

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division	NUMBER IH99390
	REVISION FINAL rev3
INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	DATE 05/17/07
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SUBJECT: Narda Model 8718B Electromagnetic Radiation Survey Meter	INSTRUMENT OPERATION:

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1.0 Purpose/Scope

This procedure provides a standardized method for the operation of the Narda Model 8718B Electromagnetic Radiation Survey Meter. It should be used in conjunction with the ESH Standard 2.3.2 *Radio Frequency and Microwaves (RF/Microwave)* and IH SOP IH-99150 *Radiofrequency and Microwave Measurement Principles*.

This instrument covers the radiofrequency and microwave wavelengths of 300 kHz to 50 GHz (electric field) and 300 kHz to 200 MHz (magnetic field). The meter is used to:

- Determine the need for area warning posting,
- Determine the need for personnel exposure monitoring,
- Determine if inclusion in a medical surveillance program is required, and
- Measure the effectiveness of engineering controls.

2.0 Responsibilities

- 2.1 **Program Administration:** This procedure is administered through the SHSD Industrial Hygiene Group.
- 2.2 Members of the SHSD Industrial Hygiene Group are required to follow this procedure. Other BNL organizations that provide BNL with field monitoring or other hazard assessment services are required to follow this SOP.

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- 2.3 **Industrial Hygiene Professional:** The *Industrial Hygiene Professional* of SHSD and other BNL organizations are to be qualified by the SHSD Program Administrator. These individuals will conduct or supervise industrial hygiene hazard assessments and personal exposure monitoring using this procedure. These *IH Professionals* are responsible for:
- Interpreting, reporting, and documenting personal exposure monitoring in accordance with the requirements of this procedure, other appropriate SOPs, and generally accepted professional standards and practices.
 - Ensuring a quality report is prepared that documents the exposure, evaluates the relevance to exposure standards, and recommends protective and corrective actions.
 - Ensuring the final report is provided in a timely manner to all appropriate parties.
 - Ensuring that the appropriate data is correctly and completely entered into the BNL IH exposure monitoring database (i.e. *Compliance Suite*[®]).
 - Ensuring that original records of sampling and analysis enter the SHSD *Record Custodian* filing system.
- 2.4 **Industrial Hygiene Technician (Sampler):** The industrial hygiene technician is to be qualified to conduct industrial hygiene personal exposure monitoring under the direction of his/her organization's *IH Professional*. The sampler is responsible for collecting personal exposure monitoring samples in accordance with the guidance of the *IH Professional* and the requirements of all SOP's pertinent to the particular monitoring requirements (i.e. Chain of custody, equipment check in/out, equipment operation, recordkeeping, etc.).
- 2.5 **Compliance Suite[®] data entry:** The management of the person conducting the sampling is responsible for entering complete and correct data into the BNL IH exposure monitoring database (i.e. *Compliance Suite*). This task may be assigned to one or more individuals who act as the data entry person for an organization, however, it remains the responsibility of the line management of the *Sampler* to ensure this task is fulfilled within 21 calendar days of the end of the sampling event.

3.0 Definitions

4.0 Prerequisites

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4.1 Training prior to using this meter:

- 4.1.1 Demonstration of proper operation of the instrument to the satisfaction of the requirements in Section 7.
- 4.1.2 Other appropriate training for the area to be entered (check with ESH coordinator or FR Representative for the facility).
- 4.1.3 Static Magnetic Field Training and review of the subject area *Non-ionizing Radiation*.

4.2 Area Access:

- 4.2.1 Contact the appropriate Facility Support Representative or FS Technician to obtain approval to enter radiological areas. Complete all training for hazards for the area to be entered.
- 4.2.2 Verify with the appropriate Facility Support Representative or FS Technician if a Work Permit or Radiological Permit is needed or is in effect. If so, review and sign the permit.
- 4.2.3 Use appropriate PPE for area.

