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# RESULTS OF DUST OBSCURATION TESTS (DOT) USING EXPLOSIVES FORT CARSON, COLORADO

by

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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)<br><br>The US Army Engineer Waterways Experiment Station (WES) conducted dust obscuration mea-<br>surements at Fort Carson, Colo., in April and August 1983 to demonstrate the validity of existing<br>models to predict crater volumes produced by a given explosive charge and to use models developed by<br>the Atmospheric Sciences Laboratory (ASL) to predict the mass of dust in clouds formed from the ex-<br>plosions. It was found that apparent craters formed agreed well with the "1.111 Power Law" used in<br><br>(Continued) |                                            |                                                                                                                                     |

## 20. ABSTRACT (Continued).

EOSAEI. 82 (COMBIC) developed by ASL. Cloud masses were calculated using techniques developed by ASL and a contractor, PEDCo, Inc. (now PEI Associates). Generally, results obtained at Fort Carson showed that from 2 to 5 percent of the excavated soil mass would be found in a dust cloud after approximately 10 sec had elapsed from detonation.

Improvements in sampling techniques, particularly those characterizing the vertical nature of the cloud, are recommended. Since the composition of the cloud can vary greatly in a few metres of downwind distance, different sampler types should be used and should be positioned as close together as practical to determine differences in the respective samplers.

Other recommendations concerning the conduct of future tests are included.

## PREFACE

The work reported herein was conducted by the US Army Engineer Waterways Experiment Station (WES), Environmental Laboratory (EL), for the Office, Chief of Engineers (OCE), US Army, under DA Project No. 4A762730AT42, Task Area B/E5, Work Unit 002. Dr. C.A. Meyer and MAJ Denton Brown, DAEN-ZCM, were the OCE Technical Monitors. This research was conducted under the AirLand Battlefield Environment Thrust. The purpose was to identify factors in the environment influencing the amount of dust lofted from explosive bursts of various sizes. These studies were conducted in April and August 1983 at Fort Carson, Colo.

In the April 1983 exercise, US Army Atmospheric Sciences Laboratory personnel performed the tasks of test layout and meteorological and dust data collection; WES personnel provided crater and soil characterization and photographic coverage. In the August 1983 exercise, a WES contractor, PEDCo Environmental, Inc., devised and executed the dust sampling program.

Mr. James B. Mason of the Environmental Analysis Group (EAG), Environmental Systems Division (ESD), EL, directed the April exercise; Mr. Randall R. Williams, EAG, directed the August exercise. The report was prepared by Ms. Katherine S. Long and Mr. Williams, EAG, and by Dr. Roger E. Davis, Science and Technology Corporation (STC), Las Cruces, NM (Contract No. DACA39-85-C-0006) under the direct supervision of Mr. Harold W. West, Chief, EAG, and under the general supervision of Dr. L.E. Link, Jr., Chief, ESD, and Dr. John Harrison, Chief, EL. STC personnel performed data analysis and prepared a major portion of the report as well as the computer graphics presented in the text and in Appendixes A and B. The report was edited by Ms. Jessica S. Ruff of the WES Publications and Graphic Arts Division (PGAD). Layout of the appendixes was accomplished by Ms. Beatrice W. Watson, PGAD.

At the time of publication, COL Allen F. Grum, USA, was Director of WES and Dr. Robert W. Whalin was Technical Director.

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# RESULTS OF DUST OBSCURATION TESTS (DOT) USING EXPLOSIVES, FORT CARSON, COLORADO

## PART I: INTRODUCTION

### Background

1. The US Army Engineer Waterways Experiment Station (WES) is conducting research related to the determination of the terrain dust concentration and composition for realistic battlefield conditions. This research is sponsored by the Office, Chief of Engineers, US Army, under the auspices of the Battlefield Terrain Working Group of the AirLand Battlefield Environment Thrust (Deepak 1983). The importance of terrain dust has increased as a result of the development of high-technology weapons, sensors, and surveillance systems. The potential effects of terrain dust upon battlefield operations and equipment are significant, and dust properties and characteristics vary greatly with geographic location, climate, season, and even time of day. The prediction of dust concentrations and composition in a region being used for a military activity is an integral part of combat survivability. WES's primary thrust has been to determine the terrain and environmental factors affecting dust generation and transmission and to develop analytical relations that describe those dependencies. This research will provide data to analysts involved in combat effectiveness studies and to military engineer teams involved in predicting the performance of weapon systems in combat.
2. An experimental research program is being conducted jointly by WES and the US Army Atmospheric Sciences Laboratory (ASL) to determine data and relationships for use in an analytical procedure for prediction of terrain dust generated by explosions such as impacting munitions, moving vehicles, weapon firings, and helicopter landings and takeoffs. The principal goal of the explosive tests has been to develop a database to correlate soil properties with airborne dust loading. The initial series of tests in the Corps of Engineers' dust research program focused on determining the correlations with dust loading by considering the sand, silt, and clay content of soils before explosive detonation. This test series was designated the Battlefield Environments from Tailored Soils (BETS) (Mason and Long 1981; Kennedy 1982; Mason and Long 1983). The objective of BETS was to account for the material removed from craters produced by uncased simulated munition rounds to infer the dust cloud mass and distribution.
3. The second series of experimental explosive tests, conducted at Fort Carson, Colo., in April and August 1983, were designated the terrain Dust Obscuration Tests (DOT). The April test (DOT I) was conducted jointly by the ASL, White Sands Missile Range, N. Mex., and WES (Long et al. 1985). The August test (DOT II) was conducted by the WES with some field support provided by a WES contractor (PEDCo Environmental, Inc.).

### Objective

4. The objective of the DOT was to gather meaningful data concerning the amount and characteristics of the obscurants released into the atmosphere by two likely components of the battlefield environment: (a) explosive activity and (b) vehicular traffic. The explosive trials were conducted by placing uncased C-4 charges upwind of the sampling array. The vehicular trials were conducted by running tracked and wheeled military vehicles upwind of the sampling array. This report documents the results of the DOT explosive tests.

## Scope

5. Part II of this report describes physical features of the test sites selected. The instruments used to measure the phenomena resulting from the blasts are also described, and the conduct of the explosive events is summarized.
6. Part III describes the kinds of data collected during the high-explosive trials. Basic soil characteristics were measured before and after each event. The data collected for the DOT I events were greater than those in DOT II in both number and kind. These data were meteorological data, transmission data, and dust collection data gathered at the time of each event and shortly thereafter until it was determined that measurable effects of the blast had vanished. In the DOT II phase, limited meteorological and soil data were taken in addition to dust collection. After each event, the physical measurements of the resulting crater were taken.
7. Part IV presents the analysis of crater geometries and resulting clouds. Part V presents the conclusions and recommendations for future studies.

## PART II: DESCRIPTION OF TESTS

### Test Sites

8. The two test sites used for the Fort Carson DOTs are respectively located 2 km north of the southernmost gate of the Military Reservation (DOT I) and approximately 2 km southeast of Camp Red Devil (DOT II), as shown in Figures 1 and 2. The sites are gently sloping, with the Rocky Mountains approximately 60 km to the northwest and open terrain and low hills to the east and south. The Fort Carson reservation can be considered analogous to many semiarid regions of the world in terms of surface soil types and vegetation ground cover types. Figure 2 shows the portions of the reservation that are covered by the predominant short- and mixed-grass prairie species that occur at the two test sites. Figures 3 and 4 are presented as pictorial records of the terrain and ground cover found at the DOT I and II sites, respectively.
9. The surface soil at Site 1 (DOT I) was a light brown sandy clay material classified according to the Unified Soil Classification System (USCS) as a sandy clay (CL). The in situ moisture content of the surface soil ranged between 6.7 and 26.7 percent, with the maximum moisture occurring just after the site received some light rainfall. Soil strength or cone index (CI) was 50 at the surface and increased to approximately 200 at a 15-cm depth and 750+ at a 30-cm depth. The surface soil at Site 2 (DOT II) was a reddish-brown, sandy clay-sandy silt material classified as CL according to the USCS. The moisture content ranged from 7.2 to 17.5 at the surface, and the soil strength varied from 100 CI in the surface layer to 750+ CI at the depth of 15–30 cm. Figure 5 shows the surface soil grain sizes at the two test sites.
10. The predominant vegetation types occurring at the sites were short grasses and plants of blue grama, Russian thistle, lamb's-quarters, and prickly pear. Height of the plants ranged 10–20 cm, and the ground area of coverage was 50–70 percent, as illustrated in Figures 3 and 4. Figure 6 displays typical root depths (approximately 15–20 cm) for the grass clumps growing at the sites.
11. Site 1 near the southern boundary normally receives approximately 9–11 in. (23–28 cm) average annual rainfall. Site 2, near Camp Red Devil, receives an average of 12–13 in. (30–33 cm) of rainfall annually. Some rainfall did occur during both the April and August tests, which is reflected in the in situ moisture data presented.

### Instrumentation

12. The instrumentation for the April explosive tests was provided by the ASL and consisted of a multiwavelength transmissometer, eight Hi-Vol dust samplers (height 1.5 m, spaced 6–10 m apart), five nephelometers, a Knollenberg counter, a spectrophone, four Gelman vertical samplers (heights 2, 6, 11, 15 m), and 2- and 16-m meteorological towers containing sensors for measurements of wind speed, wind direction, air temperature, dew point, humidity, and solar radiation. Additional meteorological sensors were included on the 16-m tower at heights of 4 m and 8 m. Meteorological sensor measurements were digitally recorded at 2-sec intervals. Figure 7a shows the layout and general ground-level view of the instrumentation. Further description of the instrumentation and calibration procedures is provided in a preliminary project report by Hooch and Kennedy (1983).
13. For the August tests, the instrumentation (Figure 7b) consisted of five Hi-Vol dust samplers (spaced 20 m apart and 2.5 m above ground), two tethered balloons each with four 47-mm polyvinyl chloride vertical samplers located at heights of 1.5, 7.6, 15.2, and 22.9 m above the ground,

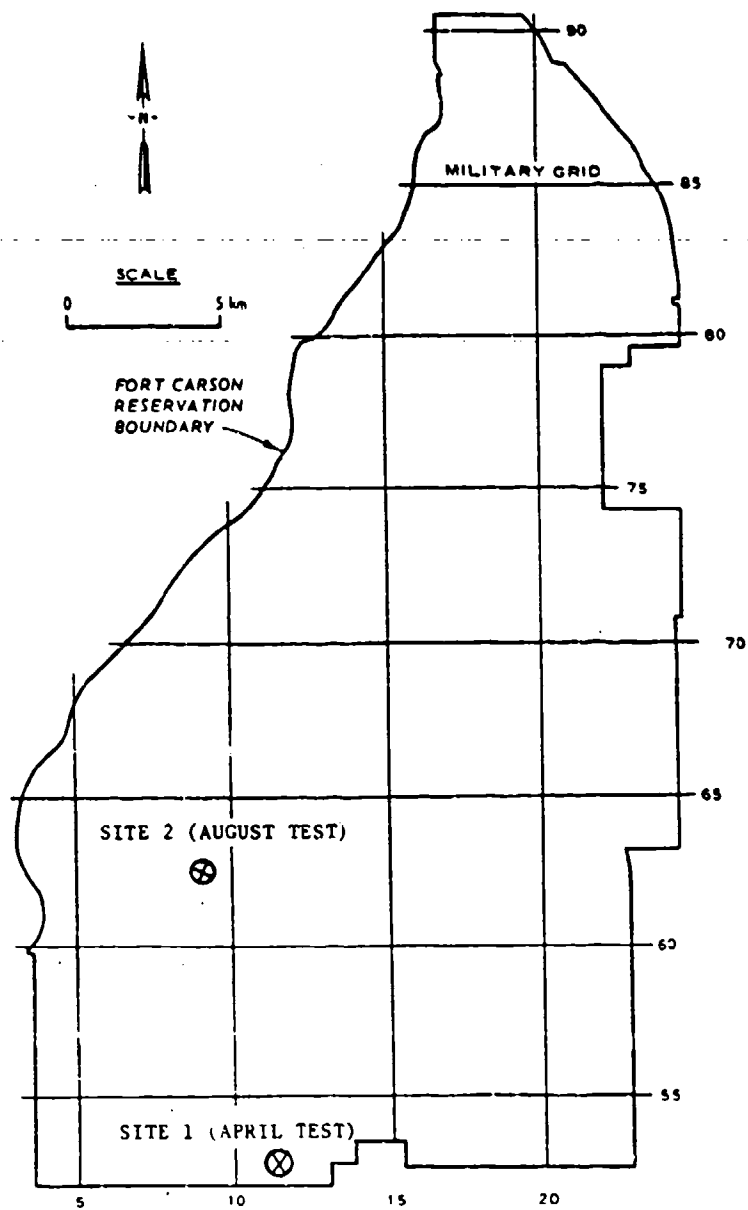


Figure 1. Location of test sites at Fort Carson, Colo.

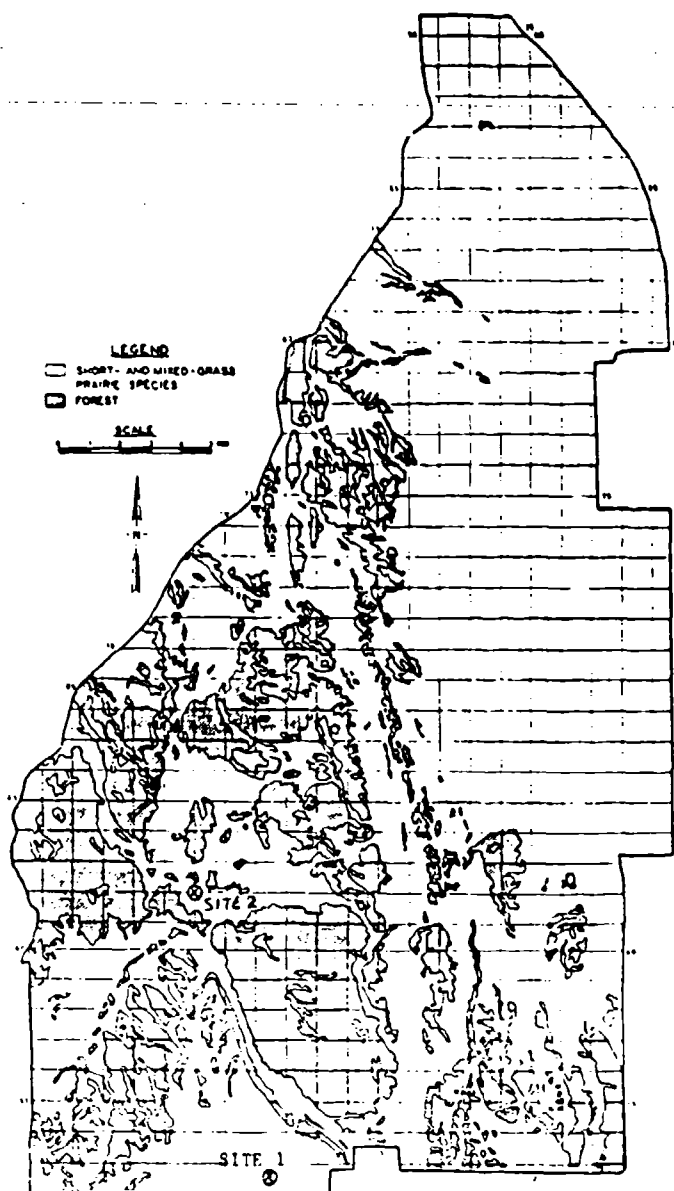


Figure 2. Vegetation cover at Fort Carson, Colo.

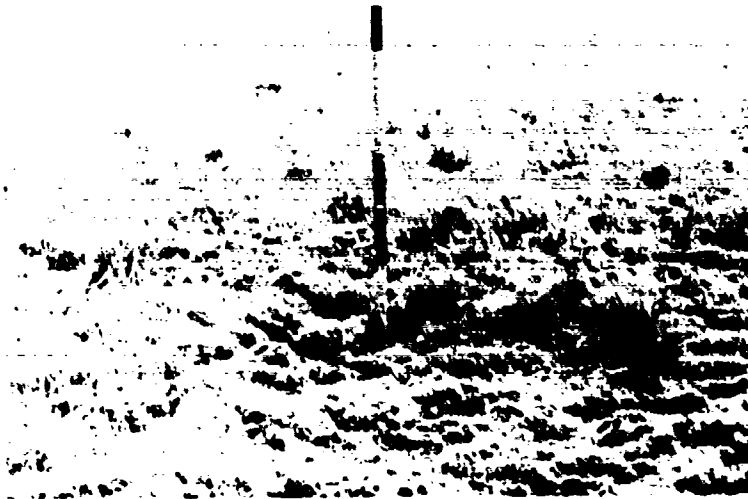


*Figure 3. Site 1 (April tests, DOT I)*

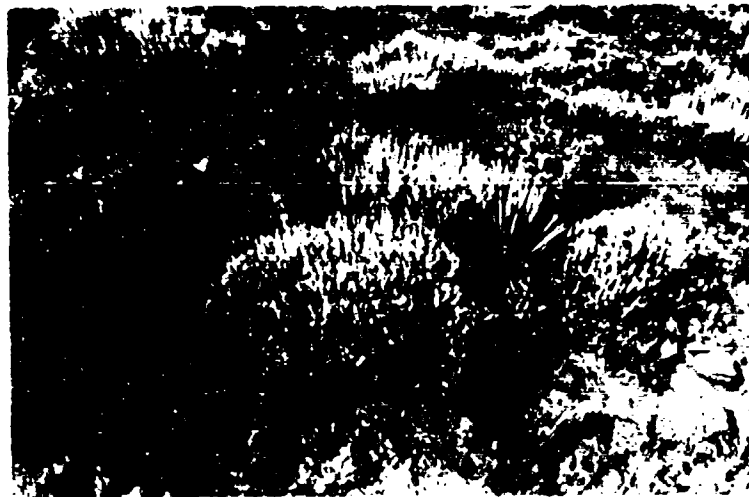


*Figure 4. Site 2 (August tests, DOT II)*

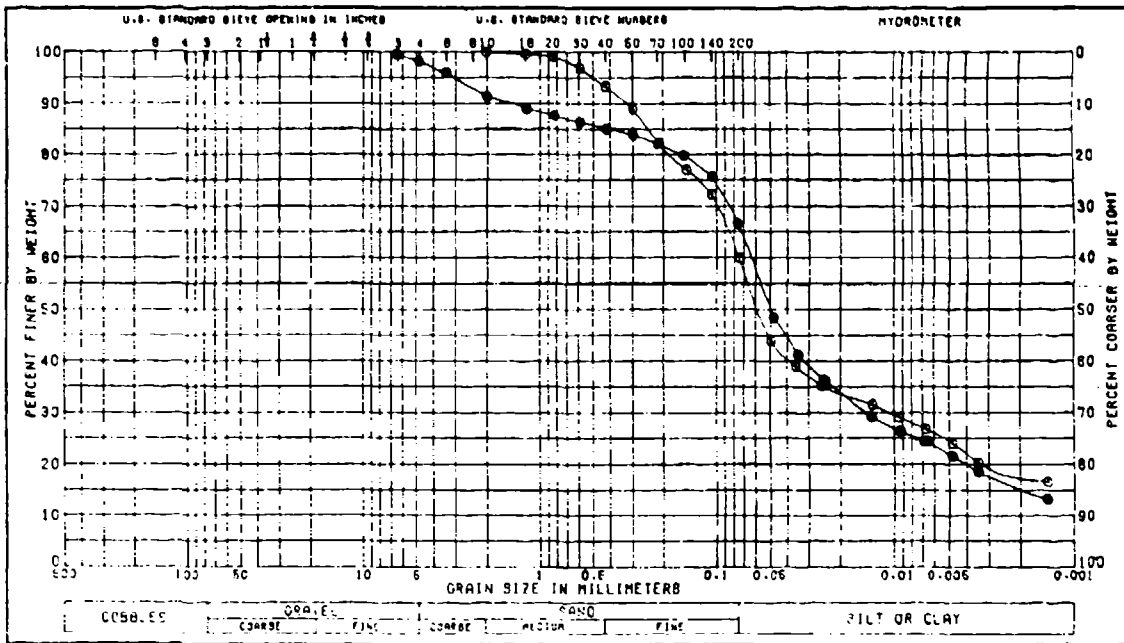


Figure 5. Average grain size distribution of surface soil at each of the two sites (● - Site 1; ○ - Site 2)

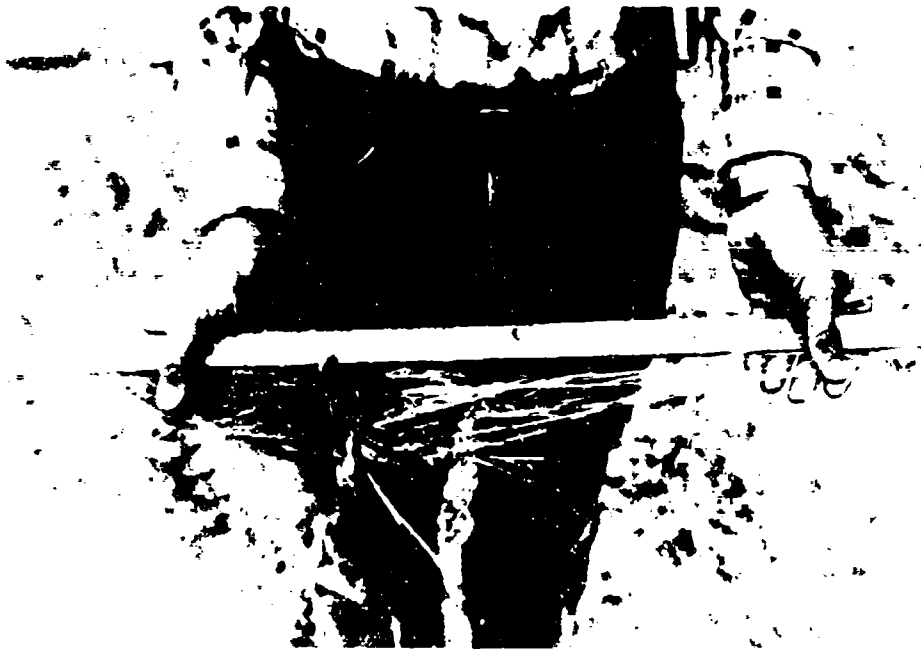
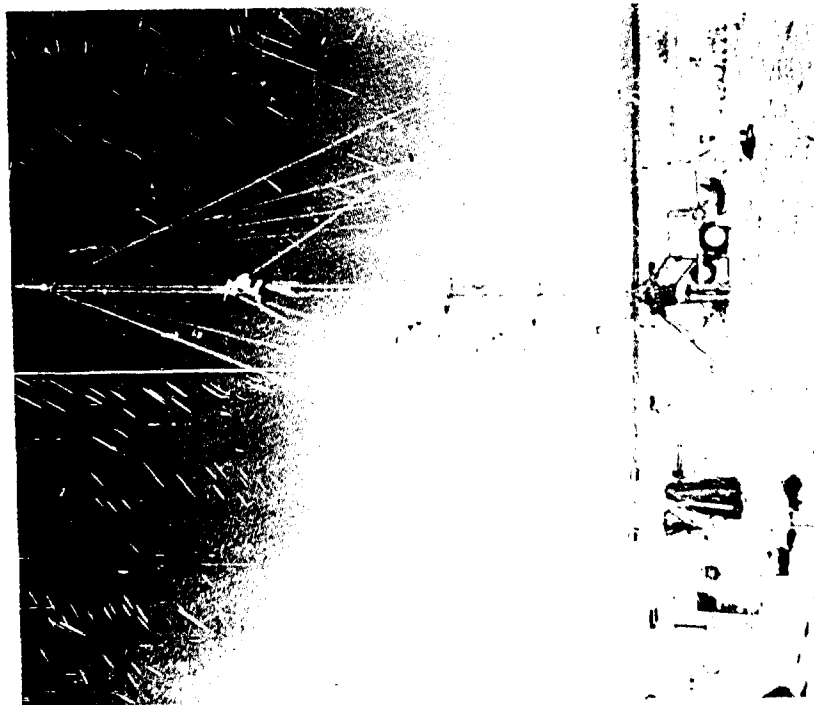


Figure 6. Typical grass root depths at Site 1



*a. Site 1 (April tests, DOT I)*



*b. Site 2 (August tests, DOT II)*

*Figure 7. Instrumentation used at the DOT*

Best Available Copy

and several meteorological sensors (wind speed, wind direction, air temperature, barometric pressure, relative humidity, and solar intensity) located at a height of 2 m. The instrumentation for Site 2 was provided by PEDCo Environmental, Inc., under contract to WES. The instrumentation and calibration procedures are described in PEDCo Environmental, Inc. (1985).

