing Prefix should be set to None unless it is needed to reach an outside line.
7. Press ◀ / ▶ to move to Test Modem and then press **SELECT** to test the modem settings. The testing will start and its status will be displayed on the screen. If an error message appears, a suggested solution will also be made.

   > ***Testing**: The Omniguard 4 will attempt to call a special Test phone number set up by Engineering Solutions. It will connect with a PC and confirm the modem is operating correctly.*

8. Press **SAVE** to save the settings and return to the Main Menu.

Pressing the **EXIT** *key will return you to the Main Menu* ***without*** *saving the updated settings.*

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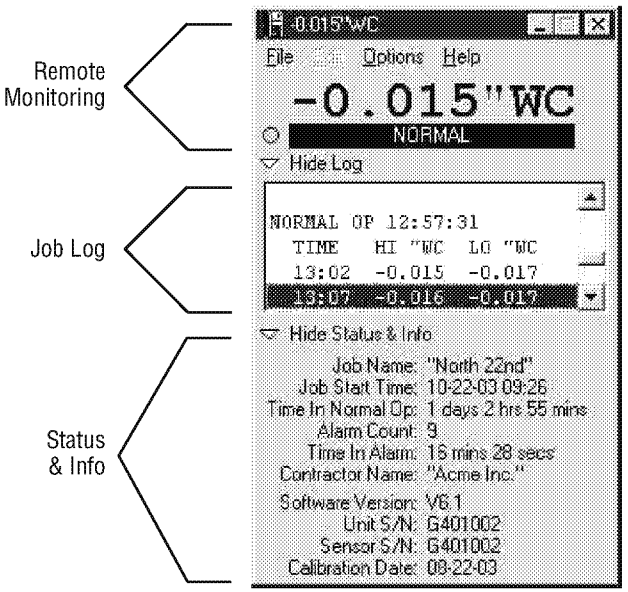
Omniguard 4 Communication
Remote Monitoring Screen

Each section of the window can be opened or closed independently. Remote monitoring occurs in real-time and does not affect the normal operation of the *Omniguard 4*.



Appendix A: Troubleshooting

If you experience problems with your *Omniguard 4,* use this section to try to solve the problem. If you are unable to solve the problem, consult with your dealer or call Engineering Solutions at (206) 241-9395 (8:00 a.m.-12:00 noon, 12:30-4:30 p.m. Pacific Time) and ask for Technical Support, or e-mail techsupport@engsolinc.com.

Problem: The unit does not display the proper pressure.

Remedy: Check to see that the tubing is connected properly to the **#1** inlet port.

Remedy: Make sure that the tubing does not have a kink or a sharp bend.

Remedy: Make sure that you are using the correct 3/16" ID tubing size, and the end of the tubing on the inlet nozzle is not worn. If it is worn or loose, cut off 1" of the tube using a sharp knife and reinsert on the inlet nozzle.

Remedy: Make sure that the tubing connection into the containment area is properly placed and secured as described in Section 4: Work Area Setup.

Problem: Excessive momentary alarms.

Remedy: Adjust alarm setpoints to allow for normal air pressure fluctuations caused by entries into work area or other equipment. Make sure that you are within the minimum negative air pressure requirements.

Remedy: If you suspect that wind may be causing rapid pressure fluctuations, reduce the setting for Response Rate (see Section 4: Detailed Operation).

Problem: Printer indicates an alarm but audible alarm was not activated.

Remedy: Confirm that the Audible Alarm is on. The buzzer icon should be shown, in the right corner of the display, without an **X** through it (see Section 4: Alarm Silence, Disable and Rearming).

Problem: Printer is not working properly or a paper jam occurs.

Remedy: The printer may be turned off. Turn it on using the **PRINTER ON/OFF** key.

Remedy: Thermal paper prints on only **one** side, the side away from the paper roll. If installed incorrectly, the printer will be able to advance the paper but unable to print on it. Make sure that the paper is fed properly as described in Section 3: Loading the Thermal Printer Paper.

Remedy: Paper jams can occur if the paper is allowed to fall back into the printer head after tearing off a report. If a paper jam occurs, the unit will automatically shut the printer off to prevent

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damage. The printer symbol will be displayed with a JAM message (see Section 4: Turning Printer On/Off). After the paper jam is cleared, use the **PRINTER ON/OFF** key to turn the printer back on.