5.0 Precautions

5.1 Hazard Determination:

- 5.1.1 The operation of this meter does not create exposure to any chemical, physical, or radiological hazards.
- 5.1.2 The meter is sensitive and can be burned by entry into fields above their capacity. Approach the source from a low background.
- 5.1.3 The primary hazard from rf/microwave is heating of the body. The eyes and genitals/reproductive organs are the most sensitive body parts. Prolonged exposure to very high sources can result in death to the individual.

5.2 Personal Protective Equipment:

- 5.2.1 If high fields are expected, the *NARDA* alert alarming meter can be used as an alarming device to indicate high fields.
- 5.2.2 Microwave protective clothing is not available. Rely on engineering and administrative controls such as remaining a safe distance from the source as indicated by this direct reading meter.
- 5.2.3 Additional PPE: Other appropriate PPE for hands, feet, skin, head, or eyes may be needed for the area being entered. Check with the FS Representative for the area.

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- 5.3 **Job Risk Assessment:** Consult the *Job Risk Assessment* SHSD-JRA-05 for the risk analysis of this operation based on the hazards and controls of this SOP.
- 5.4 **Radiation Contamination:** It is possible that some surfaces in areas to be tested may have radiation contamination. In these cases, personal protective equipment and administrative controls must be implemented for the radiation contaminant hazard in addition to the chemical hazard.
- 5.5 **Work Planning:** All requirements of work permits and work planning system reviews must be met in performing this procedure.
- 5.6 **Environmental Impact and Waste Disposal:** This sampling does not have adverse impact on the environment or create waste for disposal.

6.0 Procedure

6.1 Follow all the decision logic and monitoring strategy design outlined in IH99150. Determine if the range of the source is within the range of this meter:

- 6.1.1 Electric probe B8722D - range 300 kHz – 50 GHz
- 6.1.2 Magnetic probe A8732D - range 300 kHz – 200 MHz

6.2 **Turn instrument on** by pressing the “On” button.

The LCD display will present the initial screen that contains the meter,

model, serial and firmware version. The display will automatically move to the next screen to show the last calibration date, and calibration due date. *Note:* Calibration date of body of instrument that will flash on the screen and verify that meter is usable.



CAL DATE 07/06/01			
CAL DUE 07/06/02			
CONNECT PROBE NOW			
MEASURE		MENU	
F1	F2	F3	F4

6.3 **Check Battery:** Press F4 “Menu”, then press “4” for *Bat/Lite*: Check if the battery is >50% charged. If there is insufficient charge (<50%) do not use the meter as you may not be able to zero the probe.

1. DATA LOG	5. UNITS
2. TIME AVG	6. RS232
3. SPATIAL	7. PROBE
4. BAT/LITE	8. NEXT

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6.4 Connect the probe.

6.4.1 Press **F1** *Measure* then **F4** “*Menu*”. Then select the correct probe from the list and enter the corresponding number. Select either (2) B8722D (Electric probe) or (5) A8732D (Magnetic probe). It is best to start with the E field probe. The display will show you the last probe that was selected. If this is the correct probe number press **F1** *Yes*. You will get a confirmation with the details of the probe.

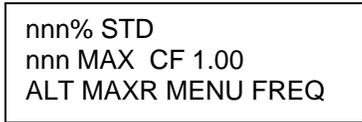
6.4.2 Attach the probe to the meter body.

Information for Electric Field Probe B8722D 300 kHz-50 GHz E-Fld 300 % Std Shaped	Information for Magnetic Field Probe A8732D 300 kHz – 200 MHz G-Fld 300%Std Shaped
--	---

6.5 **Zero the meter:** The meter will prompt to place the meter into a zero density field. Place probe into the *zero bag* or in the case. Press **Enter**. The display will read “*Zeroing...*” during the setup.



6.5.1 If zero is successful the meter will beep in about 15 seconds after zeroing is complete. The menu will reappear with information on the % Std detected, the maximum value. The top line will be a graphic indicator of the value. The meter will then automatically advance to the measuring mode.



6.5.2 If the meter cannot zero itself, the display will prompt for recalibration.

6.6 Testing the Probe

6.6.1 The Model 9718B is equipped with two RF sources for testing probes. When **TEST SOURCE** is pressed both sources will stay on for approximately 20 seconds. A contact on the right side of the unit is used for testing low frequency probes and the low frequency section of the ultra-broadband probes.