14. Figures 8 and 9 are schematic representations of the instrumentation and coordinate systems used for DOT I and DOT II. A rectangular coordinate system was used in DOT I while polar coordinates were utilized in DOT II. Polar coordinates for DOT II were deemed appropriate because the sampler line could be rotated in order to adjust for prevalent wind shifts. Figure 9a shows locations of shots and measuring devices for the first three shots, while Figure 9b shows those for the rest of the shots.

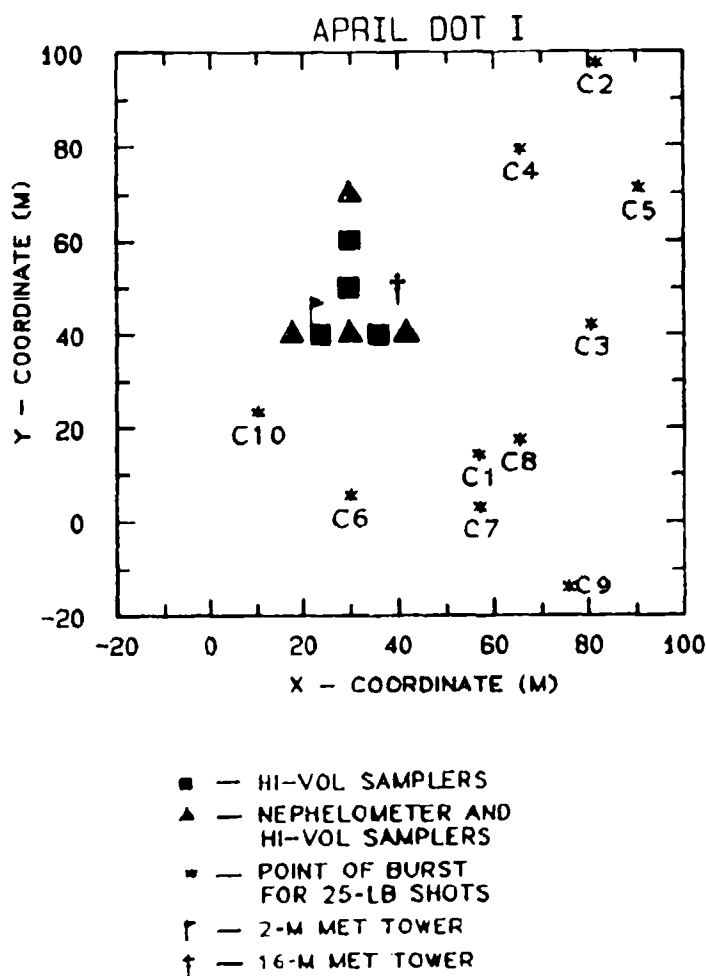
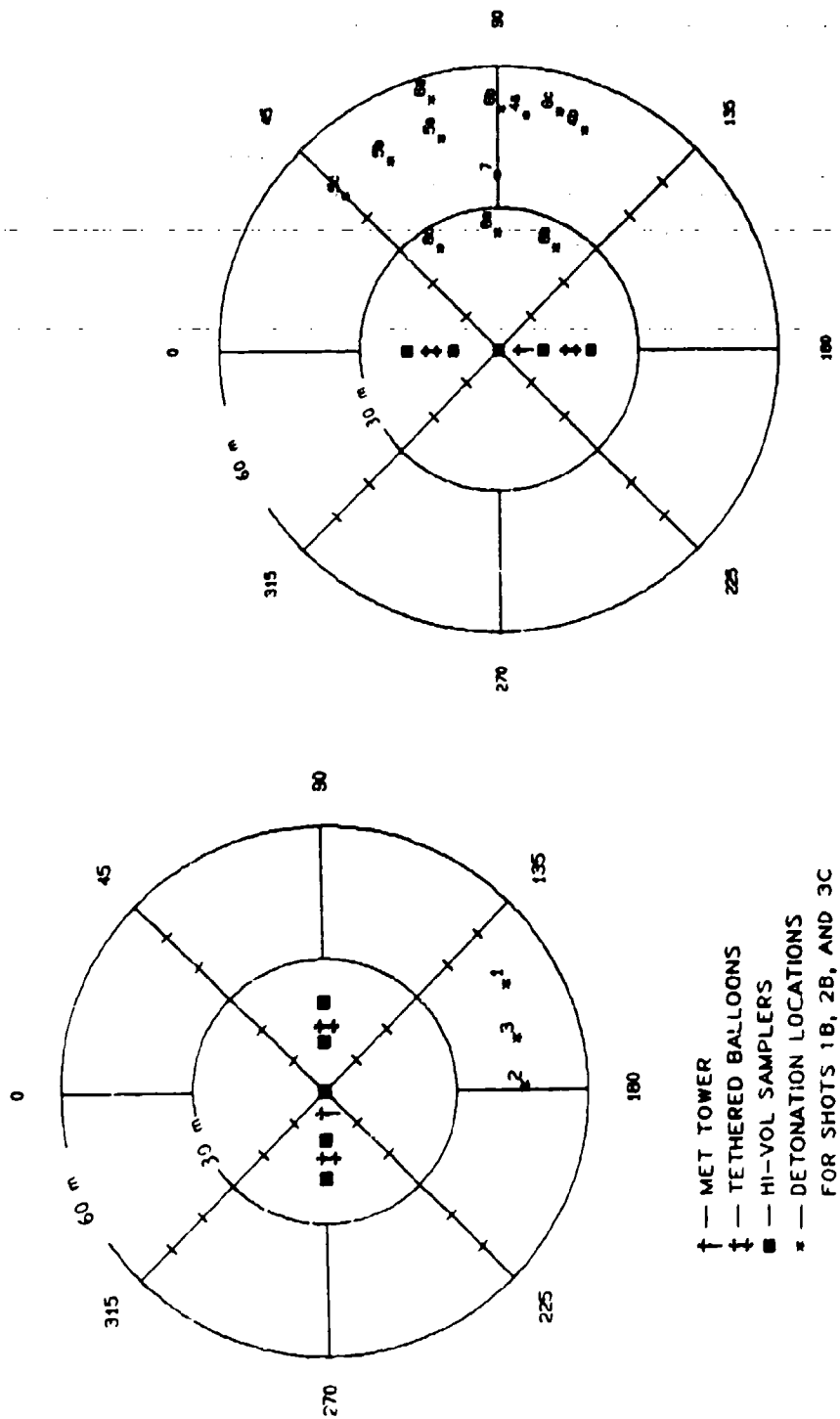


Figure 8. Schematic site layout for DOT I



*a. Layout of first three shots*

*b. Layout of other shots*

*Figure 9. Schematic site layout for DOT II*

## Conduct of Tests

15. The explosive agent used for the DOT explosive phases was uncased C-4 detonated by personnel of the 52d Engineering Battalion, Fort Carson. Charges were either blocks or molded spheres (Figure 10) of 7.5 lb (3.4 kg, designated "A"), 15 lb (6.8 kg, designated "B"), and 25 lb (11.3 kg, designated "C"). A total of 35 shots were made during DOT I, the majority being surface tangent (ST) blasts. Trial B16 had three separate charges of 15 lb each detonated at 5-sec intervals, making it the only multiple charge shot of DOT I. The B14 shot was detonated on a stick with the C-4 center of mass at 39 cm above the surface. No crater was formed by this shot. Trials B12, B13, and B15 were surface tangent buried (STB) shots with the charges shaped as blocks formed from individual 1.25-lb (0.6-kg) bricks of C-4 and placed in the ground with the top of the charge flush with the surface. The B5 trial was unusual in that the charge was inadvertently placed over a soil sample plug hole 1.5 in. (3.8 cm) in diameter and 8 in. (20.3 cm) deep. The true and apparent crater volumes resulting from this shot were approximately three and five times larger than those of the respective B shot means. Evidently the plug hole caused a focusing of the blast energy.

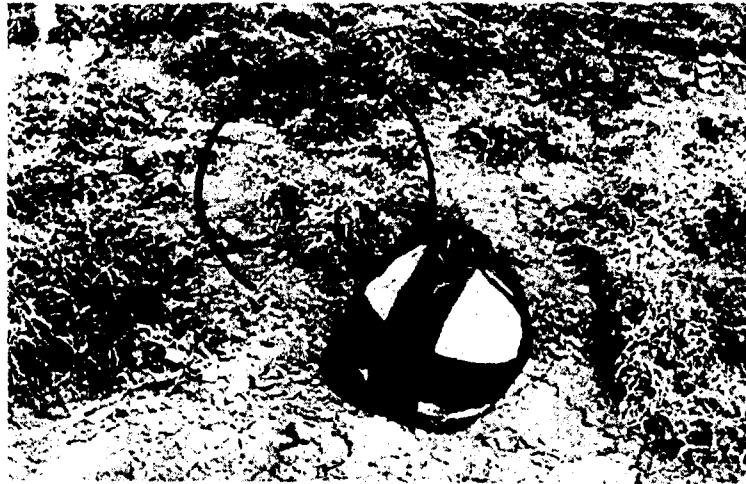


*Figure 10. Typical molded C-4 sphere*

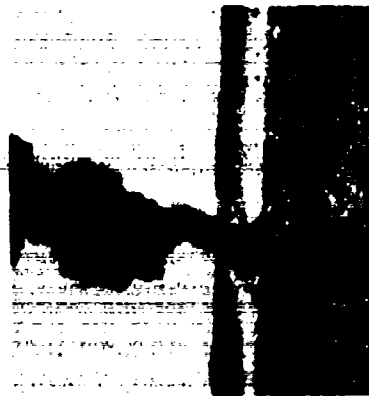
16. The DOT II high-explosive phase consisted of eight shots, four of which were multiple-detonation trials. However, only seven of the trials yielded data because the Hi-Vol sampler filters were blown out by the blast in Trial 8. Charges for the measurable DOT II shots were 15- and 25-lb spheres.
17. The location for the point of burst (POB) was an important consideration for the tests. The POB for the April tests was determined by using the onsite measured wind direction and speed data and the center (location of sampler 3) of the Hi-Vol sampler array. The actual POB was determined by using the direction from which the wind was blowing and selecting a distance from the Hi-Vol array that would allow representative measurement of the horizontal and vertical composition of the dust cloud. The POB distance ranged from 19-75 m for all of the April tests, while the POB distance range for the August tests was somewhat less (40-45 m).
18. Tables 1 and 2 provide reference logs for the high-explosive trials at the DOT. Both timed still photographs and video records were taken for most of the DOT I events. A typical young cloud generated by a 15-lb C-4 charge is shown in Figure 11. Note the significant amount of dust (appearing white in Figure 11) generated to the 2- to 3-m heights by the detonation shock waves. The craters were measured immediately after the blast as shown in Figure 12.



a. Dust cloud at time 0.1 sec



b. Dust cloud at time 0.5 sec



c. Dust cloud at 1.0 sec

Figure 11. Dust cloud generated at DOT 1 (April 1983) using a 15-lb C-4 charge



*Figure 12. Measurement of crater following static surface tangent detonation of C-4*

### PART III: DATA COLLECTED

19. Data from the DOT I and DOT II high-explosive trials are presented in Appendix A. The DOT I data are the more comprehensive set, reflecting the instrumentation differences between the April and August trials. However, some additional information concerning the meteorology, Hi-Vol sampler data, and balloon sampler data obtained during DOT II are included in the WES contract report by PEDCo Environmental, Inc.

#### DOT I Event Data

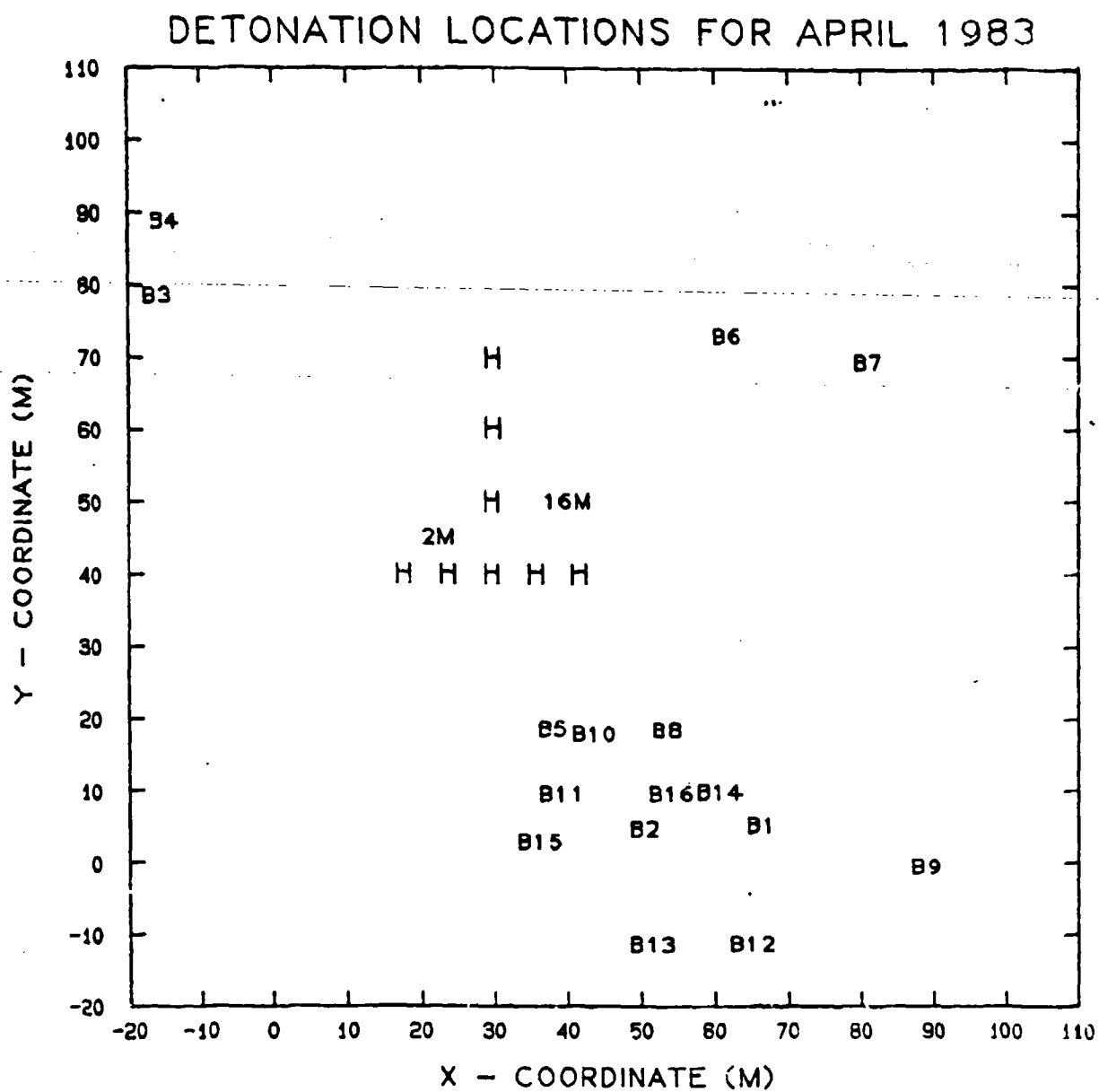
20. The DOT I (April 1983) data are presented in Appendix A (pages A3-A180) in sequence by charge weight, starting with the A-(7.5-lb) shots. Figure 13 shows typical data for one shot, as presented in Appendix A. At the beginning of each charge weight group is a schematic diagram locating the Hi-Vol sampler positions and the location of each shot for the data set (Figure 13a). The meteorological, transmissometer, Hi-Vol, nephelometer, and Gelman data have been reduced and provided by ASL. Crater profiles, crater volumes, cone indices, soil densities, and soil moisture contents have been measured and/or calculated by WES. Information for each shot includes an Event Summary Table (Figure 13b) followed by a crater profile plot (Figure 13c), a cloud track and Hi-Vol data plot (Figure 13d), time-dependent nephelometer concentration plots (four stations) (Figures 13e-f), time-dependent transmission plots (four bandpasses) (Figures 13g-h), plots of visibility, solar flux, and sky and target voltages (Figure 13i), and time of obscuration histograms for four levels of transmission (four bandpasses) (Figure 13j). The following comments pertain to the DOT I data.

#### Meteorological data

21. The 2-m tower data are not presented in this report. The 16-m tower data are presented in tabular form as mean values for the 2-, 4-, 6-, and 16-m levels (Figure 13b). These means are computed for the 2-sec sampling intervals, which usually began several minutes before the detonation (event time) and continued until the cloud was well past the data acquisition instrumentation (usually 5 to 10 min). The "start" time and "end" time values identify this 2-sec sampling period for each shot.
22. The soil temperature, dew point, air temperature, relative humidity, and absolute humidity data are also means computed during the 2-sec sampling period (Figure 13b). The solar flux, visual range, Vista Ranger, and sky-target contrast data are the values observed at the start time given for each shot. Mean values for these data were not computed, as these data are strongly affected by dust cloud trajectory and location. However, the time-dependent plots of these variables are displayed for each shot.
23. The Richardson number values presented are means computed from both the 2- and 16-m levels and have been noted to be noisy.

#### Cone index

24. Cone indices were acquired for most shots before (pre-shot) and after (post-shot) the detonations (Figure 13b). These indices are presented for surface (SFC) and 15-, 30-, and 45-cm depths. The 15-, 30-, and 45-cm values, however, are averages for 0-15, 15-30, and 30-45 cm, respectively. The maximum value the instrument would register was 750. Any excess of this maximum value is logged as 750+ in the event summary CI data.