Note: Do not apply oil or grease of any kind to the printer as this will attract dirt and debris and could cause permanent damage to the printer mechanism.

Problem: OMNIGUARD 4 unit does not enter normal operation when turned on, and does not print.

Remedy: For normal operation, the monitored pressure **must** be between the Alarm 1 and Alarm 2 setpoints. When the unit is first turned on, the containment pressure will not likely be within the alarm setpoints, and the unit will not print or log the pressure readings. The unit will begin printing and logging the pressure readings only after it senses containment pressure has reached the normal operating window.

Problem: The unit displays Date & Time Not Set **followed by** Factory Default **after the power has been off.**

Remedy: The internal clock battery is discharged. Leave the unit plugged in for 24 hours to recharge the battery. It will be necessary to update the Date and Time settings. The internal battery should last for 30+ days without recharging. It recharges automatically any time the unit is plugged in. No other settings need to be re-entered (they are saved in non-volatile memory and do not require the internal clock battery).

Shipping & Repair

Please call the Engineering Solutions customer service department for a return authorization. A number will be assigned to aid in tracking your unit.

Send the entire unit, enclosing a brief explanation of the problem along with your company name, address, phone number and name of the individual responsible for the unit. **The return authorization number must be clearly marked on the outside of the box**. No COD's will be accepted. If the original packing materials are not available, package the unit securely in a sturdy container with enough padding to surround the unit on all sides. The unit should not be able to be shift after packing. Engineering Solutions will not be responsible for any damage which may occur.

Send to : Engineering Solutions, Inc.
6000 Southcenter Blvd, Suite 70
Tukwila, WA 98188-5742
(206) 241-9395 sales and service

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Appendix B: Specifications

Differential Pressure Range: +/-0.250" WC (+/-6.35mmWC, +/-62.5 Pascals)

Accuracy: +/- .003" WC or +/-1% of reading whichever is greater

Resolution: 0.001" WC, (+/-0.05mm WC, +/-0.5 Pascals)

Burst Pressure: 3 psi (20 kPa) on either inlet port

Pressure Units Displayed: "WC (Inches Water Column), mmWC (millimeters Water Column), or Pa (Pascals)

Data Storage: 128,000 characters, 30+ days of readings (over 4,000 logged events) in non-volatile memory (no battery req'd)

Display: Graphic Liquid Crystal Display (LCD) with adjustable backlight and over 3.5 sq. inch viewing area

Internal Clock: the internal clock is powered by a self-charging lithium-ion battery that provides 30+ days of clock operation when AC or DC power is not present

Printer: 20 character wide thermal printer (uses 2.2" wide thermal printer paper)

Printing/Logging Rates:
Normal Operation -- highest and lowest pressure readings printed/logged at intervals of 5, 15, 30 minutes or OFF
Alarm Condition -- current pressure reading printed/logged at intervals of 15, 30, 60 or 120 seconds for first 10 minutes of alarm condition, increasing to 15 minute intervals thereafter

Alarms: Two programmable alarm setpoints, 95db audible alarm with flashing LED and on-screen warning indicate alarm condition

Pressure Inlets: Two 3/16" OD barbed hose connectors, 10 ft of hose provided

Serial Port: DB-9 Male, RS232

USB Port: USB V1.0 Type-B

Aux Alarm Port: 1/8" stereo phono jack, relay contact outputs: NC, NO and Common rated 1A @ 30Vdc or 0.5A @ 115VAC

Power: 115 VAC 60Hz with 6 ft power cord (220 VAC 50Hz optional, 6VDC battery pack optional)

Case: Dimensions 9.25" x 7.5" x 4.5", Shipping Weight 6 lbs., Material is copolymer polypropylene with polycarbonate window in the lid, handle and stainless steel hanging hook

Warranty: One Year Limited Warranty

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Appendix C: Establishing a Containment Site

The *Omniguard 4* monitors and records the differential pressure between the **#1** inlet port and the **#2 (Reference)** inlet port.

In abatement applications the *Omniguard 4* should be located outside the containment area and not in any antechambers (i.e. shower or changing room). This allows a supervisor or hygienist to monitor pressure readings without entering the containment area.