6.6.2 The magnetic probe has three test points around the head of the probe. Position the probe so that one of the test points touches the contact on the meter and is parallel to the meter body. The meter reading should show an increased reading (amount of



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deflection is not important). Repeat for the other two test points to insure that the probe is working correctly. A probe that does not show a movement of the bar graph display for all tests may be damaged and should not be used to make measurements.

- 6.6.3 A microwave window on the right side of the probe is used for testing high frequency electric probes. The B8722D 300 KHz -50 GHz *electric field* probe is an ultra- broadband probe that contains both high frequency and low frequency sensors. These probes require six checks – three high frequency and three low frequency. Position the probe so that one of the test points touches the window on the meter and is parallel to the meter body. The meter reading should show an increased reading (amount of deflection is not important). Repeat for the other five test points to insure that the probe is working correctly. A probe that does not show a movement of the bar graph display for all tests may be damaged and should not be used to make measurements.



6.7 Sampling Strategy:

- 6.7.1 Start with the E field measurement.
- 6.7.2 Spatially averaged levels are specified in the BNL Occupational Exposure Limits (OELs). Take at least 10 measurements along the vertical plane from floor to about 6.5 feet high. Measurements should be at a maximum 20 cm (~8 inches) apart. Determine the point of highest concentration. The 8718B can perform spatial averaging so this will simplify the calculations. See Section 6.9.
- 6.7.3 It is also recommended to take single point measurements at the following locations:
- Source measurement: however no closer than 8 inches from the surface of the source. (If personnel are never in close proximity to the source, then it is not necessary to measure surface levels.) Additional measurements at equal distance away from the centerline, repeated along all surfaces of source.
 - Shielding: determine if there are any leaks in the barriers.
 - Typical operating position: (sitting, standing or bending) to estimate personal exposures.
 - Locations where maximum employee exposures are possible.

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6.8 Taking Measurements

- 6.8.1 **Operator Position:** The meter operator should be further from the source than the probe. If readings exceed 100% of Standard, stop field sampling and seek a professional evaluation of exposure potential.
- 6.8.2 Approach source from a low background. Make sure the probe does not get overloaded. Overloading could result in burning out the probe. The probes will readout in Percent of Standard. The permitted exposure for these probes is 300% of standard.
- 6.8.3 Keep the probe away from reflective surfaces.

6.9 Spatial Averaging by Data logging

- 6.9.1 Press **F3 Menu**, then select **3 Spatial Average**

1. DATA LOG	5. UNITS
2. TIME AVG	6. RS232
3. SPATIAL	7. PROBE
4. BAT/LITE	8. NEXT

- 6.9.2 Press **F1 On** to accept the mode

SPATIAL AVG MODE			
MODE IS ___			
ON			
F1	F2	F3	F4

- 6.9.3 Press **F1 Start** while slowly moving the probe vertically at a constant rate of movement. (Meter beeps at 1 second intervals) The meter will log the values and average them. Strive for an interval of about 10 seconds between starting and stopping the time. When the probe reaches the height equal to the top of an adult's head (about 6 Ft) press **F1 Stop** to stop.

nnn % STD			
Nnn MAX CF 1.00			
START MAXR MENU QUIT			
F1	F2	F3	F4

The meter will show the average value on the second line of the display and the maximum value on the left side of the third line of the display. The bar graph will be indicating the instantaneous field magnitude in real time. The averaging interval will be shown on the right side of the third line.

- 6.9.4 To make another spatially averaged measurement, press **F1 Start** again.

- 6.9.5 To temporarily suspend the spatial average mode and make real time measurements press **F2 Clr**. To resume spatially averaged measurements, press **F1 Start** again.

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6.9.6 To end spatial averaging, press **F4 Quit**.

6.10 **Monitoring for a specific frequency.** If you know the specific frequency of operation of equipment, then this information can be entered into the meter. During this process, a correction factor should be applied to the data. See the Narda 8718B instrument manual for operating instructions.