*a. Schematic diagram of POBs (DOT I)*

*Figure 13. Data items for typical 15-lb C-4 event (Sheet 1 of 6)*

# EVENT SUMMARY DATA

Test Number: HEB6  
 Date: 22 APRIL 83  
 Detonation Coordinates (M):  
 X: 61.7  
 Y: 72.7  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 15.0 LB  
 Event Time: 11:22:01

## METEOROLOGICAL DATA:

Pasquill Category: D  
 Richardson Number: -0.020

16 Meter Tower (Means)  
 Start Time: 11:20:49 End Time: 11:24: 1

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 6.20  | 7.07  | 7.17  | 8.65  |
| Wind Dir. (DEG)  | 32.7  | 29.8  | 32.3  | 27.4  |
| Sigma WSP        | 1.00  | 1.15  | 1.08  | 0.94  |
| Sigma WDIR       | 10.5  | 9.4   | 8.6   | 7.0   |
| UTW Components   |       |       |       |       |
| U (N-S) (M/S)    | -5.15 | -6.08 | -6.01 | -7.64 |
| V (E-W) (M/S)    | -3.25 | -3.42 | -3.75 | -3.92 |
| W (Vert) (M/S)   | 0.46  | -0.04 | 0.65  | •     |
| Sigma U          | 1.16  | 1.30  | 1.18  | 1.03  |
| Sigma V          | 0.96  | 0.97  | 0.96  | 0.95  |
| Sigma W          | 0.22  | 0.32  | 0.34  | •     |
| Temperature (C)  | 11.0  | 10.9  | 10.8  | 10.6  |

Soil Temperature (C): 11.7 Solar Flux (W/M<sup>2</sup>): 131.5  
 Dew Point (C): 2.7 Visual Range (M): 30480.0  
 Temperature (C): 10.2 Vista Ranger Voltages:  
 Rel. Hum. (%): 59.4 Sky: •  
 Target: •  
 Abs. Hum. (G/M<sup>3</sup>): 5.69 Sky-Target Contrast: •  
 Rain Accumulation (MM): 0.00

b. Event Summary Data  
 Figure 13. (Sheet 2 of 6)

# CONE INDEX:

X,Y Coord (M)  
 SPC  
 Pre-Shot 26 192 308 667  
 Post-Shot 25 70 130 195

## CRATER DATA

Moisture Content: 13.1

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 1.260  
 Apparent Crater: 0.231  
 Flow: 1.029

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.380  
 Flow: 1.040  
 Bottom: 0.975  
 Side: 1.104

## HI VOL DATA (G):

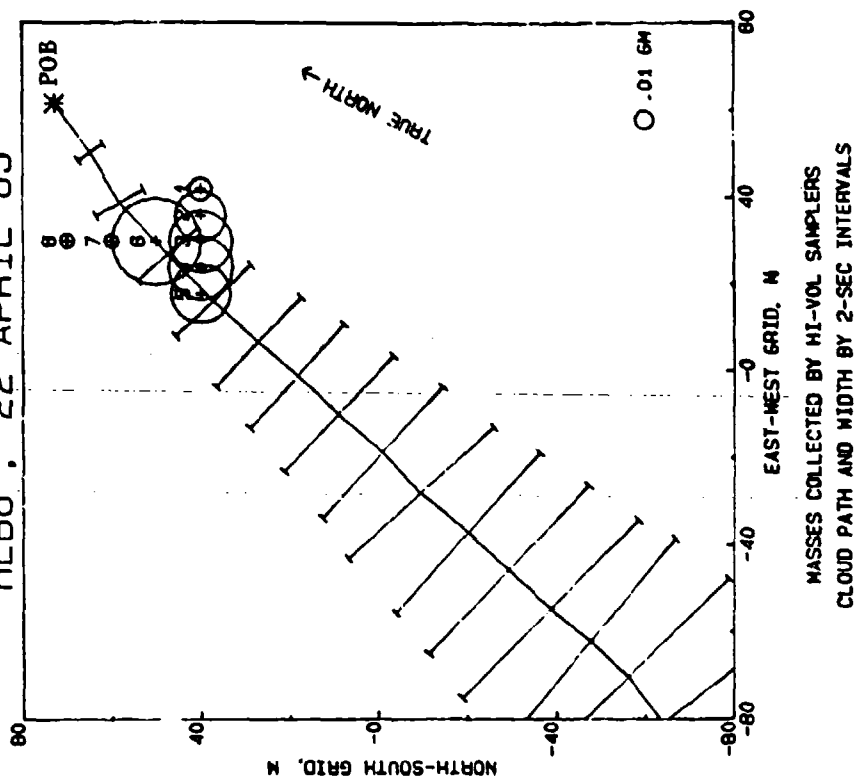
HV1 HV2 HV3 HV4 HV5 HV6 HV7 HV8  
 0.0147 0.0693 0.1081 0.1129 0.0568 0.2123 0.0049 0.0059

SUN: 0.6249

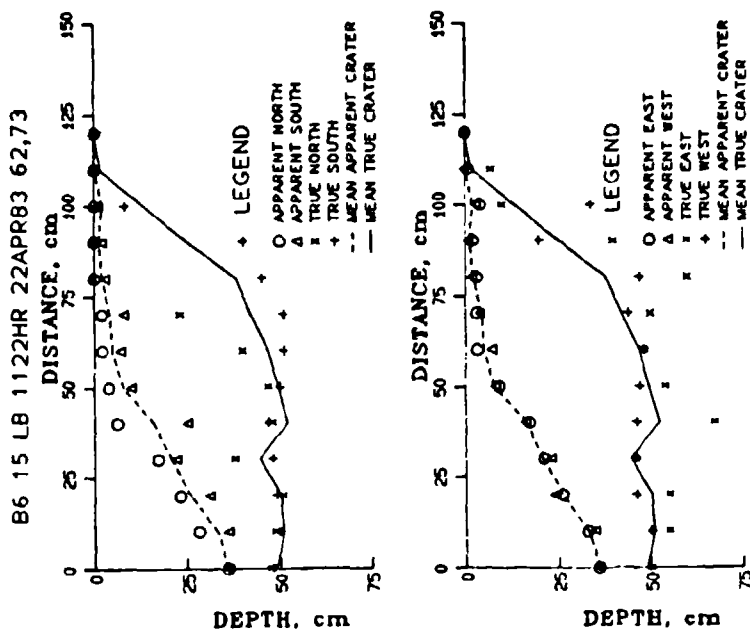
## GELMAN DOSAGE (G S/M<sup>3</sup>):

GELMAN A GELMAN B GELMAN C GELMAN D  
 16.114 55.200 76.961 67.562

HEB6 . 22 APRIL 83

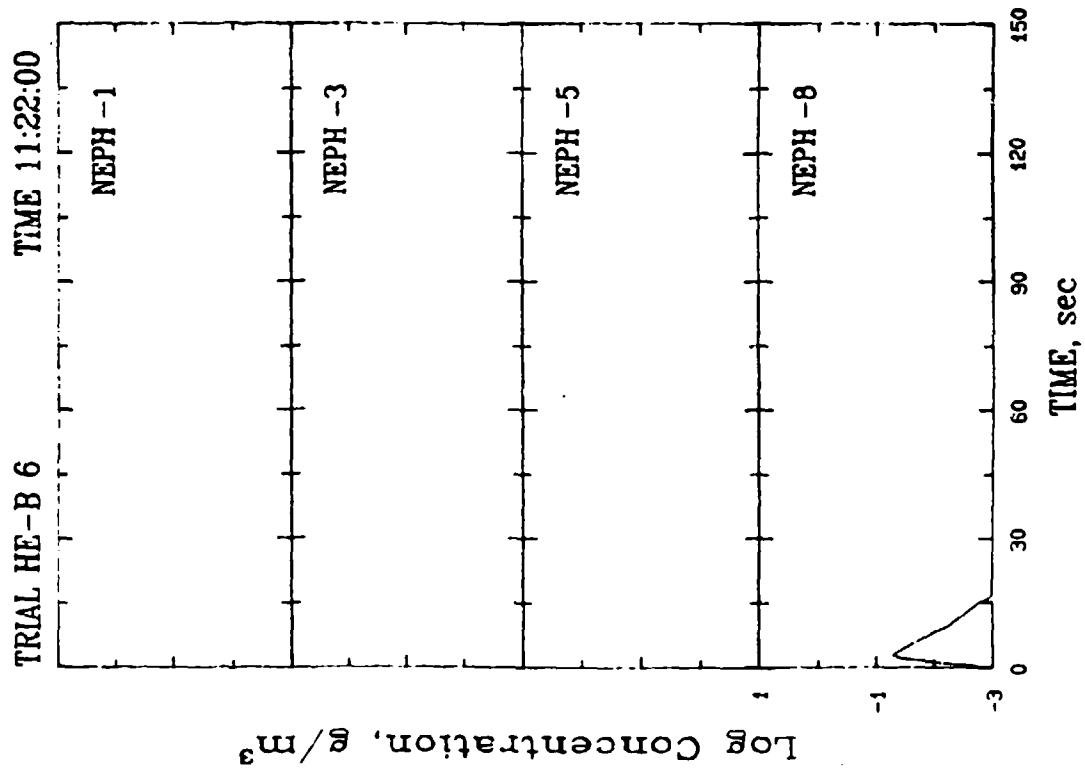


d. Dust cloud masses collected by Hi-Vol samplers with predicted cloud path and width by 2-sec intervals

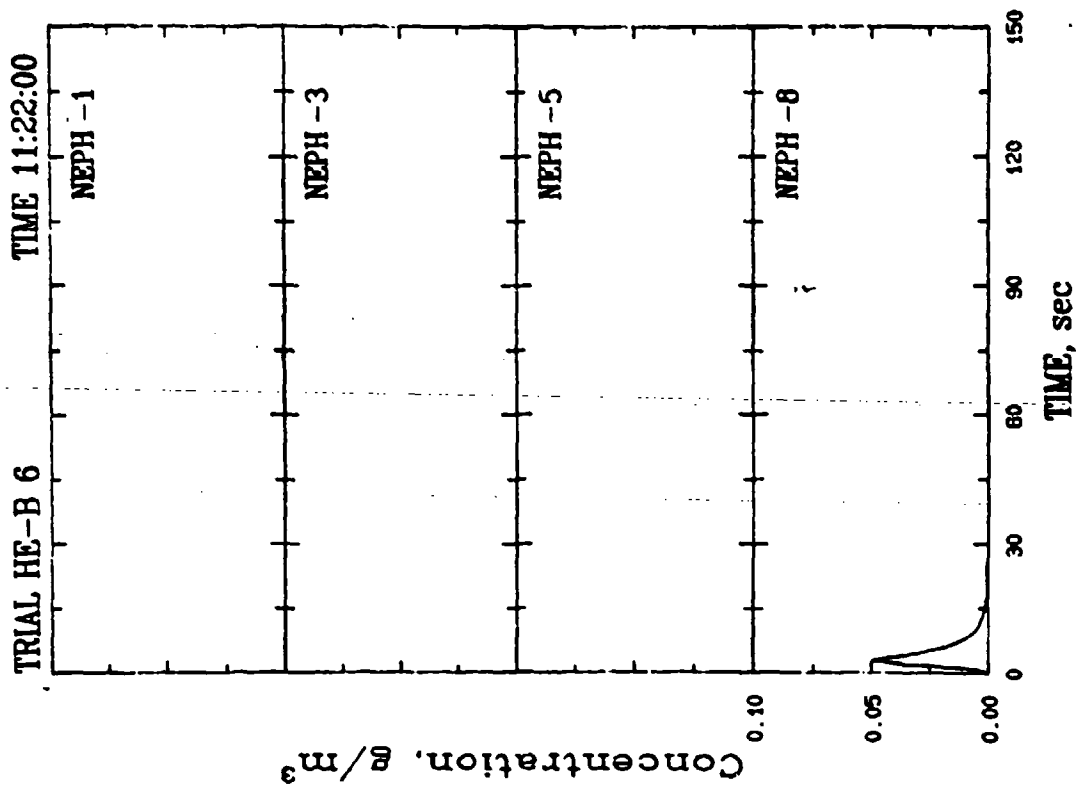


c. Radial crater profile plots

Figure 13. (Sheet 3 of 6)

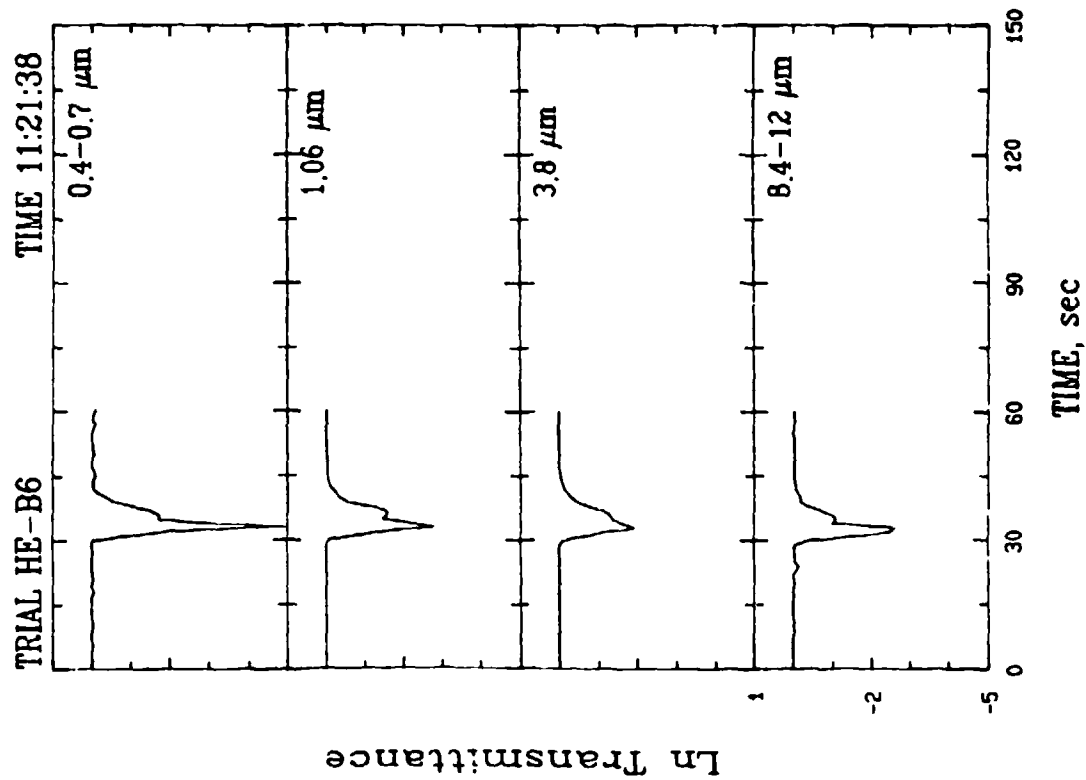


e. Time-dependent nephelometer log concentration plots

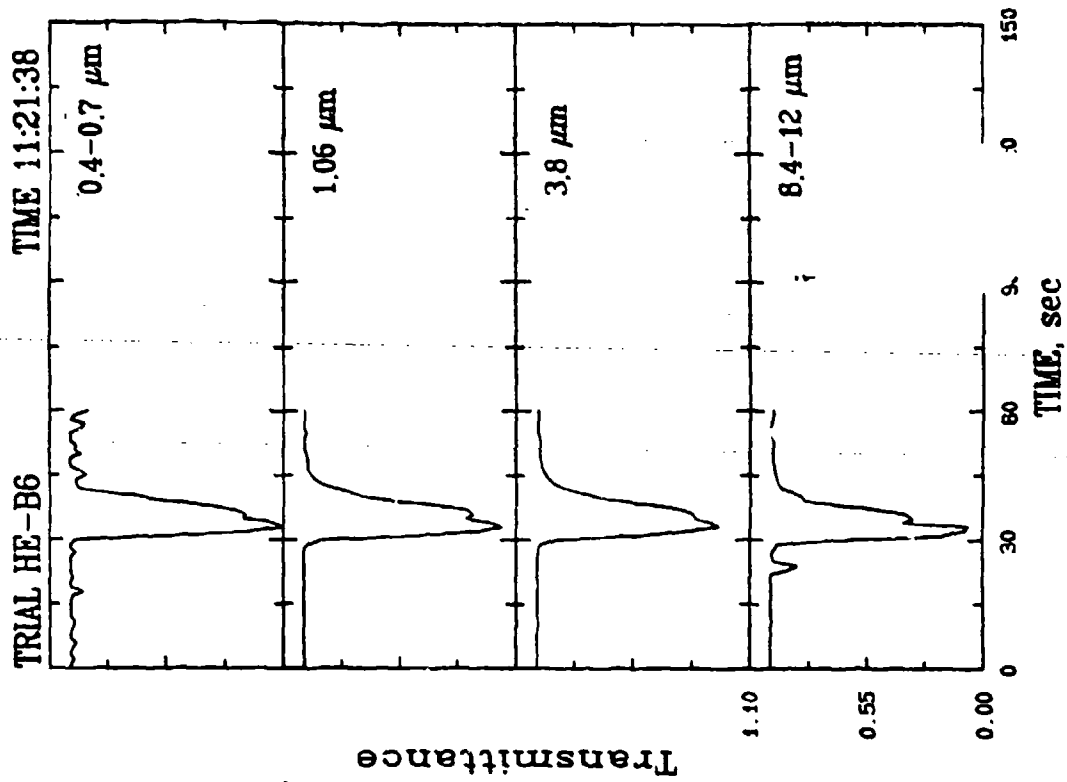


f. Time-dependent nephelometer concentration plots

Figure 13. (Sheet 4 of 6)

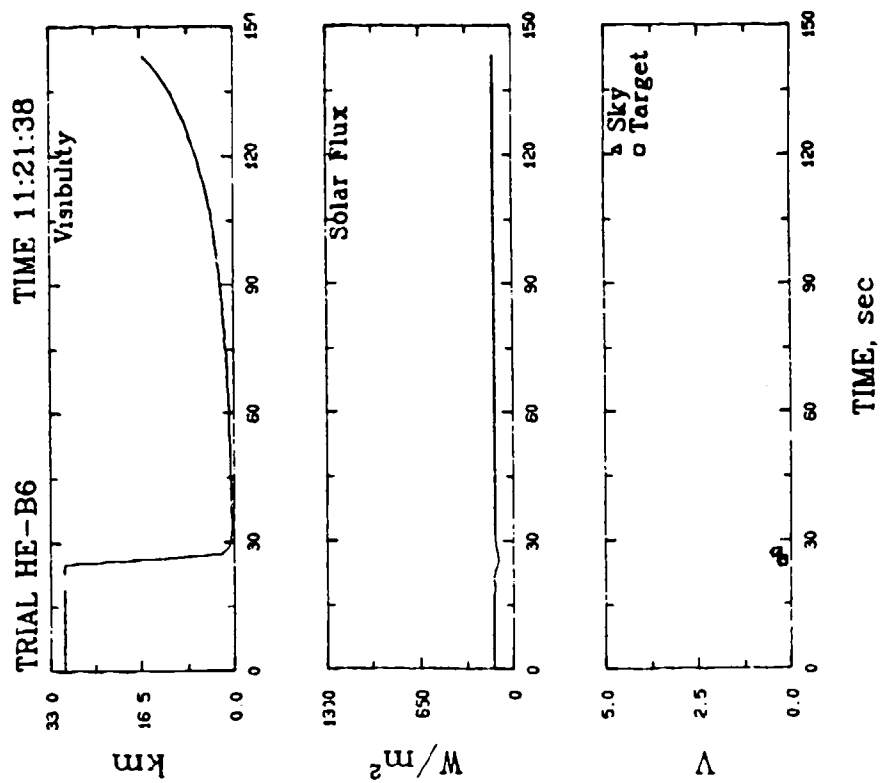


8. Time-dependent natural logarithmic transmittance plots

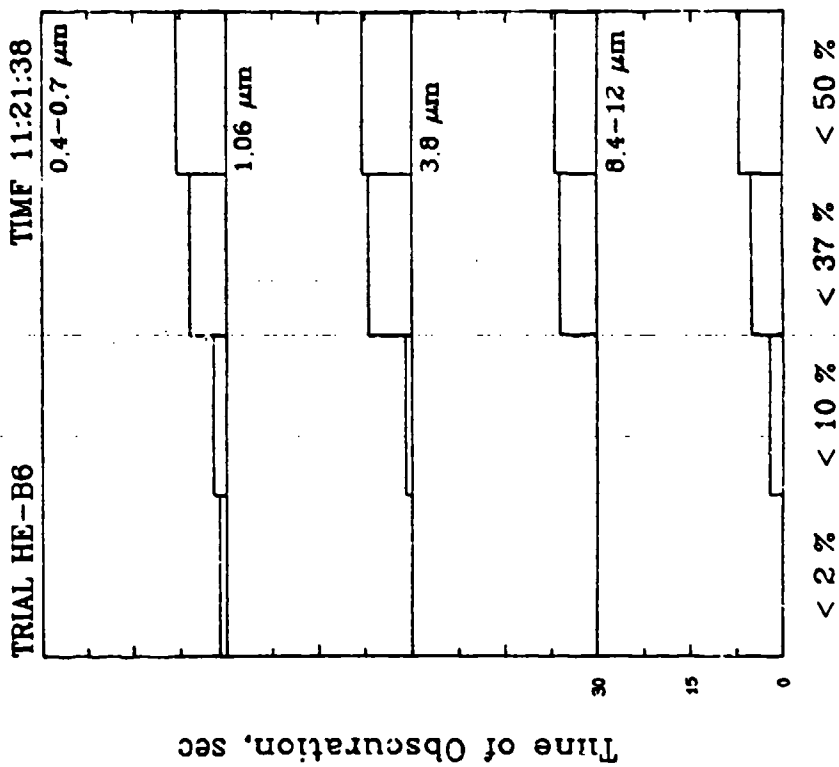


h. Time-dependent transmittance plots

Figure 13. (Sheet 5 of 6)



i. Visibility, solar flux, sky and target voltages



j. Time of obscuration histograms

Figure 13. (Sheet 6 of 6)

## Crater data

25. The crater data include soil moisture content, crater volumes, and soil densities both before and after the shot.
26. *Crater volumes.* A number of different approaches were tested for calculating crater volumes. The approach that apparently yields the most accurate results is a Simpson's rule integration. Four volumes for each crater were determined using a vertical through the crater center as the axis of rotation for each quadrant profile (see discussion of crater profiles below). The calculated volumes defined by the resulting surface of revolution for each quadrant profile were then averaged to yield the volumes presented in this summary. The flow volume refers to the volume of material which includes sheared material ejected with insufficient energy to carry it past the crater rim and ejecta which has fallen back into the crater. The flow volume is the difference between the true crater volume and the apparent crater volume.
27. The flow density given is a mean value of several samples taken from the flow material. Often this is just the mean of the bottom and side flow densities, as given in the event summary table.
28. *Crater profiles (Figure 13c).* Crater profiles, that is, the depths of the apparent and true crater surfaces, were measured along east-west and north-south diameters. The apparent crater was measured from the surface to the crater floor, i.e., the top of the flow in the crater. The true crater was measured from the surface to the point at which the measuring stick was perceived to encounter a significant change in soil structure when pushed through the flow material, i.e., the bottom of the flow material. This measuring technique is expected to yield more accurate apparent crater profiles than true crater profiles. This expectation is confirmed in the large scatter in the calculated true crater volumes (see Part IV, paragraph 46).
29. The crater profile information is displayed in two plots for each shot, one plot displaying the north-south quadrant profiles and the other presenting the east-west quadrant profiles. Apparent and true crater profiles are displayed together for easy comparison. The solid and dashed lines appearing on each plot are formed from averages computed from all four quadrants for the true and apparent craters, respectively.