This section of general guidelines to establishing a containment site is provided by Engineering Solutions Inc for informational purposes only. Engineering Solutions Inc is not responsible for its accuracy nor conformance with specific regulations for your area. Engineering Solutions Inc specifically advises all users to obtain the advice of qualified professionals for each use and application of the *Omniguard 4*. Engineering Solutions Inc makes no claims as to the proper usage or interpretation of the data provided by the *Omniguard 4*.

General Guidelines to Establishing a Containment Site

1. The contractor and hygienist are to be certified prior to qualifying to bid on an abatement job.
2. All workers are to have undergone specific training in abatement procedures.
3. Typical abatement requirements:

   a. containment area to be sealed within a double layer of 8 mil plastic or equivalent.

   b. before beginning work within the containment area and at the beginning of each shift, the containment area must be inspected for breaches and smoke-tested for leaks, and any leaks sealed.

   c. air volume within containment must be changes 4 times per hour, i.e. the entire air volume must be evacuated every 15 minutes.

   d. minimum pressure in containment is -0.020"WC, i.e. the differential pressure between containment pressure and ambient/outside pressure must be at least -0.020"WC as measured by a manometer.

   e. the containment area must be kept under negative pressure throughout the period of its use.

   f. air movement must be directed away from employees within containment and toward a HEPA filtration unit.

   g. fiber levels within the containment area must be sampled at a specific interval and be less than a proscribed level, i.e. sampled 1 time a day or more and fiber levels below "5 fibers/100 fields".

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4. Calculating site airflow requirements:

   A typical heavy duty HEPA fan/filter unit has a 1000 CFM (cubic feet per minute) capacity with a new filter. Units are typically derated by 25%, so a 1000 CFM unit is derated to 750 CFM by the hyiegenist when calculating actual site airflow requirements.

   Example #1: A room measuring 20 x 20 ft with a 10 ft ceiling encloses 4000 CF of air. To meet the 4X per hour change rate the fan/filter unit must be capable of pulling 267 CFM of air (4000 x 4/60) from the containment area and maintain a minimum negative pressure of -0.020"WC.

   Example #2: Room size is 20 x 50 with 12 ft ceiling. Requires (20 x 50 x 12) CF x 4 / 60 = 800 CFM or 2 units (of a 1000 CFM fan/filter unit... remember the fan/filter unit is derated to 750 CFM).

   Example #3: Room size is 100 x 100 with 16 ft ceiling. Requires (100 x 100 x 16) CF x 4 / 60 = 10667 CFM or 15 fan/filter units (of a 1000 CFM unit).

5. The containment area pressure should be monitored at various points to confirm adherence to abatement requirements. Remember that air is a medium, and air pressure is not identical throughout the containment area. The pressures at specific locations within the containment area vary due to distance, room temperature, proximity to openings, room geometry, etc. Typically one manometer is used for every two "rooms" that have a doorway and attached hallway, up to 1000 square ft.

5. Using a manometer that provides highly accurate pressure readings, timestamped logging of all readings, and audible alarm and printouts of all logged readings protects workers and the public from accidental exposure to airborne hazards and provides proof of containment to protect employers from environmental contamination lawsuits.

NOTE: It is important that there be no kinks or sharp bends in any part of the tubing. Any blockage could inhibit accurate recording of the pressure in the containment area.

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Appendix D: Limited Warranty

Engineering Solutions warrants that all products, component parts and accessories will, for a period of twelve (12) months from date of purchase, be free from defects in material and workmanship under normal use and service.

PURCHASER'S SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY IS LIMITED TO THE REPAIR OR REPLACEMENT OF DEFECTIVE PARTS F.O.B., ENGINEERING SOLUTIONS, INC., 6000 SOUTHCENTER BLVD, SUITE 70, TUKWILA, WA 98188.

To keep this warranty valid, the purchaser must (a) return signed Registration card to Engineering Solutions within fifteen (15) days of purchase, (b) have promptly informed Engineering Solutions' customer service department of any defects in writing, (c) properly used, maintained and repaired the Product, and (d) have proof of purchase.

This warranty does not cover normal wear and tear or defects due to (a) improper or negligent handling or unauthorized modifications, (b) defective or improper premises, chemical, electrochemical or electrical influences, (c) weather or other influences of nature.