6.11 **Data Logging:** The 8718B has data logging capabilities. It permits the data to be stored and downloaded at a later time. See the Narda 8718B instrument manual and Attachment 8.3 for more information.

6.12 **Recording readings:**

6.1.1 Plan and conduct hazard assessments and exposure monitoring using the procedure outlined in *IH 60500 Reporting Personnel Exposure Monitoring Results* for:

- Exposure Assessment Sampling Strategy,
- Initial Notification of Employee Monitoring Results, and
- Preparation of a formal report on the exposure monitoring or hazard assessment.

6.12.1 Record values by writing down the findings or logging the data (See section 6.9 and Attachment 8.3). Use a *BNL IH Group Direct Reading Sampling Instrument Form* or equivalent to record the electric and magnetic field readings and additional required information.

6.12.2 Return meter and original sampling form to the SHSD IH Laboratory. Copy goes to the ESH Coordinator.

6.13 **Calculations**

6.13.1 Determine the spatial average (manually or by the meter logging mode). If the spatially averaged mode was not used, average the values across the vertical range (take the square root of the average of the squares of the values of the vertical range) or visually identify the highest value as the worst-case incident.

6.13.2 Compare values with numbers in OEL standard.

6.13.3 If values are greater than or equal to 50% of the standard, then individuals are referred to the occupational medicine clinic for inclusion in the RF protocol. Further review should be made to determine what additional controls or procedures should be instituted.

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6.13.4 Ensure that a copy of any hazard evaluation report written by a competent person on the survey is sent to the IH Laboratory and the Occupational Medicine Clinic, the department ESH coordinator, and the individuals surveyed.

7.0 Implementation and Training

Prior to using this procedure, the user:

- 7.1 Demonstrates proper operation of this instrument to the satisfaction of the SHSD IH Program Administrator.
- 7.2 Completes other appropriate training for the area to be entered (check with ESH coordinator or FS representative for the facility).
- 7.3 Completes OT&Q Training and a medical surveillance required for any PPE used on the job or for other hazards encountered in the work area.
- 7.4 Completes qualification on this procedure on at least a 3 year basis, providing the professional uses the equipment several times per year.
- 7.5 Personnel are to document their training using the Attachment 9.4 with its *Job Performance Measure Completion Certificate* for this meter.

8.0 References

- 8.1 ESH Standard 2.3.2 RF and Microwaves.
- 8.2 Model 8718B Electromagnetic Radiation Survey Meter User's Guide. Narda Communication P/N 42983600 Rev A.
- 8.3 Narda Safety Products and Services Handbook.

9.0 Attachments

- 9.1 Photo of meter
- 9.2 Short Operating Instructions
- 9.3 Using Data Logging features
- 9.4 *Job Performance Measure Completion Certificate*.