## Cloud data

30. *High-volume samplers (Figure 13d).* Complete descriptions of the Hi-Vol samplers and reduction techniques are found in the ASL reports on the DOT test. Presented here are the masses (in grams) accumulated by the Hi-Vol samplers for each test shot. Also, the individual Hi-Vol masses for each shot have been added and recorded as "Sum" in the Hi-Vol data presented in the event summary table. This sum has no quantitative significance other than to benchmark the cloud track relative to the sampler array. The Hi-Vol masses and predicted cloud tracks determined from the observed winds are displayed graphically in Appendix A (see following discussion).
31. *Cloud tracks (Figure 13d).* In order to provide a visual representation of each shot, cloud transport and diffusion are displayed with the Hi-Vol sampler data. The transport of the cloud was predicted by use of the 2-sec interval wind speed and direction data acquired at the 2-m level of the 16-m tower. (The Hi-Vol samplers were 1.5 m above the ground.) Assuming a Gaussian cloud, the diffusion is approximated in the horizontal by

$$\sigma_x = uX^2$$

where  $\sigma$ , is the standard deviation in the horizontal direction perpendicular to the wind direction. The coefficients  $a$  and  $b$  are Brookhaven National Laboratory (BNL) parameters (Hanna, Briggs, and Hosker 1982) and  $x$  is the downwind distance.

32. These standard deviations computed with the BNL parameters tend to be representative of the lower portion of the clouds' mass distributions. To support this conjecture, the Hi-Vol sampler positions and their respective recorded masses are also displayed on these plots. The relative Hi-Vol masses are reflected by the areas of the circles centered on the sampler positions.
33. The predicted dust cloud tracks represent remarkably well the paths taken by the individual clouds as confirmed from the video records of the shots.
34. *Nephelometer data (Figures 13e-f).* The nephelometer data for those instruments placed adjacent to the Hi-Vol sampler stations Nos. 1, 3, 5, and 8 are presented as time-dependent plots. A complete description of the instruments and reduction procedures is given in ASL reports of the DOT test (Bruce, Unthank, and Jelinek 1985; Hooek\*). The reduced data in grams per cubic metre are presented here as both linear and logarithmic (base 10) representations. Passage of the shock dust and cloud is easily identified in the nephelometer data. Occasionally, data are missing due to acquisition problems.
35. *Transmissometer data (Figures 13g-h).* As with the nephelometer data, a complete description of the instrumentation and data reduction is found in ASL reports. The transmission data are presented as a function of time in both linear and natural log representations. Shock dust is more difficult to observe in the transmissometer data since the line-of-sight (LOS) was nearly a metre above the nephelometers. However, the shock can be seen in many of the trials. Note that the time at which the transmissometer data start is not the same time as the event time.
36. *Other data (Figure 13i).* Visibility, solar flux, and sky and target voltages were acquired in some of the DOT I events. These data are likewise presented in Appendix A, with the appropriate event, if they were available.
37. *Time of obscuration (Figure 13j).* To estimate quantitatively the obscuration potential of the high-explosive dust clouds, total time of transmission below the 50, 37, 10, and 2 percent levels has been determined from the transmissometer data. These results have been calculated for those clouds which passed between the transmissometer transmitter and receiver in all four bandpasses and are displayed as histograms. These times of obscuration are the actual observed times at the transmissometer LOS and have been neither corrected for wind direction nor normalized to a common wind speed. These modifications to the data are presented later in the text (Part IV, paragraph 85).

#### DOT II Event Data

38. The DOT II (August 1983) data comprise the second part of Appendix A (pages A181-193). The data are grouped by charge sizes with the 15-lb charges designated B and the 25-lb charges designated C. Since there were no 7.5-lb charges, no shots were designated A as for DOT I. No data were recorded for the final DOT II shot because it blew the samplers away and thus no data were collected. DOT II data are not nearly as voluminous as those of DOT I because no

\*Personal Communication, 1984, D.W. Hooek, US Army Atmospheric Sciences Laboratory, White Sands Missile Range, N. Mex.

transmissometer, nephelometer, or high time-resolution meteorological data were taken. Likewise, only eight trials were attempted in DOT II whereas 35 were attempted in DOT I.

39. The field trial identification for DOT II was made by numbering the trials sequentially, including both the vehicular and high-explosive trials. For purposes of this report the trial identification has been altered to match more closely that of DOT I. The high-explosive trials for DOT II are identified by the following notation:

$$HEmp - n$$

where

$m$  = the sequential number of the high-explosive trial starting with  $m = 1$

$p$  = the charge weight identifier, either B (15 lb) or C (25 lb)

$n$  = the charge identifier (A, B, C) if multiple charges were detonated for the trial

Note that the DOT II Event Summary Data tables include the field trial test number in parentheses for cross-reference purposes.

40. Hi-Vol and Gelman sampler data are presented in the WES draft contract report by PEDCo Environmental, Inc., and are therefore not included in this report. The meteorological data, crater profiles, crater volumes, soil densities, soil moisture contents, and cone indices are provided in the DOT II Event Summary Data tables (Appendix A).
41. The summary data are preceded by two graphical representations of the DOT II field coordinate system which mark the sampler line and POBs for the high-explosive shots (see pages A181 and A185). Note that the sampler line was rotated 90 deg after the first three trials in order to adjust for a wind shift. The vertical samplers were positioned by tethered balloons, one between the rightmost two Hi-Vols and one between the leftmost two Hi-Vols. The meteorological station was positioned near the center Hi-Vol.

#### Soil Classification Data

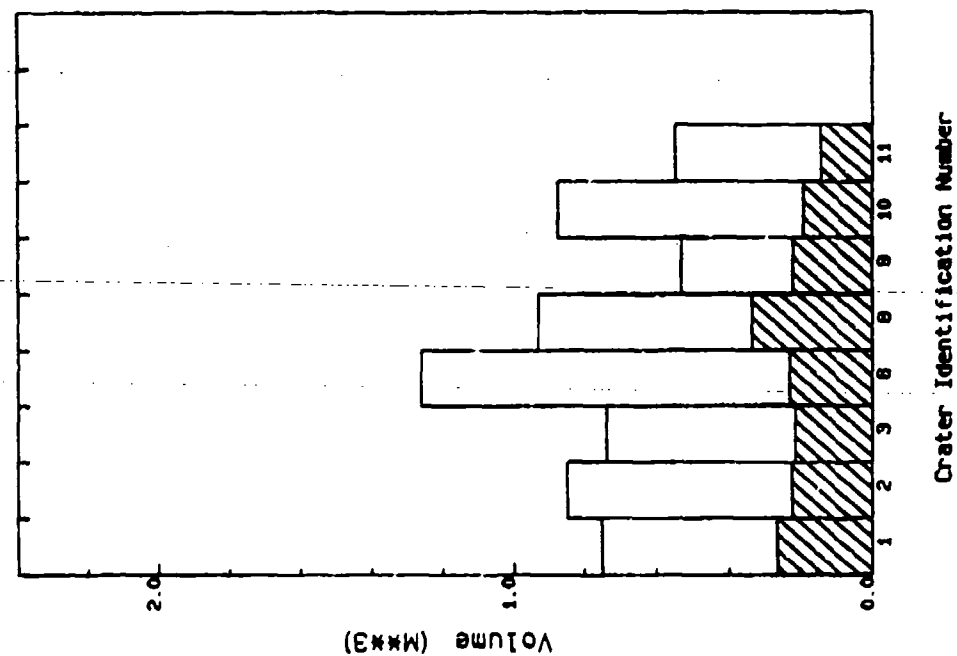
42. Acquisition of data for soil characterization at the DOT sites included soil samples taken at various depths in approximately 2-m-deep pits (dug by backhoe) and in shot craters. Presented in Appendix B are summary tables (pages B3 and B18), pit profiles (pages B4-B6), and soil gradation curves (B7-B17 and B20-B34) from soil samples obtained at the DOT I and II sites. Information provided in the individual curve figures includes the site location and depth of the sample, liquid and plastic limits, specific gravity, and organic content. Mean curves (Figure 5) have been formed for both sites and yield percent finer values of 67 and 60 percent for Sites 1 and 2, respectively. Cone index data acquired at the shot locations are found in the individual Event Summary Data tables of Appendix A.

## PART IV: DATA REDUCTION AND ANALYSIS

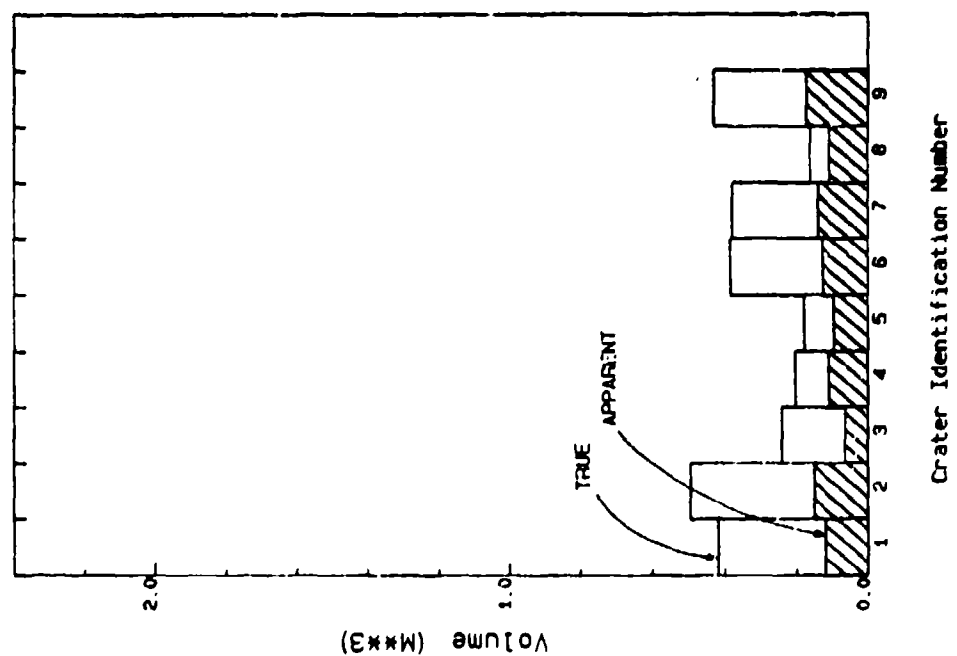
43. One of the most obvious results of a high-explosive surface blast is the excavation of a crater. Consequently, much initial work in field tests similar to DOT sought to infer dust cloud masses from crater volumes under the assumption that only the percent fines less than some specified diameter composed the cloud. It was soon recognized, however, that mass predictions based on this assumption greatly overestimated the cloud masses and that only a very small fraction of the excavated crater volume remains in the sustained clouds.
44. The problem of identifying relationships among explosive charge weights, crater volumes, and resulting dust cloud masses is complicated by a host of variables that include soil compaction during crater formation, fallback material into the craters, soil/terrain properties, and ejecta which does not become part of the sustained clouds. Because of the compounding factors and the fact that only a small fraction of the excavated mass remains lofted, a large error potential exists in formulating charge weight-crater volume-cloud mass relationships. The DOT test was designed to minimize the errors in defining these relationships by providing direct measurements of dust cloud mass loading in both the horizontal and vertical planes. The results of the DOT data analysis are presented below.

### Crater Volumes

45. Twenty-nine crater profiles were measured during DOT I, and 10 such profiles were measured during DOT II. Appendix A contains plots of the individual profiles, and the measurement procedure is described in Part III of the text. From the profile data, true and apparent crater volumes were calculated using a modified Simpson's rule. Table 3 includes these calculated volumes as well as soil densities, moisture contents, bulking factor (i.e., the ratio of pre-shot to post-shot densities), and volumes normalized to the charge weights.
46. Figures 14a-d (DOT I) and 15a-b (DOT II) provide histograms of the true and apparent volumes determined for the individual craters; Figures 16a-d present plots of these volumes versus explosive charge weights. The DOT I volumes show a wide scatter in true volumes, while the apparent volumes show much more consistency. This result suggests that the true crater profiles determined from the DOT I tests probably were more prone to measurement error than the apparent crater profiles. A possible cause for the inability to measure the true profiles more precisely may be that substantial fracture zones were established at the true crater boundaries, thereby causing an ambiguity in the determination of the boundaries. That is, the depths for the true crater profiles were not measured directly; they were determined by forcing a graduated range pole through the loose material commonly called fallback. Thus, overestimations were possible should the pole be overextended into the true crater "fracture zone" or underestimations were possible should the vertical path to the true crater boundary be blocked by dense fallback material. In contrast to the DOT I volumes, the true crater boundaries measured in DOT II appear to be more consistent from crater to crater.
47. Additional differences between the DOT I and DOT II craters are highlighted by calculating mean crater profiles for each charge weight. Four profiles were measured from the center of the crater to past the crater rim along north-to-south and east-to-west radii (see Part III, paragraph 28). These four radii profiles, one for each quadrant of the crater, were generated to employ the modified Simpson's rule techniques to calculate the crater volumes. Mean profiles (true and apparent) presented in Figures 17a-f have been calculated for each charge weight group and detonation configuration (i.e., ST or STB) by averaging all quadrants of all craters in their respective groups.

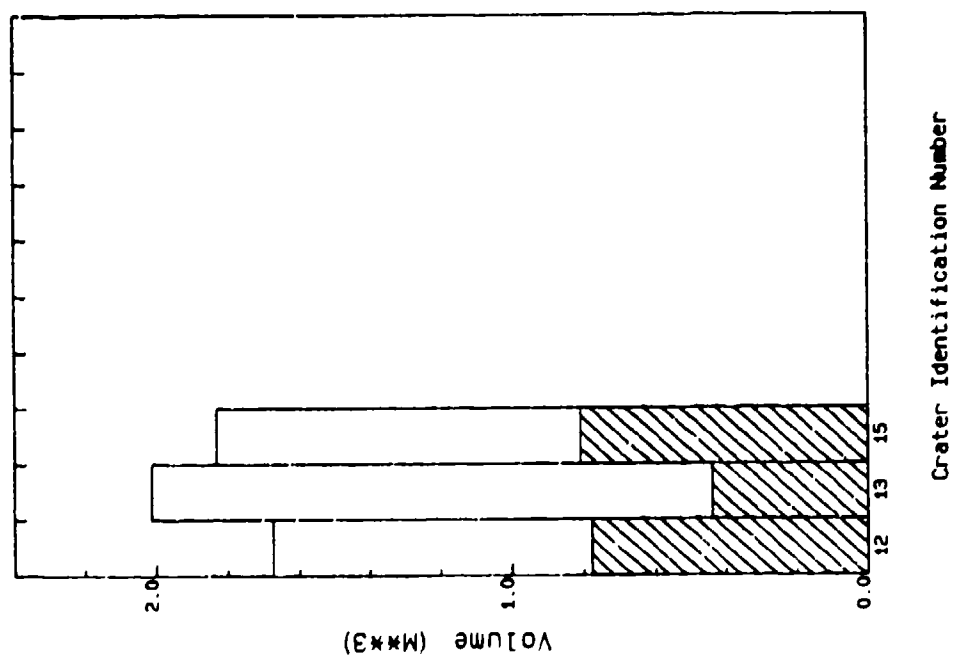


a. 7.5-lb charge

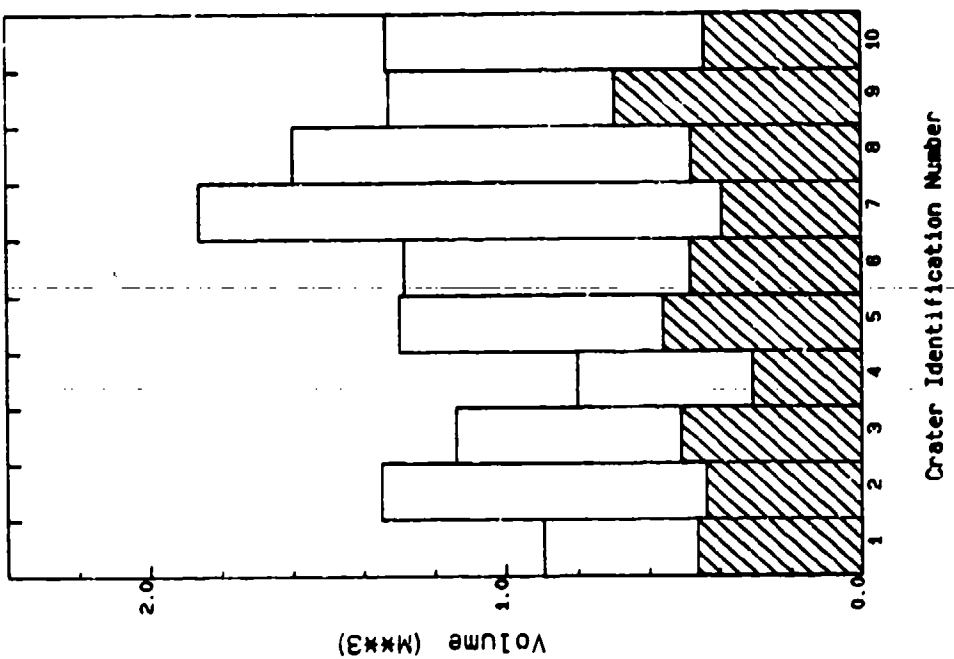


b. 15-lb charge

Figure 14. Volumes of true and apparent craters, DOT 1 (April 1983) (Continued)

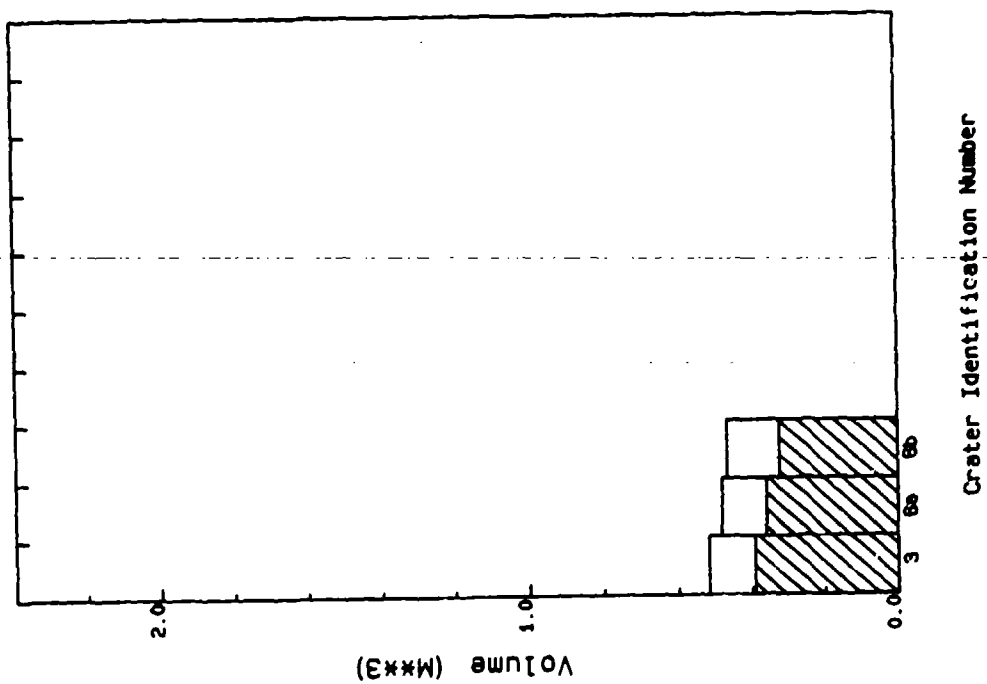


c. 15-lb charge

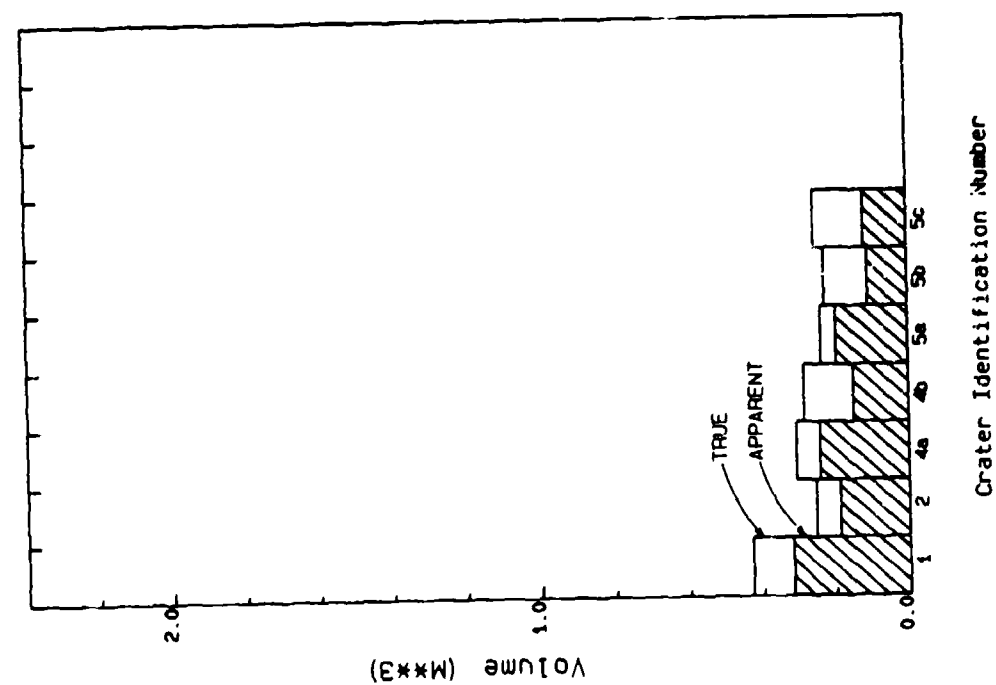


d. 25-lb charge

Figure 14. (Concluded)