LIMITATIONS OF WARRANTY - THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY AND ALL OTHER WARRANTIES AND OBLIGATIONS OF ENGINEERING SOLUTIONS OR ITS SUPPLIERS, EXPRESS OR IMPLIED. ENGINEERING SOLUTIONS EXPRESSLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF REMEDY- Under no circumstances shall Engineering Solutions or any of its suppliers be liable for any loss or damage, including, but not limited to, loss or damage arising out of failure of the Product to operate for any period of time, inconvenience, use of rental or replacement equipment, loss of profit or other economic loss, or general, direct, special, indirect, incidental or consequential damages or property damages.

PRODUCT SUITABILITY - Many states and localities have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While Engineering Solutions attempts to assure that its Products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the Products are installed or used. Engineering Solutions recommends that, before purchasing and using a Product, purchasers review the Product application, and federal, state and local regulations, to be sure that the Product, installation, and use will comply with them.

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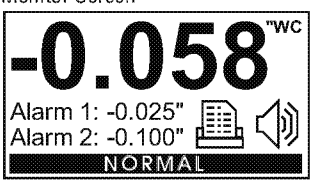
$10.00 P/N OG4-MAN.100

Starting A New Job

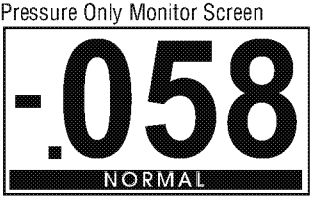
1. **PRINT JOB** for printout of current job.
2. **START JOB** to name new job & end previous job.
3. Check Date & Time, set if needed.
4. Check Alarm 1 & 2 setpoints (operating window), adjust if needed.
5. Connect pressure tubing to #1 inlet.

Unit will display WAITING FOR PRESSURE and STATUS LED will flash green until pressure reaches operating window. Once reached, displays NORMAL and STATUS LED shows steady green, unit begins printing & logging of pressure readings.

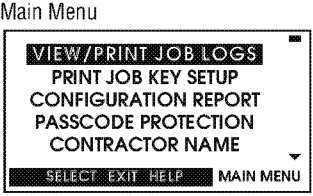
Monitor Screen



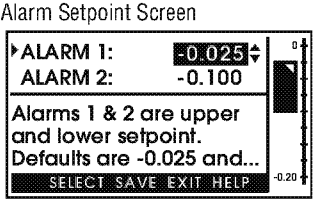
Pressure Only Monitor Screen



Main Menu



Alarm Setpoint Screen



Main Menu

View/Print Job Logs
Print Job Key Setup
Configuration Report
Passcode Protection
Contractor Name
Alarm Setpoints
Date & Time
Print/Log Rates
Response Rate
Pressure Units
Zero Calibrate
Aux Alarm Setup
Display Setup
Modem Setup

• use **SELECT** to view or change settings of main menu functions •

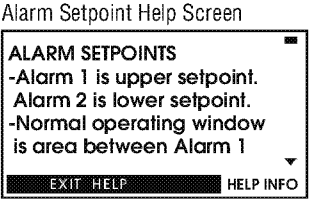
Example Editing Session

1. **MENU** to go to main menu.
2. Scroll highlight to ALARM SETPOINTS using ▲/▼.
3. **SELECT** to go to the settings screen.
4. Alarm 1 setting can now be increased or decreased by using ▲/▼.
5. Once desired value is reached, press ◀ / ▶ to highlight Alarm 2 setting. Pointer to left of Alarm 1 will move to Alarm 2 and info box text will show Alarm 2 info.
6. Use ▲/▼ to adjust value of Alarm 2 setting.
7. **SAVE** updated settings for Alarm 1 & 2 by pressing **SAVE**. **SAVE**'ed settings are printed & logged to memory.

or

EXIT to return to main menu **without** saving . You can exit editing session at any time.

Alarm Setpoint Help Screen



Help Menu

How To Navigate
Current Status
Audible Alarm Silence
Loading Paper
? Will Not Print
? Pressure Stuck
? Paper Jam
? False Alarms
? Tech Support

• detailed **HELP** information is **always** available by pressing **HELP** •