10.0 Documentation

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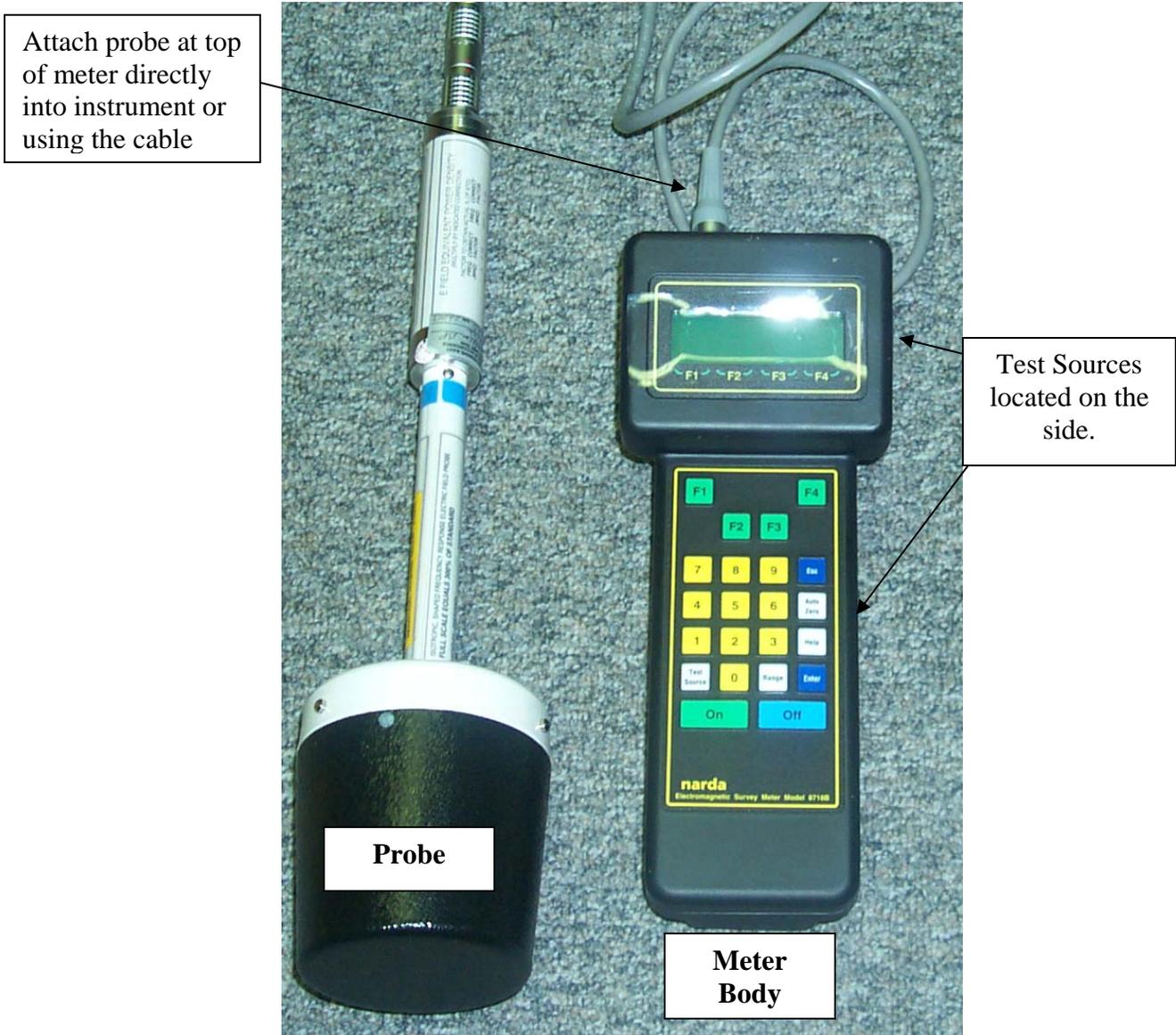
Document Development and Revision Control Tracking		
PREPARED BY: <i>(Signature and date on file)</i> N. M. Bernholz Author Date 12/05/01	REVIEWED BY: <i>(Signature and date on file)</i> J. Peters SHSD IH Group Date 01/30/02	APPROVED BY: <i>(Signature and date on file)</i> R. Selvey SHSD IH Group Leader Date 02/06/02
ESH Coordinator/ Date: <i>none</i>	Work Coordinator/ Date: <i>none</i>	SHSD Manager / Date <i>none</i>
QA Representative / Date: <i>none</i>	Training Coordinator / Date: <i>none</i>	Filing Code: IH52
Facility Support Rep. / Date: <i>none</i>	Environ. Compliance Rep. / Date: <i>none</i>	Effective Date: 02/06/02
ISM Review - Hazard Categorization <input type="checkbox"/> High <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Low/Skill of the craft	Validation: <input type="checkbox"/> Formal Walkthrough <input type="checkbox"/> Desk Top Review <input type="checkbox"/> SME Review Name / Date:	Implementation: Training Completed: Tracked in BTMS Procedure posted on Web: 05/17/07 Hard Copy files updated: 05/17/07 Document Control on forms: 05/17/07