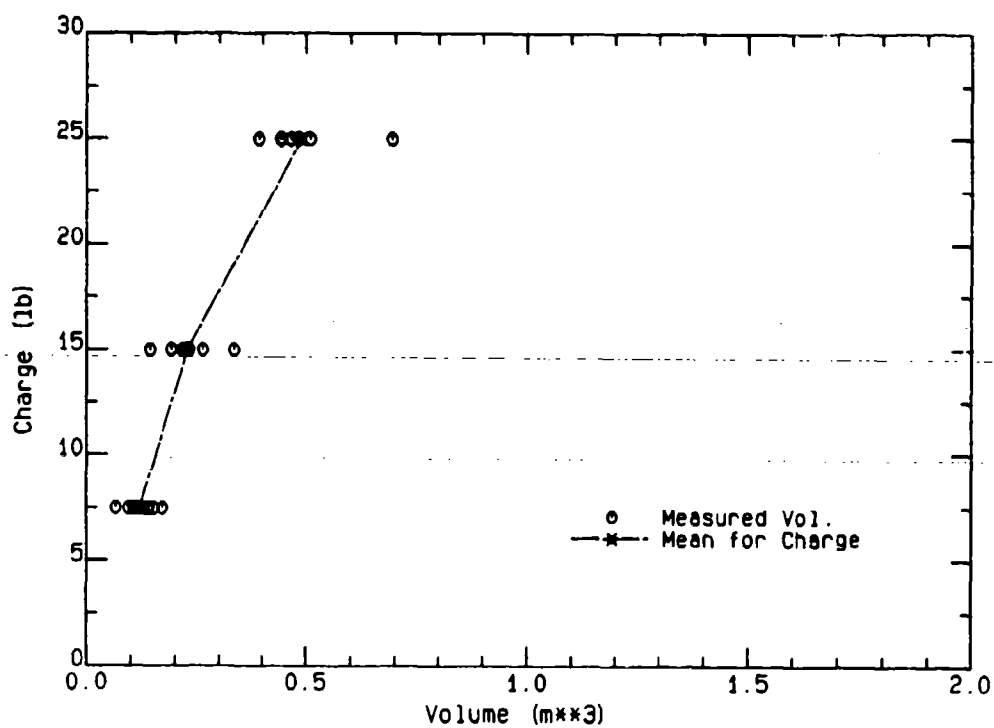


a. 15-lb charge

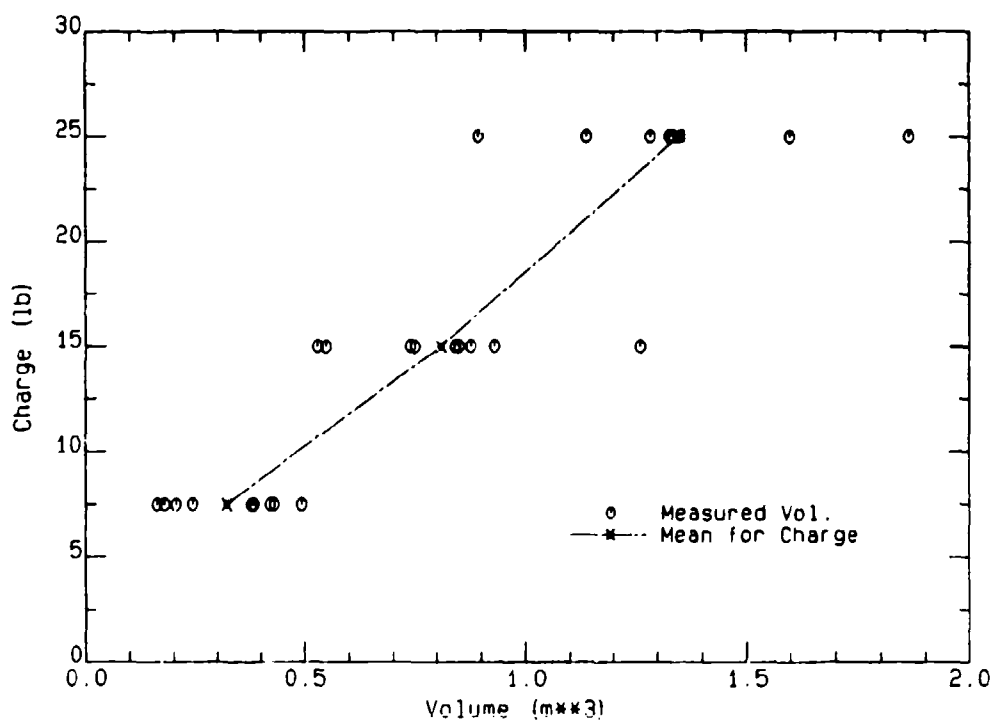


b. 25-lb charge

Figure 15. Volumes of true and apparent craters, DOT II (August 1983)

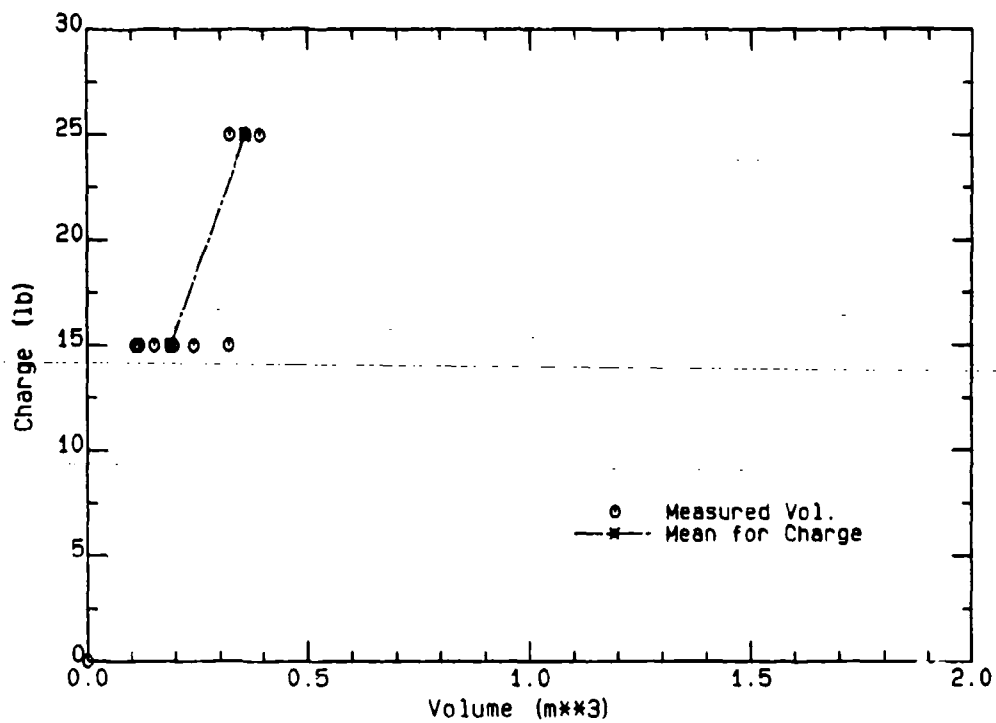


a. Apparent volume, DOT 1

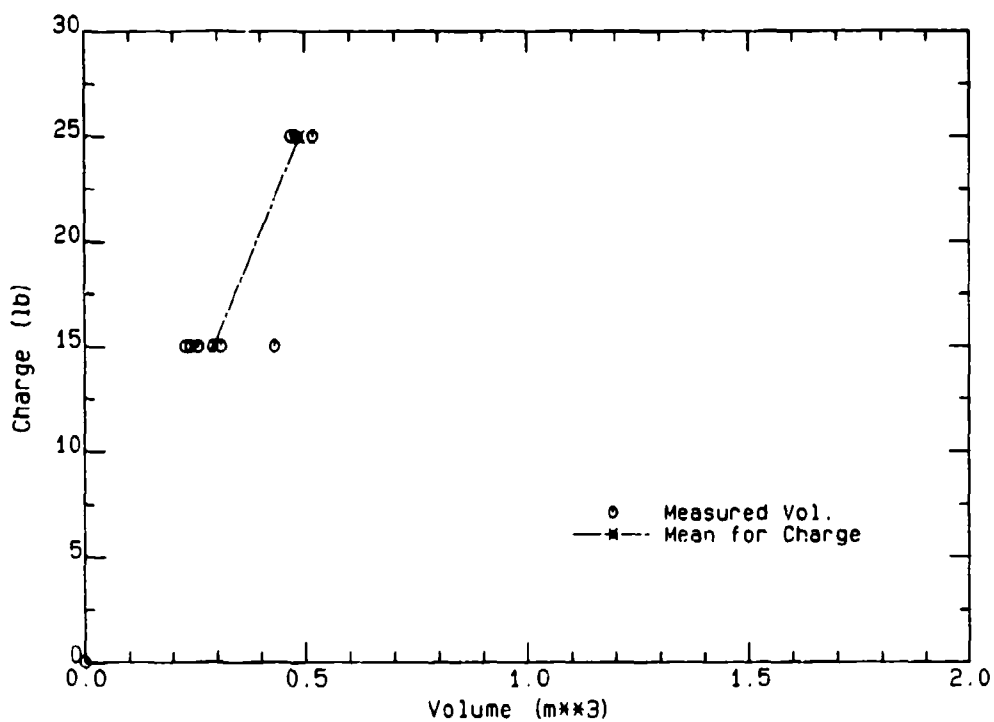


b. True volume, DOT 1

Figure 16. Plots of apparent and true crater volumes versus charge weights (Continued)

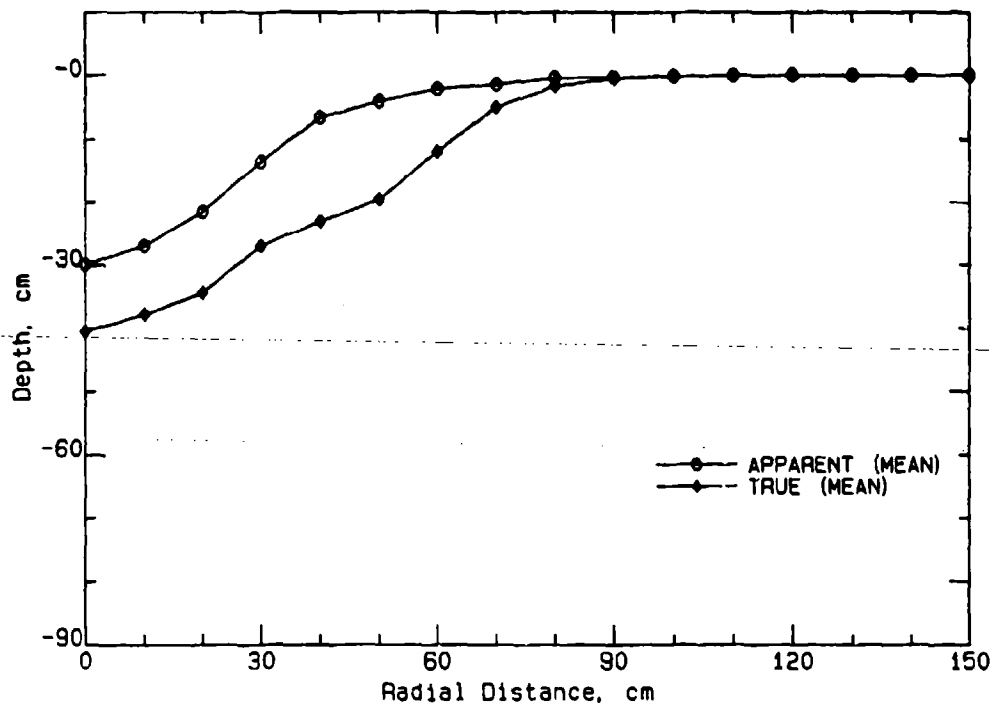


c. Apparent volume, DOT II

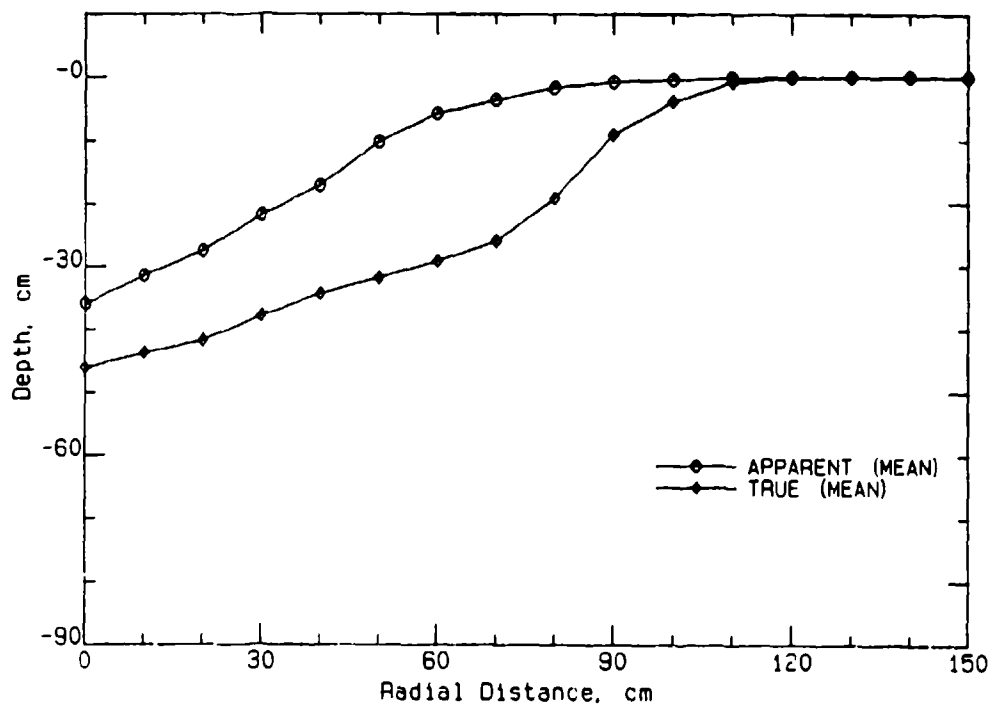


d. True volume, DOT II

Figure 16. (Concluded)

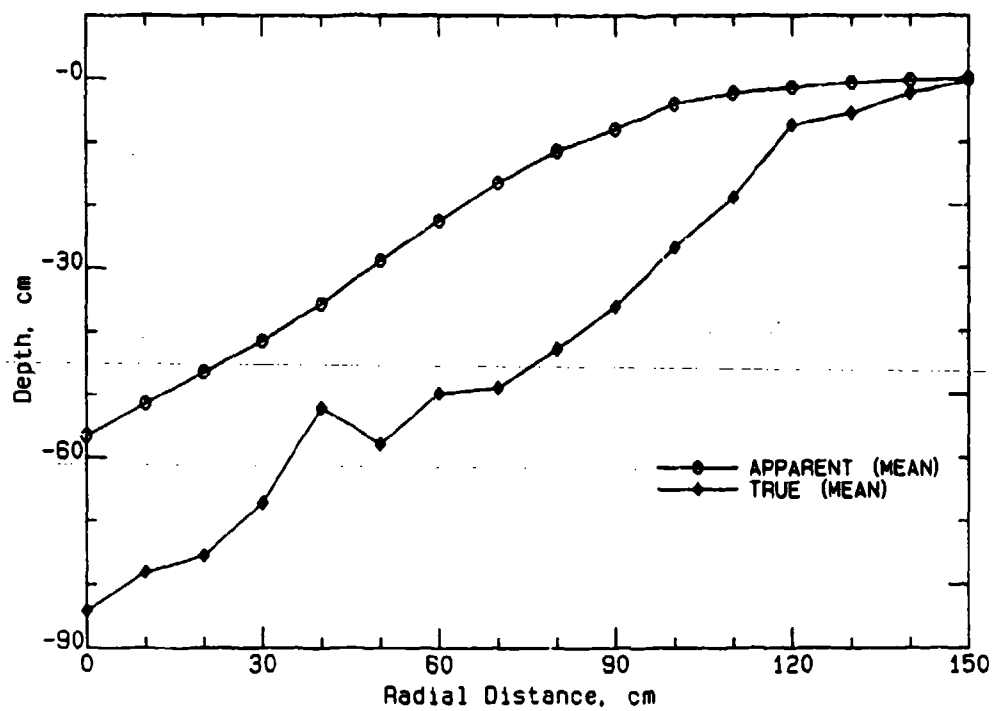


a. "A" shot (ST) profiles, DOT 1

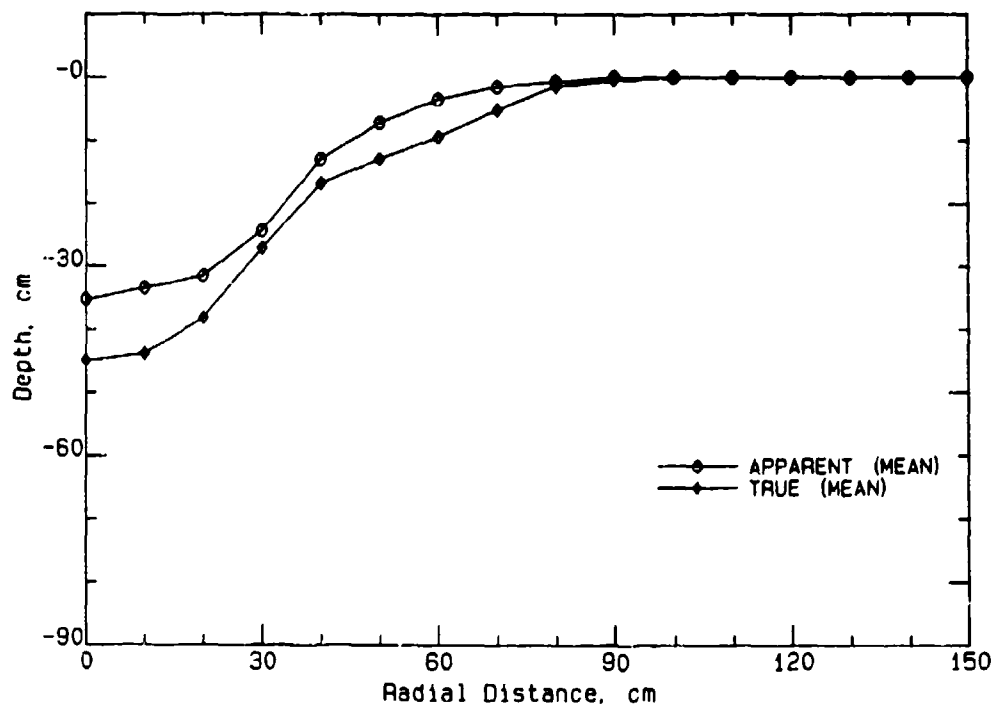


b. "B" shot (ST) profiles, DOT 1

Figure 17. Mean (apparent and true) shot profiles (Sheet 1 of 3)

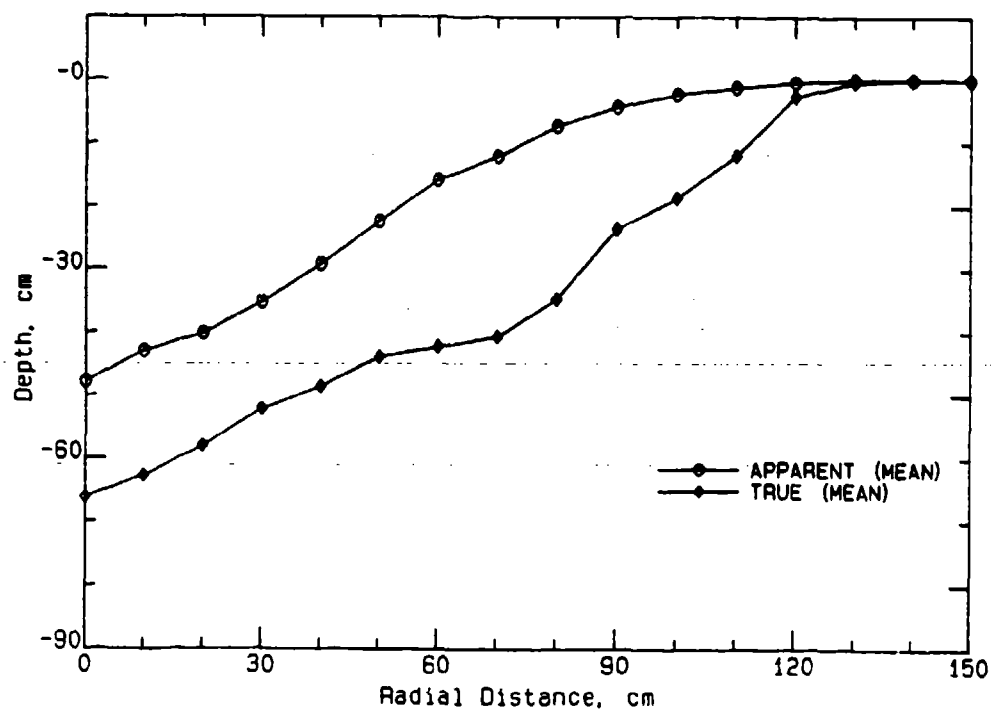


c. "B" shot (STB) profiles, DOT I

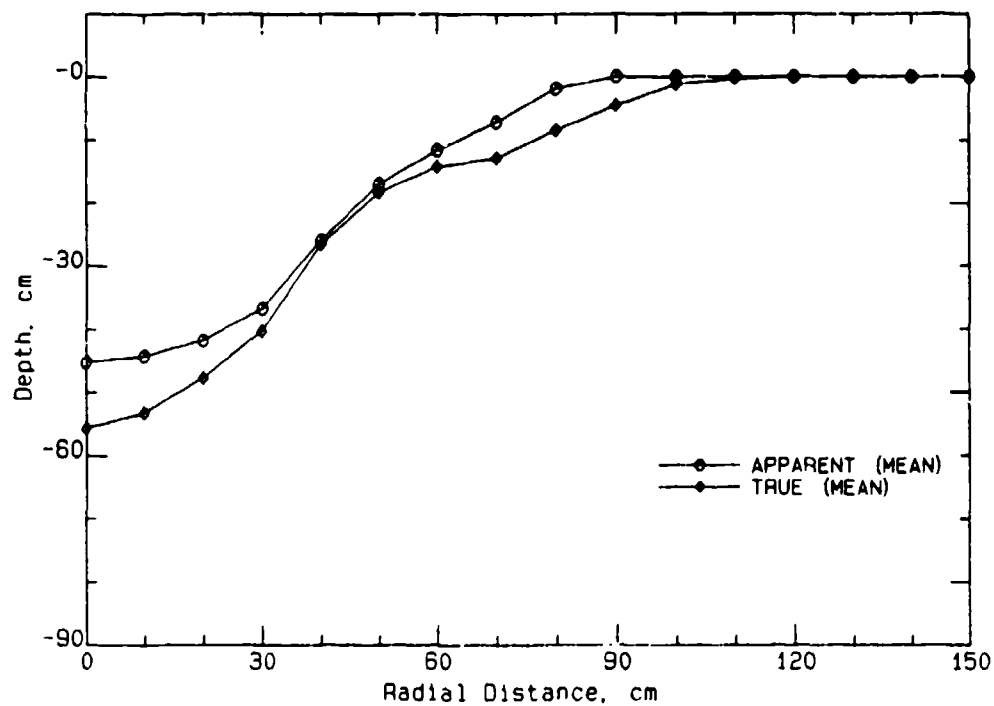


d. "B" shot (ST), DOT II

Figure 17. (Sheet 2 of 3)



e. "C" shot (ST) profiles, DOT I



f. "C" shot (ST) profiles, DOT II

Figure 17. (Sheet 3 of 3)