Revision Log		
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input type="checkbox"/> Periodic review <input type="checkbox"/> Clarify/enhance procedural controls Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above Section/page and Description of change: Revised to include Section 7 Implementation and Training. Text added to Section 2, 4,5, 6, and 7. JRA added to Section 5.		
<i>R. Selvey 03/29/05 (Signature/date on file)</i> SME Reviewer/Date:	Reviewer/Date:	Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input type="checkbox"/> Periodic review <input type="checkbox"/> Clarify/enhance procedural controls Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above Section/page and Description of change: Section 2.2, 2.3, 4.1, 7.1, and 7.5 revised to reflect qualification requirements. Section 5 revised to remove JRA table and link to OHSAS web site and add/update the description of radiation contamination, environmental waste, and work planning. Attachment 9.4 Job Performance Measure was added.		
<i>R. Selvey 01/10/07 (signature/date on file)</i> SME Reviewer/Date:	SME Reviewer/Date:	SME Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input type="checkbox"/> Periodic review <input type="checkbox"/> Clarify/enhance procedural controls Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above Section/page and Description of change: Added attachment # to 9.4. A few minor text corrections of typo errors.		
<i>R. Selvey 05/17/07 (signature/date on file)</i> SME Reviewer/Date:	SME Reviewer/Date:	SME Reviewer/Date:

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Attachment 9.1



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Attachment 9.2 Short Operating Instructions

Step	User Action	Meter Response
Turn meter on	Press " ON " membrane button	Meter display activates and meter cycles through <i>start up</i> and <i>main</i> menus.
Select Probe	Attach probe to meter body	The model and serial number of the last probe used will be displayed on the second line of the display.
	Verify that the information on the screen matches the probe you are using. If yes, press " Enter "	Meter display information on the probe.
	If the right probe model is not displayed, enter the number for the correct model numbers in the F1 and F2 legends. Verify information that appears on next screen by pressing " F1 " <i>yes</i>	Meter display information on the probe.
Zero Probe	Place probe in the protective case or in the zero bag. Press " Enter " when ready	The meter will beep and the main measurement screen will appear in about 15 seconds after zeroing is completed.
Test the probe with an internal test source.	Place the meter probe head marked " L " to the source site on the side of meter and press " Test Source ".	Meter detects source. Acceptable reading is any increase above background. Typically increase is 5% of Standard.
Measure field source	Proceed to perform measurements using either the direct reading mode or data logging. Take spatially averaged readings from floor to 6'5". Take measurements across the surface of the instrument. Survey the operator positions and close to source (>8").	Meter reads in % of OEL Standard. Record reading on data sheet.

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Appendix 9.3 Using Datalogging Features

1.0 Go to menu and select **“1” Data Log**. (If you want to log averaged data, the spatial average mode must have been previously turned on).

1. DATA LOG	5. UNITS
2. TIME AVG	6. RS232
3. SPATIAL	7. PROBE
4. BAT/LITE	8. NEXT

2.0 Then select **“2” Log AVG with Ref#**.

1. Log with Ref#			
2. Log AVG with Ref#			
3. Continuous Logging			
MEM		QUIT	
F1	F2	F3	F4

3.0 The screen will prompt you for a reference number for this series of data.

New Logging Run:			
Enter New Ref No:			
OK	CLR	MENU	QUIT
F1	F2	F3	F4

4.0 Press **F1 OK**. Make note of the number so you can later associate this survey number with the data points collected.

nnn % STD			
Nnn MAX CF 1.00			
START	MAXR	END	QUIT
F1	F2	F3	F4

5.0 PRESS **F1 Start**. You will hear the machine beep each time it takes a measurement. It will show how many seconds you have been running.

nnn % STD			
Nnn MAX CF 1.00			
STOP			
F1	F2	F3	F4

6.0 You will be shown the information collected and you will have a choice to discard or save. Press **F1 Save** or **F3 Discard**

DATA POINT NO. 001			
0.0562% STD AVG			
0.0812 % STD MAX _____ sec			
SAVE		DISCARD	
F1	F2	F3	F4

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You will have the opportunity to take another data measurement or quit the application
 If you end, you will be requested to enter another data point no.; otherwise you will have a series of data points for a particular location (data points)