48. Comparison of the mean profiles for similar charge weights shows distinct differences in crater profiles between DOT I and DOT II, both in shape and resulting volumes. These differences are particularly striking for the true crater profiles, with the DOT I profiles showing a distinct "shelf" as opposed to the smooth profiles of DOT II. The volumes calculated from these mean profiles are given in Table 4 and are compared to the mean volumes found by averaging the individually determined volumes found in Table 3. Note that no significant differences are found in the mean values for the two methods. The effect of burying the charges (STB) on the crater volumes is also illustrated by the mean crater profiles, as the 15-lb STB shots typically created much larger craters than even the 25-lb ST shots.
49. Two factors that have been identified as likely contributors to the differences in the DOT I and DOT II craters are (a) the existence of a hardpan approximately 10 to 20 cm below the surface at the DOT I site and (b) the difference in soil densities between the two sites.
50. The hardpan layer at the DOT I site was noted by field workers as they encountered and broke through this layer while acquiring CI data. This region was relatively thin (several centimetres) as it cannot be identified in the CI data. The shelf seen in the DOT I crater profiles, particularly in the A shots, is undoubtedly a manifestation of the hardpan zone. The hardpan is also likely to be the cause for the greater than usual height obtained by the ST shots. The shape and height of the clouds generated by ST shots during DOT I resembled buried shot clouds seen in earlier high-explosive tests (e.g., DIRT [Dusty Infrared] tests).
51. The second difference between the two sites noted above was in soil density. Site 1 had a mean pre-shot surface soil density of approximately 1.4 g/cm<sup>3</sup> (1.22 g/cm<sup>3</sup> dry) while the DOT II mean site density was approximately 1.75 g/cm<sup>3</sup> (1.58 g/cm<sup>3</sup> dry). The soil moisture contents measured at the two sites were nearly the same, with values of 14 percent and 10 percent for Sites 1 and 2, respectively. The resulting voids ratios (the volume of voids divided by the volume of solids) for the two sites are calculated to be approximately 1.2 and 0.7.
52. Additional differences between the two sites include slightly different soil characteristics and surface soil grain sizes (see Figure 5).
53. Regardless of the causes for scatter in true crater volumes and differences in crater profiles, the relative consistency of the apparent crater volumes is encouraging, implying that for a given charge weight and set of site/soil properties, a predictable apparent crater volume will be formed. This leads to a simple calculation for the mass excavated by the explosions. By ignoring complicating effects such as soil compaction in the true crater, the excavated mass is computed by simply taking the product of the dry pre-shot soil density and the apparent crater volume. Table 5 displays the results of these calculations and shows that approximately equivalent amounts of mass have been ejected for similar charge weights in both DOT I and DOT II. An oversimplified physical argument would conclude that the energy available from a given charge will remove a well-defined amount of mass, given similar soil characteristics. Similar charges detonated in terrains quite different from the Fort Carson area may produce different results. Nevertheless, the Fort Carson study provides very important data for quantifying a charge weight-mass ejecta relationship.
54. The DOT crater data provide information for verifying charge weight/crater volume algorithms previously developed and currently used in various DoD models. A widely used algorithm is that of the EOSAEL 82 COMBIC module (Hoock et al. 1982) which is expressed as:

$$V = SW^{1.111}$$

where  $V$  is the crater volume, in cubic metres;  $S$  is a scaling factor, dimensionless, reflecting site variability; and  $W$  is equivalent weight of charge, in kilograms TNT. Figure 18 displays the mean apparent crater volumes from DOT as functions of charge weight in equivalent kilograms of TNT. The dashed line in Figure 18 represents the 1.111 power law used by the EOSAEL 82 COMBIC module. While the power law seems to describe the relationship quite well, the actual COMBIC predictions for the Fort Carson crater volumes are high. This is a result of the rather coarse grid offered by COMBIC for setting the scaling factor coefficient. Therefore, the future focus of the charge weight/crater volume studies should be directed toward refinement of the scaling factor.

55. Correlations between crater volumes and soil density or soil moisture content were not evident in the DOT data. This is a reflection of the similarity in soil types and grain sizes between Sites 1 and 2 and the rather narrow range of soil moisture contents. Figures 19 and 20 present the soil density and soil moisture content data from DOT as functions of the normalized apparent crater volumes, i.e., the apparent crater volumes divided by the charge weight. In the data collected in the DOT tests, at least, it is apparent that soil densities and range of moisture contents had negligible influence on crater volume.

### Dust Clouds

56. The focal point of the DOT test was the characterization of the dust clouds in context of source generators and site/soil factors. Mass loading, cloud masses, cloud structure, and cloud optical properties have been studied from the acquired data. The following paragraphs present the dust cloud analysis for DOT I and DOT II.

#### Mass extinction coefficients

57. The mass extinction coefficients presented in Table 6 are courtesy of Dr. Donald Hooch, ASL, White Sands Missile Range. Hooch first identified those dust clouds which passed through the interior of the Hi-Vol sampler line 1 through 5 from video tapes. This ensured that a cloud profile could be determined with good confidence. Trials A7, A8, B4, B5, B6, B10, B13, and C4 were found to meet this requirement. Path integrated dosages ( $\text{g} \cdot \text{sec}/\text{m}$ ) were determined for these trials as well as integrals of the negative of the natural log of transmittance (at each wavelength band) over the time the transmittance was between 85 percent and 0.1 percent. The ratio of the transmittance integration to the dosage integration yields the mass extinction coefficient as presented in Table 6.
58. Hooch notes these coefficients will be somewhat underestimated if the dust is more concentrated at the 1.5-m level (Hi-Vol samplers) than at the 2.5-m level (transmissometer LOS) and somewhat overestimated if the converse is true. Details of these calculations will be found in the ASL final DOT report.\* We also note that the presence of significant amounts of burn products (e.g., carbon) along the transmissometer LOS causes the coefficients to be overestimated. Unfortunately, no data concerning the amount and type of burn products mixed in the dust cloud exist.

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\*Personal Communication, 1984, D.W. Hooch, op. cit., p 24.

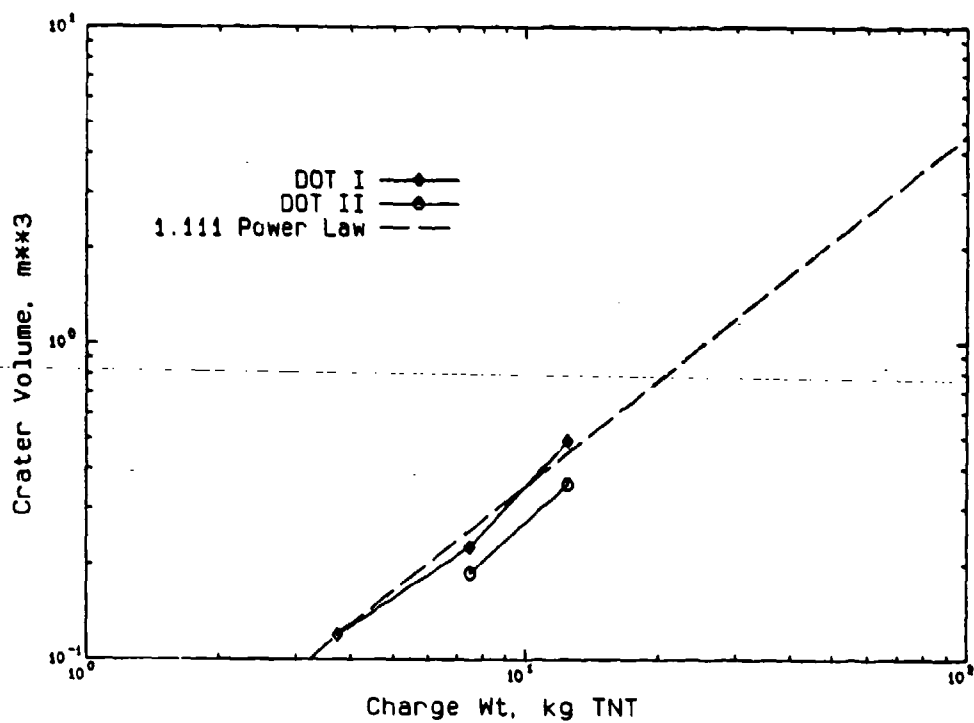


Figure 18. Mean apparent crater volumes as a function of charge weight

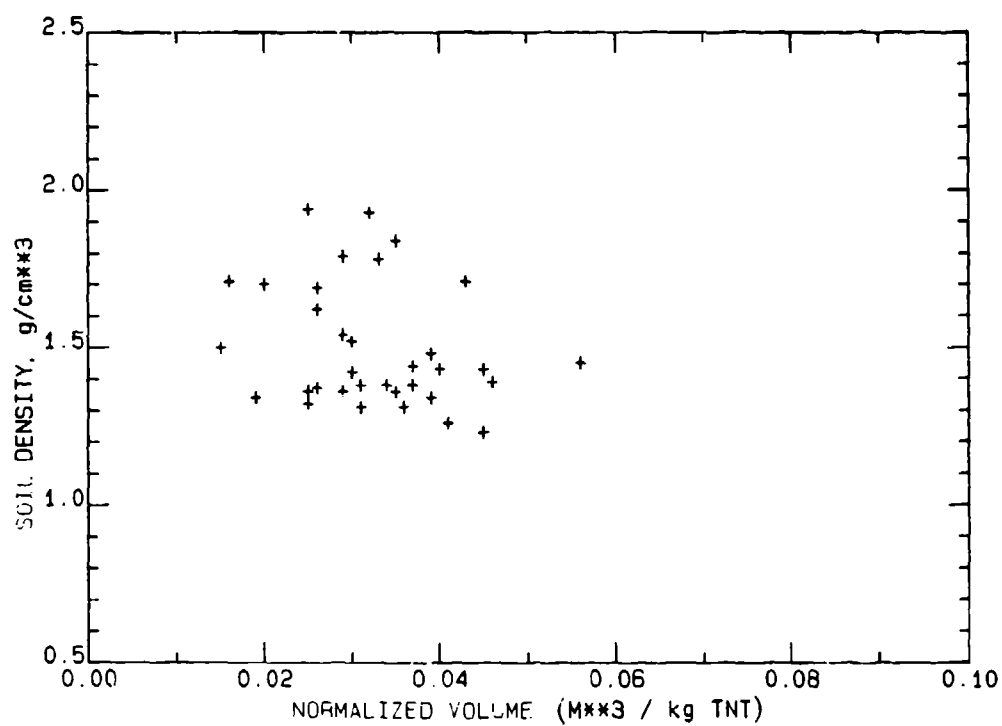


Figure 19. Soil density compared to normalized crater volume

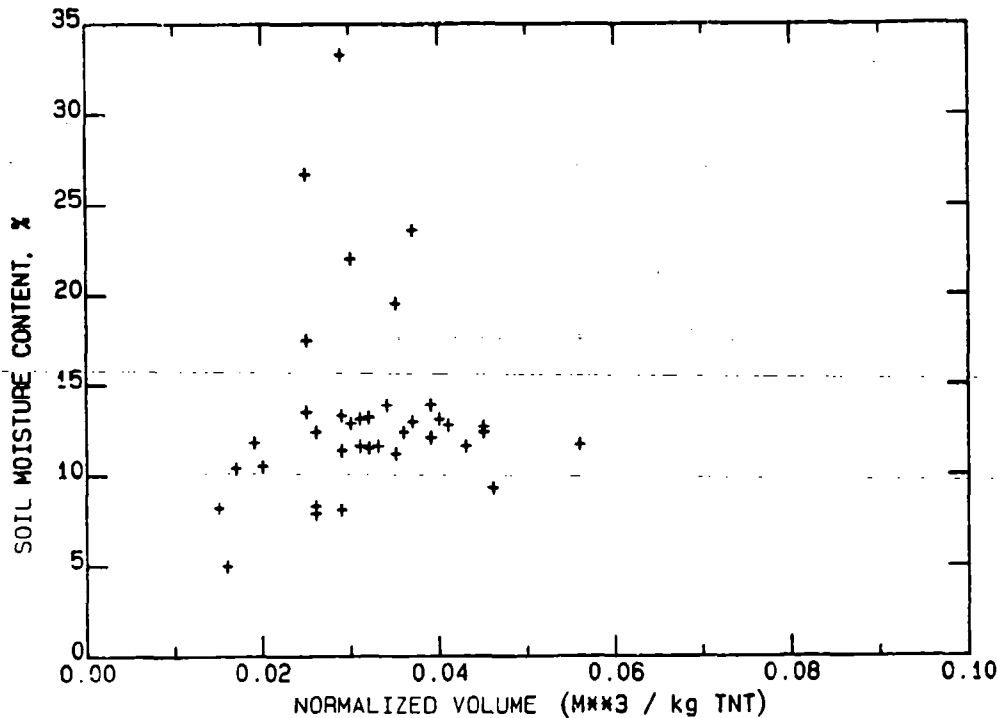


Figure 20. Soil moisture content compared to normalized crater volume

#### Dust cloud masses

59. The determination of accurate dust cloud masses has been proven to be difficult and inexact in past tests. Consequently, a new strategy was formulated for evaluating the DOT-generated clouds (see Hooek and Kennedy 1983). Much of the measuring difficulty lies in the individuality of each cloud, both in structure and dynamics. Although general geometries, structure, and dynamics exist, the effects of micrometeorology, local perturbations in terrain and soil, and any existing peculiarities of explosive charges all contribute to the uniqueness in detail of individual clouds. (A survey of the video tapes reveals the extent of this problem.) Thus, a rather large scatter in mass determinations was expected, making different and independent calculations highly desirable.
60. The cloud masses presented in this report are independent calculations provided by Dr. Don Hooek and Dr. Charles Bruce et al. for the DOT I data and by PEDCo Environmental, Inc., for DOT II. Although cursory comments outlining the different mass calculation approaches are made here, reference is made to the appropriate final reports (Bruce, Unthank, and Jelinek 1985; Hooek\*; PEDCo Environmental, Inc. 1985) for complete descriptions of the computations.
61. Hooek's approach for calculating cloud masses utilizes the transmissometer data by computing the total mass of dust in a 1-m-thick layer at 2.5 m above the ground (the transmissometer LOS).

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\*Personal Communication, D.W. Hooek, *ibid.*

The working equation for computing this layer mass is given by

$$\frac{dm}{dz}_{2.5} = \frac{-v_r \int_0^t \ln T(\lambda) dt}{\alpha(\lambda)}$$

where

$\frac{dm}{dz}$  = rate of change of mass, g, with height, m

$v_r$  = speed of cloud perpendicular to the LOS, m/sec

$T(\lambda)$  = transmittance (0 to 1) at wavelength  $\lambda$

$t$  = duration of test, sec

$\alpha(\lambda)$  = mass extinction at wavelength  $\lambda$ ,  $m^2/g$  (see Table 6)

62. The perpendicular velocity was determined both from the meteorological data as well as from the time it took for the dust to reach the transmissometer LOS and the perpendicular distance from the detonation point to the LOS. As those velocities were always different, giving two values of  $dm/dz$  for each shot, the average value was computed. The final step in the calculations involves the assumption that for well-defined cloud shapes the mass loading was constant with height. Then, from the heights of the clouds measured from the video tapes, masses were calculated from

$$M = (dm/dz) Z$$

where

$M$  = mass, g

$dm/dz$  = rate of change of mass, g, with height, m

$Z$  = height of the cloud, m

63. Several caveats to this approach are noted. First, the assumption of the mass loading consistency with height is only a working approximation. The vertical samplers do not support this assumption for individual clouds but indicate a variety of distribution profiles. Second, the cloud heights used were measured from the surface to the top of the visible clouds. There is currently supporting evidence from the vertical samplers that dust does not exist in significant amounts to the heights indicated by the visible cloud tops. The upper cloud regions are black for most shots, as opposed to the brownish lower portions of the clouds. This suggests that most of the upper part of the clouds may be burn products of the munition and contains little dust. The question of height of the dust in the cloud is reconsidered below.
64. The Bruce calculations are somewhat more involved than the previously described Hooek method and have required a number of assumptions and approximations in reducing the data. Therefore, the reader should refer to the Bruce, Unthank, and Jelinek (1985) final DOT report for details of the cloud mass calculations, as the analysis will be only briefly discussed here.
65. The principal data required by Bruce are the Hi-Vol sampler and nephelometer data that have been used to map density profiles of the dust clouds in both the horizontal (at 1.5 m) and vertical planes. From the video tape as well as the sampler array information, only those clouds which passed through the sampler arrays (vertical and horizontal) and maintained manageable geometry were selected for analysis. The dosage (and density) profiles as provided by the horizontal

samplers suggest a Gaussian distribution in the clouds. Thus, the following distribution function was adapted:

$$q_{1.5}(r) = q_{1.5}(0) \exp(-r/r_0)^2$$

where

$q_{1.5}(r)$  = density in the horizontal plane at 1.5 m and at a distance  $r$  from maximum density,  $\text{g/m}^3$

$q_{1.5}(0)$  = maximum density in the 1.5-m horizontal plane,  $\text{g/m}^3$

$r$  = distance from point of maximum concentration, m

$r_0$  = distance at which the density is  $e^{-1}$  of the maximum density, m

66. While the vertical profiles were neither consistent nor easily characterized, heights which significant amounts of dust reached were determined with a straightforward extrapolation of the implied profiles. The heights obtained in this manner gave quite repeatable results and, in general, strongly suggest that the maximum altitude acquired by significant dust is generally much lower than the visible top of the clouds (see Table 7).

67. Two algorithms were selected in calculating the cloud masses, both of which assumed circular cylindrical symmetry. The first, termed the rectangular method, is given by

$$M = \pi r_0^2 Z q_{1.5}(0)$$

where

$M$  = total mass of the cloud, g

$Z$  = height of dust in cloud, m

68. This approach assumes every horizontal slice has exactly the same central (maximum) density as the 1.5-m slice. This approach was formulated for comparison with the cloud masses determined by the Hooek method and ignores the vertical structure of the clouds. The vertical samplers, however, indicate that the maximum concentration is a function of height. This function is apparently highly variable and must be formulated for each cloud.

69. The second Bruce algorithm attempts to account for the functional height dependence and is written:

$$M = \int q(r, \theta, z) r dr d\theta dz$$

or

$$M = \pi q_{qv} r_0^2 \int_0^1 F(z) dz$$

where

$q_{qv}$  = peak concentration in the cloud,  $\text{g/m}^3$

$F(z)$  = functional form of the vertical concentration profile from graphical fit

70. The peak concentration  $q_{qv}$  was calculated from the ratios of the peak vertical and horizontal dosages as determined from the profile fits multiplied by the maximum concentration at 1.5 m. This is expressed as

$$q_{qv} = q_{1.5}(0) (D_v / D_{1.5})_{\max}$$

The dust particle masses determined by this algorithm are similar but, in general, slightly smaller than by the rectangular algorithms.

71. The PEDCo Environmental, Inc., calculations are similar to the second Bruce algorithm. Both horizontal and vertical concentration profiles are used to integrate over the cloud volumes. Unlike DOT I, a number of cloud masses were determined for multiple-shot trials. These multiple-shot cases are not used in the comparisons made below.
72. Table 8 compares the results of the mass calculations made for DOT I and DOT II. While mass means from the Bruce and PEDCo Environmental determinations seem to agree, the Hooch mass means are almost a factor of four larger. If Hooch's masses are recalculated using the cloud heights suggested by the vertical samplers instead of the visible cloud tops (see Table 7), the Hooch masses are reduced by approximately 40 percent. These recalculated masses are listed as "modified Hooch" masses in Table 8. (Unfortunately, no A-shot clouds tracked through the vertical sampling tower, so no vertical profile data are available.) However, if a 40-percent reduction for the A shot clouds is used, the resultant mass falls in nicely with the B and C shot modified values.
73. An important question to be answered in the high-explosive phase of DOT concerns the amount of mass that remains lofted relative to the mass excavated by the crater generation. Results from Tables 5 and 9 provide an answer to this question. By using mean values from excavated masses and cloud masses, values of approximately 2 percent are easily derived for the percentage of excavated mass remaining in sustained clouds (Table 10). Even if the larger cloud mass estimates in Table 9 are assumed (instead of the means), the percentages remain smaller than 5 percent. While these results are quite significant, it should be emphasized that the DOT results really provide only one data point in the charge weight-soil/terrain-crater volume-cloud mass relationship as these values are valid only for bare ST charges and a rather narrow range of soil and moisture conditions. Near-surface buried charges create larger craters and are suspected to result in more massive dust clouds. Since only one STB dust cloud was adequately sampled for mass determination, the DOT test provides no statistics for cloud masses from buried shots.
74. Figure 21 is a plot of the excavation and cloud mass means given in Tables 5 and 9 for all the techniques discussed for the ST trials. The Bruce means for the B shots *do not* include B15, as it was a buried shot, nor B7, as it appears extremely anomalous. All values have been rounded to the nearest hundred grams.
75. A final note should be made concerning cloud ages at sampling time. The cloud ages at the sampling arrays ranged between 6 and 20 sec. No correlation between cloud mass and cloud age in these data has been detected, implying that cloud masses in this age range do not change significantly and/or the errors in the cloud mass estimates overwhelm changes in mass for this rather narrow time interval. It does seem logical that cloud mass will be a function of cloud age as settling and scavenging occur, at least until the cloud reaches a quasi-stable state. However, a much wider range in ages than those observed at the DOT test is needed for confirming this reasoning and to establish decay rates.

#### Cloud heights

76. The clouds produced by the ST DOT test shots appeared, in general, to be more representative of STB shots because of the relatively large heights attained. It is proposed that this phenomenon may have been caused by the hard subsurface layer found throughout the test site. This fact should be remembered when comparing cloud heights of this test with those of other high-explosive test clouds.

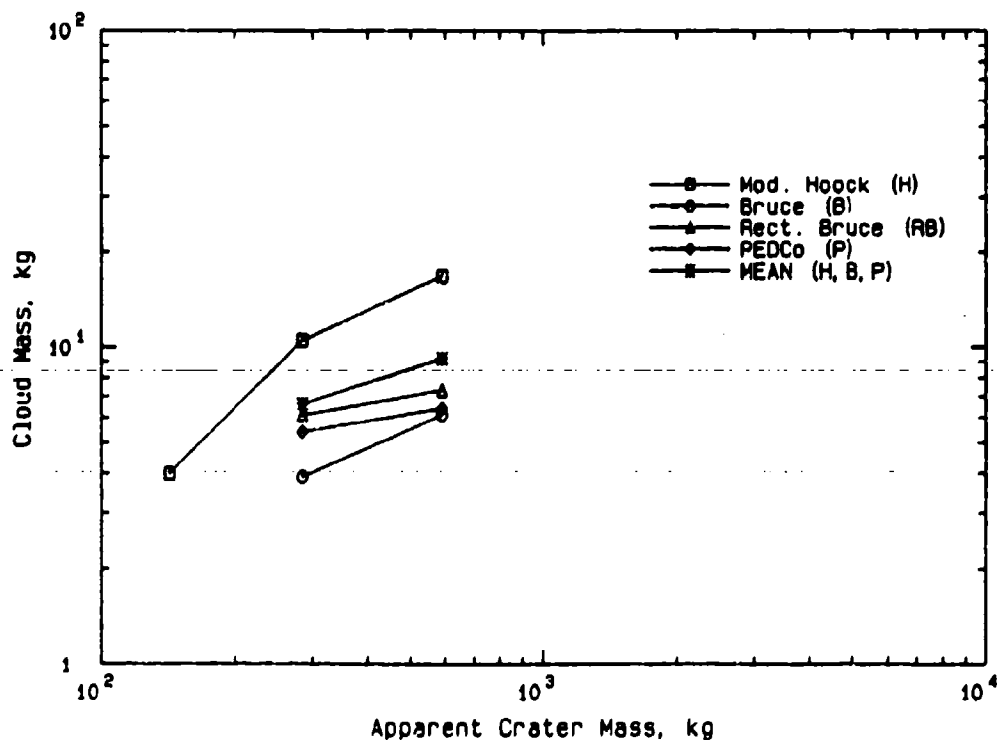


Figure 21. Estimated cloud masses (by four different methods) compared to their respective apparent crater volumes

77. The cloud heights presented in Table 7 are measured in two ways. The first is from the Hoock cloud mass analysis in which the visible tops of the clouds were measured from the video tapes. The second is from the vertical sampler data. Striking consistency is apparent in the means of both sets of measurements. The visible cloud top means measured from the video are very nearly equal for all three groups of explosive charges, with a value of approximately 30 m. However, the scatter among individual measures is quite large. In contrast, the vertical samplers imply very repeatable but charge-dependent heights for the dust in the clouds, giving mean heights of 14.5 and 18.5 m for the B and C shots, respectively. It is likely the difference in the heights between the video-visible and sampler measurements is due to the fact that the upper portions of the clouds are buoyant, i.e., mainly hot gases and burn products that contain little dust. This conjecture draws some support from the strong color difference seen between the upper and lower portions of the cloud, but whether a significant amount of dust is entrained by the upper cloud is uncertain.

#### Radii and widths

78. The DOT dust clouds have been characterized in this analysis by defining widths in two different manners. The first characterization defines an  $e^{-1}$  density radius  $r_0$  and assumes a Gaussian density distribution. The second characterization defines obscuration widths based on obscuration times below 50-, 37-, 10- and 2-percent transmission levels.
79. The first manner of characterizing the cloud radii by  $r_0$  has been approached with two independent sets of calculations. One set has been determined by Bruce using the Hi-Vol density profiles. By assuming a Gaussian distribution to the observed profiles,  $e^{-1}$  radii are easily measured.

These radii are then corrected for wind angle relative to the sampler array. These radii have been used by Bruce in calculating cloud masses. The second set of  $e^{-1}$  radii have been calculated using the transmissometer data as described below.

80. Assume, as before, that the dust clouds are circular symmetric in the horizontal plane and have a Gaussian distribution in density. Then, as the clouds drift through the transmissometer LOS, a minimum transmittance will occur when the LOS cuts through the cloud center. Using the Beer-Lambert law at the minimum transmittance and assuming the entire cloud lies between the transmitter and receiver yields

$$\ln T_\lambda = -\alpha_\lambda \int_{-\infty}^{\infty} Q_{2.5}(0) e^{-(r/r_0)^2} dr$$

where

$T_\lambda$  = minimum transmittance at wavelength  $\lambda$   
 $\alpha_\lambda$  = mass extinction coefficient for wavelength  $\lambda$ ,  $m^2/g$   
 $Q_{2.5}(0)$  = peak concentration at the 2.5-m level,  $g/m^3$

Integrating and solving for  $r_0$  gives

$$r_0 = \frac{-\ln T_\lambda}{\sqrt{\pi} \alpha_\lambda Q_{2.5}(0)}$$

81. Problems arise once the minimum detectable transmittance threshold has been reached. For the DOT test, this limit is less than 0.1 percent transmission. Using 0.1 percent if values smaller have been recorded causes  $r_0$  to be underestimated. This is not a major problem, as threshold values, when they occur, are usually observed for very short time intervals (1-2 sec) and rarely occur in all four wavelength bands. Furthermore, factor of 10 lower than threshold, 0.01 percent, results only in a factor of 2.3 in  $r_0$  estimates.
82. Minimum values of transmittance did not always occur simultaneously in the data for all four wavelengths. However, since the minima were usually within 1 or 2 sec of each other, only minimum transmittance data were used for the calculations.
83. The mass extinction coefficients used were those of Hoock (Table 6). The peak densities at 2.5 m were calculated from the peak densities given by Bruce at 1.5 m and the vertical sampler profiles.
84. The results of these radii calculations, along with those values determined by Bruce, are given in Table 11. Although the B shot means agree quite closely, the C shot means are obviously in disagreement. The transmission radii at 2.5 m are in general expected to be somewhat larger as the vertical profiles often indicate a density increase from the surface to above the transmissometer LOS at 2.5 m. Recall that the Bruce radii were measured from the Hi-Vol profiles at 1.5 m. While the accuracy of each method is difficult to assess, the results are not so grossly different as to prohibit reasonable estimates of  $r_0$  for mean dust clouds.
85. The second width characterization of the dust clouds is that of obscuring widths for the four transmissometer wavelength bands at thresholds of 50, 37, 10, and 2 percent transmittance. The method here has been to find the total time for a given threshold and wavelength band that the transmittance was below the threshold value (see Appendix A for histogram data). Then, from the meteorological data, the wind speed component perpendicular,  $V_\phi$ , to the transmissometer LOS was calculated and multiplied by the total obscuration time to yield the obscuration width.

Tables 12-15 display the results of this analysis. (Divide the widths in Tables 12-15 by 2 to obtain obscuration radii.) Figures 22a-d present the results of these calculations. Note that only slight changes are seen in the obscuration widths between the visible and the infrared. This is expected due to the similarity in mass extinction coefficients for the four bandpasses (see Table 6).

86. It is interesting to note that the Pasquill Stability Category shows no correlation with the calculated radii. Thus, it is proposed that through the early life of clouds, the internal turbulence created by the blast completely overwhelms the surrounding atmospheric turbulence, and not until this explosive turbulent energy is dispersed will the standard atmospheric diffusion processes become dominant. The age of the clouds passing through the transmissometer LOS ran from 6 to 20 sec. A study of the video tapes suggests a significant amount of turbulent blast energy apparently remains in the clouds through this time frame, thereby supporting the above conjecture.

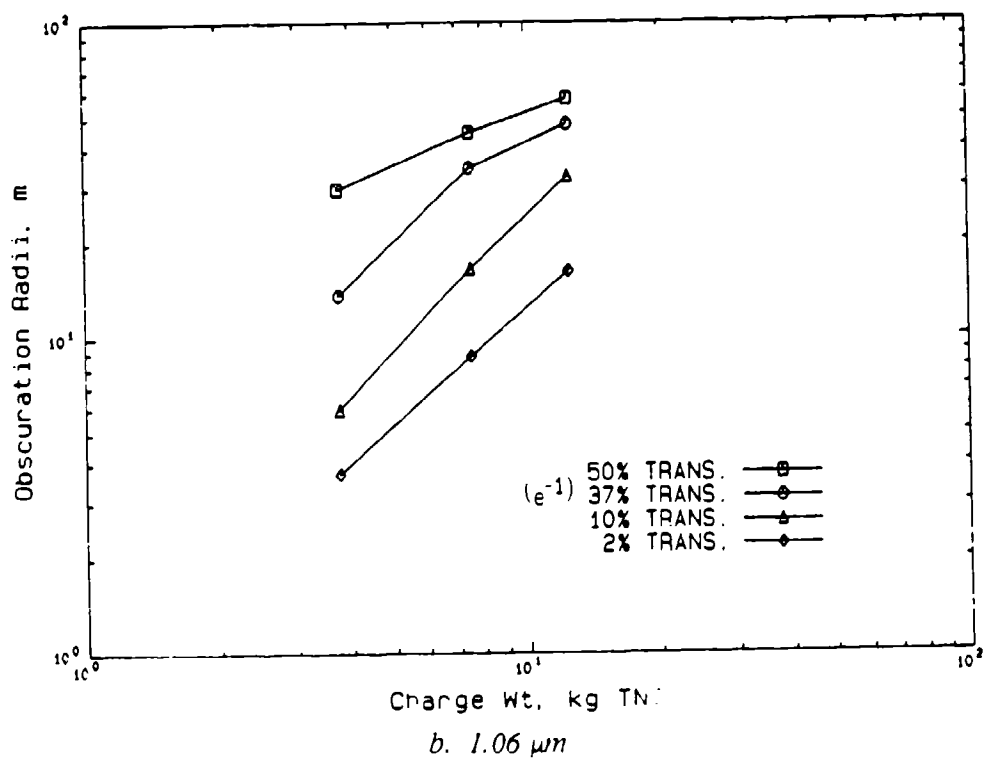
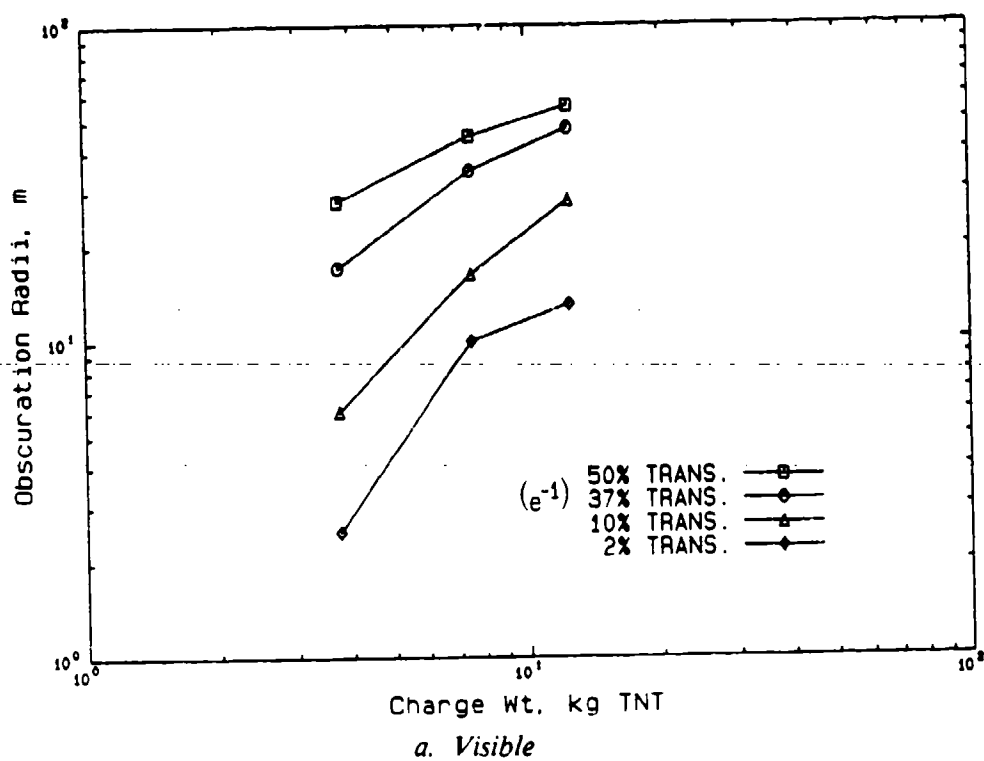


Figure 22. Obscuration radii for various wavelength bands compared to charge weight (Continued)

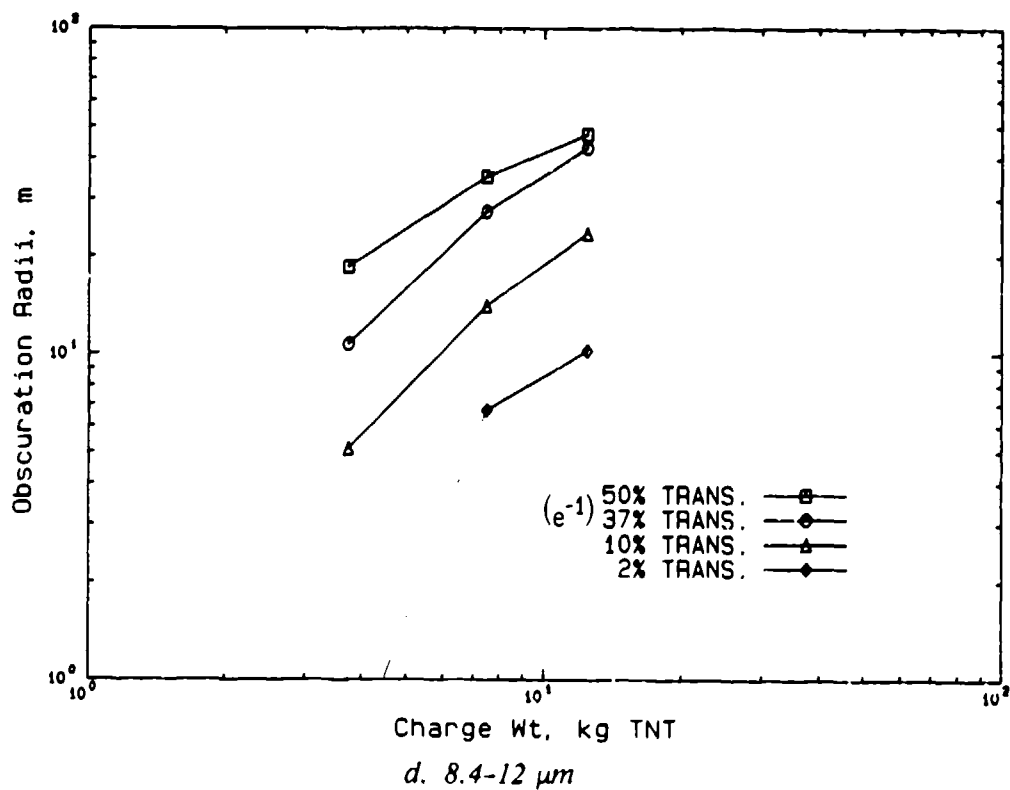
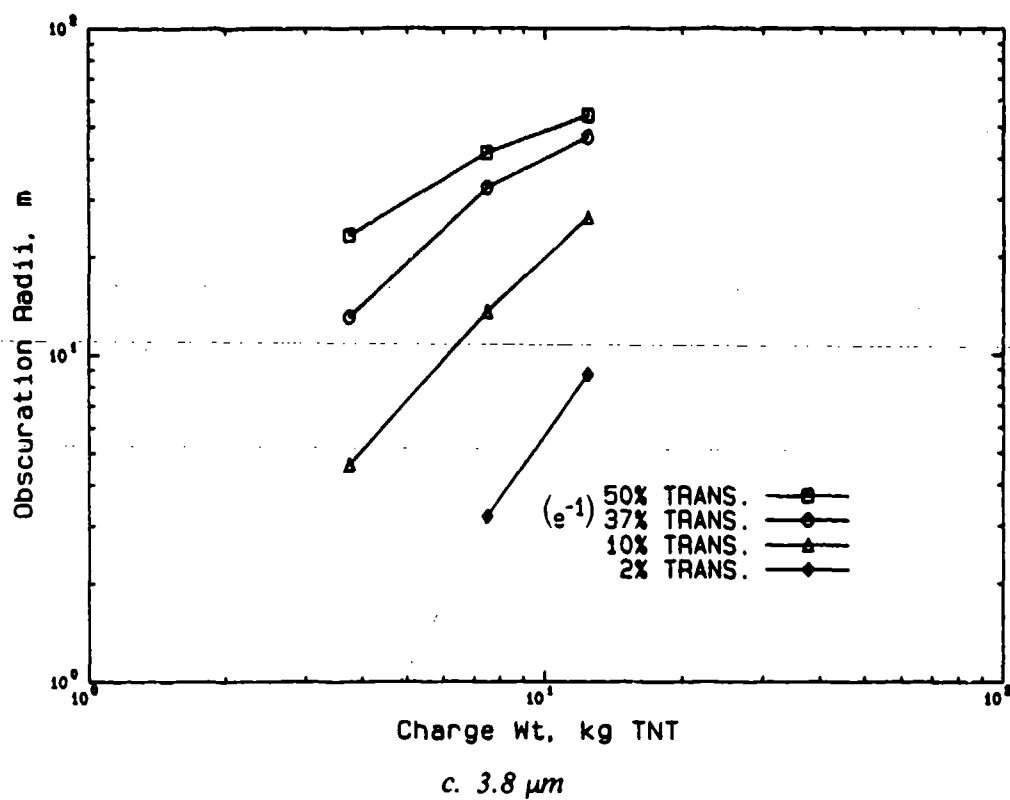


Figure 22. (Concluded)

## PART V: CONCLUSIONS AND RECOMMENDATIONS

87. The DOT tests have proved successful in establishing a number of important relationships concerning dust cloud production by high explosives. The DOT tests have also provided quantitative characterization of these dust clouds which includes physical properties and obscurant potentials in four different spectral bands. The results of the DOT I and II tests are summarized below.

### Determination and Measurement of Relevant Factors

88. One of the most important results to come out of this study is the relationship established between crater volume and dust cloud mass. From the analysis presented in Part IV, it has been determined that approximately 2 percent of the mass excavated from a crater by a ST detonation remains lofted in a young cloud. This result is also linked to the initial charge weight of the explosive through the charge weight-crater volume power law relationship (see Part IV, paragraph 54). Therefore, given a charge weight and terrain/soil parameters similar to those found at Fort Carson, a reasonably accurate prediction of cloud dust mass can be made. The apparent relationship between charge weight and excavated mass, regardless of soil moisture, density, and type, is also an important result of DOT. This relationship certainly warrants more study given the narrow range of terrain/soil parameters occurring at the test sites.
89. Dust cloud physical properties determined from the DOT data include visual heights, dust heights, cloud widths (both dust density and obscuring widths), and mass extinction coefficients. The mean visual heights, which include the buoyant upper portion of the cloud, have been determined to be approximately 30 m for all three charge weights used, but there is a large scatter about these means. However, the mean heights at which the measurable dust is lofted in these young clouds have been determined from the vertical Gelman samplers to be 14.5 and 18.4 m for the 15- and 25-lb shots, respectively (refer to Table 7 for the cloud height statistics). The cloud widths as defined by dust concentration profiles have been determined using the Hi-Vol samplers and also by the transmissometer observations. These density widths are calculated to be approximately 15 and 25 m for the 15- and 25-lb shots, respectively (see Table 11). These widths are comparable to the values of 16- and 28-m determined visible obscuration widths (corrected for wind speed and direction) of 10 percent or less transmission (see Tables 12-15.) Furthermore, the analysis reveals the transmission obscuration width of a dust cloud remains nearly constant in the four bandpasses observed at the DOT. This is a reflection of the small change in mass extinction coefficients with wavelength observed in the clouds, ranging from 0.18 m<sup>2</sup>/g in the visible to 0.12 m<sup>2</sup>/g in the 8.4- to 12- $\mu$ m bandpass. (Refer to Table 6.) Future test characterization should be pursued in terrains/soils different from those at Fort Carson in order to identify the major relationships between cloud properties, charge weight, and terrain environmental parameters.
90. Observations of the clouds as they passed through the sampling arrays indicate the clouds were still dissipating turbulent energy generated by the detonation. These observations are supported by the lack of correlation between Pasquill Stability Category and cloud widths as measured at the samplers.
91. The dust clouds generated at Fort Carson displayed distinct color separations. Typically the upper, buoyant portions tended to be dark or black, indicating burn products, while the lower portions tended to be brownish, indicating a preponderance of dust. Outer regions of the lower portions of the clouds were often whitish, perhaps remnants of shock-induced dust or dust of smaller particle sizes.