At the end of the day's survey, you may download the data to a computer using a Narda program.
 The data can be imported into an Excel spreadsheet. This can then be imported or attached to a Word report. An example is listed below.

```

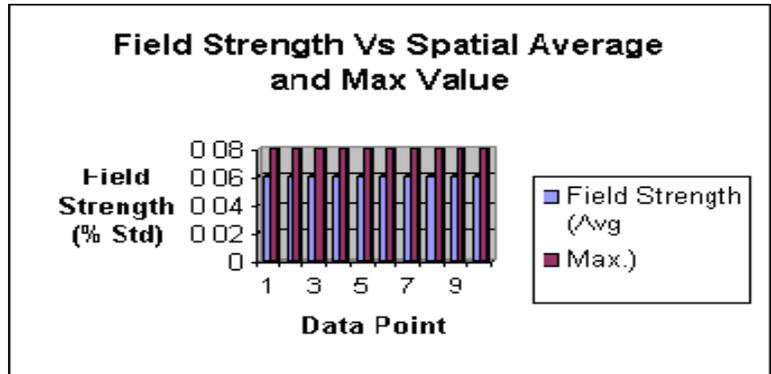
C:\PROGRA~1\8718B\SSDATA\09251313.CSV
Run Ref. Number: 01
Date: 09/25/01 Start Time: 11:16

Model 8718 S/N: 6036    Cal Date: 07/06/01    Due: 07/06/02
Probe: A8732DS/N:    Cal Date: 07/06/01    Due: 07/06/02

Freq: N/A Cor. Factor: 1.00    Logging Rate: N/A

Avg Mode: Spatial Avg. && Max.

Ref#  Field Strength (Avg          Max.)
      1                      0.06          0.08
      2                      0.06          0.08
      3                      0.06          0.08
      4                      0.06          0.08
      5                      0.06          0.08
      6                      0.06          0.08
      7                      0.06          0.08
      8                      0.06          0.08
      9                      0.06          0.08
     10                     0.06          0.08
    
```



Non-ionizing Radiation – Narda 8718B Operation Job Performance Measure (JPM) Completion Certificate

Candidate's Name	Life Number:
------------------	--------------

Practical Skill Evaluation: Demonstration of Evaluation Methodology by Oral Exam

Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
1. Hazard Analysis	Understands the need to perform a hazard analysis of the area and potential exposure to the self as sampler and workers in the area.			
2. Personal Protective Equipment	Understands the need to be aware of the potential surface contamination, airborne levels of contaminants, radiological hazards, and noise hazard. Knows how to determine the need for PPE.			
3. Sampling Equipment	Knows where equipment needed for the procedure is located and how to properly sign it out.			
4. Pre-Testing Inspection	Verifies the system to be monitored is operational and represents typical operation. Makes notation in sampling record if the operating conditions are atypical.			
5. Operating Parameters	Knows the theory to establish operating parameters (safety envelope) for the equipment. Make drawing or photo. Measure.			
6. Documentation-Technician	Demonstrates correctly filling out IH monitoring forms.			
7. IH Professional Documentation	Demonstrates correctly filling out IH forms, transfers appropriate info to IH databases, prepares an evaluation assessment report (including an evaluation of the relationship of the exposure to occupational exposure limits), and notify workers and management of the results.			

Meter Operation Practical Skill Evaluation: Demonstration of Methodology

Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
Turning on the meter	Demonstrates how to correctly operate the meter. Describes appropriate warm-up time.			
Zeroing	Demonstrates how to correctly operate the meter to eliminate background, previous stored readings, stray fields not to be measured.			
Probe placement during measurements.	Demonstrates how to correctly operate and align the meter.			
Spatial Averaging	Demonstrates how to correctly align and locate the meter probe relative to source(s)			
Time Averaging	Demonstrates how to correctly calculate exposure relative to occupational exposure limits.			

I accept the responsibility for performing this task as demonstrated within this JPM and the corresponding SOP.

Candidate Signature:	Date:
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I certify the candidate has satisfactorily performed each of the above listed steps and is capable of performing the task unsupervised.

Evaluator Signature:	Date:
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