92. Moisture content was not sufficiently varied at the two sites to provide meaningful correlations with dust masses, and even soil properties proved to be more similar than originally expected on the basis of initial field inspections. Grain sizes and percentage of fines proved not to vary significantly between the two test sites.

#### Dust cloud mass determination

93. The difficulty of determining the mass of dust lofted in a cloud created by explosion necessitated extensive and redundant sampling. In spite of the elaborate sampling design used for the DOT tests, only about one-half of the events attempted yielded a data set complete enough for analysis by the various mass calculation algorithms. This fact reflects the short-term variability in wind direction, which often foiled attempts to place the explosive charges in locations such that the wind would carry the dust clouds across the sampler array. However, incomplete data sets are not without merit, as they provide crater data and video data used to measure cloud sizes and qualitative information on cloud dynamics. Often these incomplete data sets will also contain transmissometer data or dust density profile data in one dimension. Therefore, it has been concluded the sampler array approach coupled with real-time monitoring of wind conditions is a satisfactory approach to the young dust cloud sampling problem. The mobile multiple-tethered balloon approach used in DOT II allows a statistically higher degree of success in measuring vertical profiles than the single-tower approach used in DOT I.

#### Charge size effects

94. The DOT tests have substantiated the findings of previous workers explaining the relationship between charge size and crater volume (the 1.111 power law). Unfortunately, the relationship among charge, crater sizes, and amount of dust lofted has not been thoroughly investigated, largely because reliable sampling of dust clouds is so difficult. Furthermore, the influence of specific terrain factors such as soil moisture content, soil density, and soil type is not complete, lacking sufficient range for correlations to be recognized in the DOT data. This fact is also true of previous tests of this nature and is reflected in the rather crude terrain effects scaling factor used by COMBIC (EOSAEL 82) for the charge weight-crater volume algorithm (paragraph 54).

### Recommendations for Future Studies

#### Instrumentation

95. Instrumentation that is interdependent in the sense of data analysis should be collocated. In the DOT trials, significant cloud inhomogeneities were noted to exist over distances as short as 1 m. (The clouds are clumpy.) Therefore, if test analysis requires the linking of data from two instruments for spatial information, e.g., nephelometer and Hi-Vol data, the instruments should be placed as close together as possible. Instrument size and volume of influence will, of course, dictate the limits of collocation.

#### Charge size

96. The DOT results confirm the data produced for previous field tests concerning the charge weight-crater volume relationship. Because this relationship is apparently well established and because secondary influences are only partially understood, we recommend future test designers

consider holding the driver (charge and shot configuration) constant while varying the secondary parameter. Preferably, the test should be designed to hold all parameters constant except for the variable studied.

#### Extension of event sampling time

97. In terms of cloud characterization, future test efforts should address the problem of cloud evolution. The clouds measured at the DOT exercises were approximately 10 sec old, still dispersing a significant amount of turbulent energy and containing many large nonbuoyant particles. A question that must be answered concerns the amount of mass and the particle size distribution of the clouds after the turbulent energy has dissipated and the large particles have settled. It is the older, quasi-stable clouds that may ultimately affect battlefield performance during sustained engagements.
98. Measurement of the quasi-stable cloud presents a difficult challenge to the field tester. The unpredictability of cloud trajectories makes adequate sampling of the clouds by stationary instrumentation either haphazard or prohibitively expensive. Remote sensing techniques probably offer the best solution to this problem but must be demonstrated to be valid or at least consistent with sampling instrumentation. Thus, remote sensing techniques should be validated by stationary sampling instrumentation in a few tests with physical layouts much like those used in the DOT.

#### Optical properties of cloud components

99. Because of a real need to understand the optical properties of the explosively generated dust clouds, quantitative measurements of both the amount and spatial distribution of burn products must be made in future tests. Strong color differences seen in the clouds produced in the DOT as well as the vertical mass measurements indicate the majority of the dust is in the lower portion of the clouds while much of the hot burn products are in the buoyant upper portion. However, significant amounts of burn products in the lower portion will strongly affect the transmissometer data and lead to calculations of erroneous extinction coefficients for the dust. These results will definitely affect the ability of most remote sensing techniques to determine accurate cloud masses.
100. The effects of vegetation characteristics, which have generally been excluded, may warrant more careful consideration. Future tests should provide more detailed characterization and measurement of vegetation type, density, and coverage.

#### Environmental parameters

101. We need to know much more precisely how soil moisture contributes to dust loading. Such a test should be conducted in an area where the soil structure (density, composition, percent fines, etc.) and vegetation cover are reasonably constant over the site and the charge weight and configuration (e.g., surface tangent or buried) remain unchanged from shot to shot. The moisture content could be varied artificially, and a statistically significant number of shots should be conducted. The results of these tests would provide very important results concerning dust potential for a terrain/soil. The range of moisture contents covered by DOT suggests there are quite likely saturation values of moisture for a given soil which, when reached, will dramatically alter the dust potential. If these thresholds can be established, the field commander may no longer require precise soil moisture content analysis for estimating dust potential, but may be able to use

rather crude and/or simple measurement techniques. Certainly, different soil types are expected to yield different threshold values, so the soil moisture experiments must be conducted at a variety of sites. Defining the environmental parameters could lead to a refinement of the scaling factor used in the EOSAEL 82 COMBIC model to predict crater volumes produced by a certain charge weight.

#### Summary

102. The lesson learned from the Fort Carson, Colo., DOT exercises is that quantifying cloud masses generated by an explosive charge is possible, though difficult. Larger sampler arrays extended over greater distances along the cloud path would yield information unattainable and difficult to estimate using present techniques. Moreover, sampling older clouds would permit identification of the time at which forces of the blast become negligible when compared to "natural" atmospheric turbulence. At this point, existing atmospheric models could be employed to predict cloud behavior and content, and the precision of their predictions could be determined.

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Table I  
High-Explosive Trial Log, DOT I

| Trial* | Date<br>(1983) | Charge<br>Config-<br>uration | Detonation<br>Coordinates, m |       | Wind  |     | Pasquill<br>Category | Crater<br>Profile |
|--------|----------------|------------------------------|------------------------------|-------|-------|-----|----------------------|-------------------|
|        |                |                              | X                            | Y     | m/sec | deg |                      |                   |
| A1     | 4-19           | BL,ST                        | 0.0                          | 94.5  | 5.4   | 230 | B                    | Y                 |
| A2     | 4-19           | BL,ST                        | 2.4                          | 78.9  | 5.9   | 259 | B                    | Y                 |
| A3     | 4-19           | S,ST                         | -6.1                         | 106.1 | 8.2   | 278 | D                    | Y                 |
| A4     | 4-20           | S,ST                         | 78.1                         | 65.1  | 3.3   | 94  | B                    | Y                 |
| A5     | 4-20           | S,ST                         | 77.7                         | 9.0   | 2.3   | 128 | A                    | Y                 |
| A6     | 4-22           | S,ST                         | 69.7                         | 66.8  | 6.3   | 32  | D                    | Y                 |
| A7     | 4-25           | S,ST                         | 7.7                          | 75.2  | 5.7   | 290 | C                    | Y                 |
| A8     | 4-25           | S,ST                         | 0.9                          | 63.5  | 3.1   | 112 | A                    | Y                 |
| A9     | 4-25           | S,ST                         | 30.7                         | 20.9  | 2.6   | 156 | A                    | Y                 |
| B1     | 4-20           | S,ST                         | 66.3                         | 5.2   | 3.0   | 136 | A                    | Y                 |
| B2     | 4-20           | S,ST                         | 50.4                         | 4.5   | 3.0   | 129 | B                    | Y                 |
| B3     | 4-21           | S,ST                         | -16.0                        | 78.4  | 6.7   | 267 | C                    | Y                 |
| B4     | 4-21           | S,ST                         | -14.9                        | 88.8  | 6.8   | 283 | C                    | ND                |
| B5     | 4-21           | S,ST                         | 37.9                         | 18.5  | 0.9   | 100 | D                    | Y                 |
| B6     | 4-22           | ND,ST                        | 61.7                         | 72.7  | 6.2   | 33  | D                    | Y                 |
| B7     | 4-22           | S,ST                         | 80.9                         | 69.1  | 8.8   | 30  | D                    | ND                |
| B8     | 4-23           | S,ST                         | 53.3                         | 18.3  | 4.0   | 114 | B                    | Y                 |
| B9     | 4-23           | S,ST                         | 88.9                         | -0.6  | 3.6   | 95  | C                    | Y                 |
| B10    | 4-26           | S,ST                         | 43.5                         | 17.8  | 5.6   | 117 | B                    | Y                 |
| B11    | 4-26           | BL,ST                        | 39.1                         | 9.4   | 5.1   | 136 | C                    | Y                 |
| B12    | 4-26           | BL,STB                       | 65.0                         | -11.4 | 4.4   | 131 | B                    | Y                 |
| B13    | 4-26           | BL,STB                       | 51.4                         | -11.5 | 5.1   | 125 | B                    | Y                 |
| B14    | 4-26           | BL,AGL                       | 60.5                         | 9.8   | 5.7   | 146 | B                    | N                 |
| B15    | 4-26           | BL,STB                       | 36.1                         | 2.8   | 5.8   | 155 | C                    | Y                 |
| B16    | 4-26           | BL(3),ST**                   | 44.0                         | 10.0  | 3.0   | 145 | C                    | N                 |
|        |                |                              | 54.8                         | 9.4   |       |     |                      |                   |
|        |                |                              | 65.9                         | 9.2   |       |     |                      |                   |
| C1     | 4-20           | S,ST                         | 57.0                         | 14.3  | 2.8   | 109 | D                    | Y                 |
| C2     | 4-21           | BL,ST                        | 81.7                         | 97.7  | 4.4   | 56  | B                    | Y                 |
| C3     | 4-21           | BL,ST                        | 80.6                         | 42.1  | 5.9   | 70  | D                    | Y                 |
| C4     | 4-22           | BL,ST                        | 65.7                         | 79.3  | 7.0   | 25  | D                    | N                 |
| C5     | 4-22           | BL,ST                        | 90.6                         | 71.0  | 8.8   | 52  | C                    | ND                |
| C6     | 4-23           | BL,ST                        | 29.8                         | 5.6   | 3.5   | 157 | B                    | Y                 |
| C7     | 4-23           | BL,ST                        | 57.2                         | 3.1   | 5.3   | 117 | D                    | Y                 |
| C8     | 4-23           | BL,ST                        | 65.3                         | 17.5  | 4.6   | 118 | B                    | Y                 |
| C9     | 4-23           | BL,ST                        | 75.7                         | -13.9 | 4.9   | 140 | D                    | Y                 |
| C10    | 4-25           | BL,ST                        | 10.2                         | 23.5  | 8.1   | 212 | C                    | Y                 |

NOTE: BL = charge shape—block, S = charge shape—spherical, ST = surface tangent, STB = surface tangent buried, AGL = above ground level, Y = yes, N = no, ND = no data.

\* A = 7.5 lb of C-4, B = 15 lb of C-4, C = 25 lb of C-4.

\*\* Three 15-lb shots in series.

Table 2  
High-Explosive Trial Log, DOT II

| Trial*   | Date<br>(1983) | Charge<br>Config-<br>uration | Detonation<br>Coordinates |                | Wind  |     | Pasquill<br>Category | Crater<br>Profile |
|----------|----------------|------------------------------|---------------------------|----------------|-------|-----|----------------------|-------------------|
|          |                |                              | Distance<br>m             | Azimuth<br>deg | m/sec | deg |                      |                   |
| 01B(8)** | 8-4            | S,ST                         | 50                        | 150            | 2.5   | 170 | ND                   | Y                 |
| 02B(9)   | 8-4            | S,ST                         | 46                        | 179            | 2.7   | 155 | ND                   | Y                 |
| 03C(10)  | 8-4            | S,ST                         | 45                        | 165            | 2.5   | 110 | ND                   | Y                 |
| 04B(11)  | 8-4            |                              | 50                        | 112            | 3.4   | 115 | ND                   | Y                 |
|          |                |                              | 50                        | 97             |       |     |                      |                   |
| 05B(14)  | 8-5            | S,ST                         | 46                        | 75             | 3.4   | 80  | ND                   | Y                 |
|          |                |                              | 47                        | 61             |       |     |                      | Y                 |
|          |                |                              | 46                        | 45             |       |     |                      | Y                 |
| 06C(15)  | 8-5            | S,ST                         | 55                        | 75             | 2.9   | 75  | ND                   | Y                 |
|          |                |                              | 51                        | 91             |       |     |                      | Y                 |
|          |                |                              | ND                        | ND             |       |     |                      | ND                |
| 07C(16)  | 8-5            | S,ST                         | 37                        | 90             | 4.0   | 75  | ND                   | ND                |
| 08(17)†  | 8-5            | S,ST                         | ND                        | ND             | ND    | ND  | ND                   | ND                |

NOTE: S = charge shape—spherical, ST = surface tangent, Y = yes, ND = no data.

\* B = 15 lb of C-4, C = 25 lb of C-4.

\*\* Trial number of DOT II records in parentheses. The leading alphanumeric identifier will be used to designate the high-explosive DOT II shots in this report.

† Three 20-lb charges/no data available.

Table 3  
Crater Volumes

| Trial | Preshot<br>Density<br>g/cm <sup>3</sup> | Moisture<br>Content<br>% | Bulking<br>Factor<br>dimensionless | Apparent<br>Volume<br>m <sup>3</sup> | True<br>Volume<br>m <sup>3</sup> | Apparent Volume/<br>kg TNT<br>m <sup>3</sup> /kg TNT |
|-------|-----------------------------------------|--------------------------|------------------------------------|--------------------------------------|----------------------------------|------------------------------------------------------|
| A1    | -                                       | 11.5                     | -                                  | 0.118                                | 0.420                            | 0.032                                                |
| A2    | 1.43                                    | 13.1                     | 1.53                               | 0.151                                | 0.493                            | 0.040                                                |
| A3    | -                                       | 10.4                     | -                                  | 0.065                                | 0.242                            | 0.017                                                |
| A4    | 1.54                                    | 33.3                     | 1.42                               | 0.110                                | 0.204                            | 0.029                                                |
| A5    | 1.32                                    | 26.7                     | 1.24                               | 0.095                                | 0.178                            | 0.025                                                |
| A6    | 1.38                                    | 13.9                     | 1.32                               | 0.126                                | 0.383                            | 0.034                                                |
| A7    | 1.38                                    | 13.0                     | -                                  | 0.140                                | 0.378                            | 0.037                                                |
| A8    | 1.36                                    | 11.4                     | -                                  | 0.107                                | 0.161                            | 0.029                                                |
| A9    | 1.39                                    | 9.3                      | 1.20                               | 0.172                                | 0.429                            | 0.046                                                |
| B1    | 1.36                                    | 19.5                     | 1.55                               | 0.263                                | 0.750                            | 0.035                                                |
| B2    | 1.52                                    | 22.0                     | 1.60                               | 0.224                                | 0.848                            | 0.030                                                |
| B3    | 1.36                                    | 13.3                     | 1.46                               | 0.215                                | 0.738                            | 0.029                                                |
| B5    | -                                       | 11.5                     | -                                  | 1.252                                | 2.375                            | 0.318                                                |
| B6    | 1.38                                    | 13.1                     | 1.33                               | 0.231                                | 1.260                            | 0.031                                                |
| B7*   | 1.28                                    | 11.8                     | 1.12                               | 0.230                                | 0.840                            | 0.031                                                |
| B8    | 1.43                                    | 12.4                     | 1.27                               | 0.335                                | 0.930                            | 0.045                                                |
| B9    | 1.42                                    | 12.9                     | 1.25                               | 0.221                                | 0.529                            | 0.030                                                |
| B10   | 1.37                                    | 12.4                     | 1.18                               | 0.191                                | 0.875                            | 0.026                                                |
| B11   | 1.34                                    | 11.8                     | 1.33                               | 0.143                                | 0.547                            | 0.019                                                |
| B12   | 1.28                                    | 12.1                     | 1.06                               | 0.779                                | 1.674                            | 0.104                                                |
| B13   | 1.44                                    | 7.2                      | 1.21                               | 0.440                                | 2.013                            | 0.059                                                |
| B15   | 1.26                                    | -                        | 1.13                               | 0.810                                | 1.832                            | 0.108                                                |
| C1    | 1.44                                    | 23.6                     | 1.46                               | 0.465                                | 0.893                            | 0.037                                                |
| C2    | 1.84                                    | 11.2                     | 1.92                               | 0.440                                | 1.350                            | 0.035                                                |
| C3    | 1.26                                    | 12.8                     | 1.20                               | 0.510                                | 1.139                            | 0.041                                                |
| C4*   | 1.36                                    | 13.5                     | 1.20                               | 0.310                                | 0.800                            | 0.025                                                |
| C5*   | 1.23                                    | 12.7                     | 1.10                               | 0.560                                | 1.300                            | 0.045                                                |
| C6    | 1.34                                    | 13.9                     | 1.18                               | 0.484                                | 1.284                            | 0.039                                                |
| C7    | 1.31                                    | 11.6                     | 1.19                               | 0.392                                | 1.862                            | 0.031                                                |
| C8    | 1.48                                    | 12.1                     | 1.32                               | 0.481                                | 1.598                            | 0.039                                                |
| C9    | 1.45                                    | 11.7                     | 1.33                               | 0.694                                | 1.327                            | 0.056                                                |
| C10   | 1.31                                    | 12.4                     | 1.55                               | 0.443                                | 1.335                            | 0.036                                                |
| 1B    | 1.71                                    | 11.6                     | -                                  | 0.320                                | 0.480                            | 0.043                                                |
| 2B    | 1.94                                    | 17.5                     | -                                  | 0.188                                | 0.254                            | 0.025                                                |
| 3C    | 1.93                                    | 13.2                     | -                                  | 0.393                                | 0.517                            | 0.032                                                |
| 4B(a) | 1.78                                    | 11.6                     | -                                  | 0.243                                | 0.309                            | 0.033                                                |
| 4B(b) | 1.70                                    | 10.5                     | -                                  | 0.151                                | 0.288                            | 0.020                                                |
| 5B(a) | 1.69                                    | 7.9                      | -                                  | 0.196                                | 0.238                            | 0.026                                                |
| 5B(b) | 1.50                                    | 8.2                      | -                                  | 0.110                                | 0.228                            | 0.015                                                |
| 5B(c) | 1.71                                    | 5.0                      | -                                  | 0.118                                | 0.256                            | 0.016                                                |
| 6C(a) | 1.79                                    | 8.1                      | -                                  | 0.360                                | 0.481                            | 0.029                                                |
| 6C(b) | 1.62                                    | 8.3                      | -                                  | 0.323                                | 0.467                            | 0.026                                                |

\* Only crater diameters and central depths were recorded. Volumes are calculated assuming these craters to be cone shaped.

**Table 4**  
**Mean Crater Volumes,\* m<sup>3</sup>**

| Charge Weight<br>lb | Apparent         |                  | True             |                  |
|---------------------|------------------|------------------|------------------|------------------|
|                     | DOT I            | DOT II           | DOT I            | DOT II           |
| 7.5 (ST)            | 0.119<br>(0.120) | -<br>-           | 0.320<br>(0.321) | -<br>-           |
| 15.0 (ST)           | 0.226<br>(0.228) | 0.187<br>(0.189) | 0.745<br>(0.809) | 0.281<br>(0.293) |
| 25.0 (ST)           | 0.490<br>(0.489) | 0.357<br>(0.359) | 1.345<br>(1.349) | 0.486<br>(0.488) |
| 15.0 (STB)          | 0.674<br>(0.674) | -<br>-           | 1.835<br>(1.837) | -<br>-           |

\* These volumes are calculated from mean crater profiles (see text). Values in parentheses are means computed from the volumes of the individual craters listed in Table 3. Crater volumes B7, C4, and C5 have been omitted from these mean calculations as no profiles were measured. The B5 volume has also been omitted as the charge was inadvertently placed on a core sample hole.

**Table 5**  
**Mass Excavation for ST Shots**

| Test   | Charge Weight<br>lb | Density, g/cm <sup>3</sup> |      | Moisture Content<br>% | Apparent Volume<br>m <sup>3</sup> | Calculated Excavated | Volume/<br>kg TNT |
|--------|---------------------|----------------------------|------|-----------------------|-----------------------------------|----------------------|-------------------|
|        |                     | Wet                        | Dry  |                       |                                   | Mass<br>kg           |                   |
| DOT I  | 7.5                 | 1.40                       | 1.19 | 17.2                  | 0.119                             | 142                  | 0.032             |
| DOT I  | 15                  | 1.40                       | 1.22 | 14.7                  | 0.226                             | 276                  | 0.030             |
| DOT II | 15                  | 1.72                       | 1.56 | 10.3                  | 0.187                             | 292                  | 0.025             |
| DOT I  | 25                  | 1.40                       | 1.23 | 13.7                  | 0.490                             | 603                  | 0.039             |
| DOT II | 25                  | 1.78                       | 1.62 | 9.9                   | 0.357                             | 578                  | 0.029             |

Table 6  
Path Integrated Dosage and Mass Extinction  
[Mass Extinction Coefficients,  $\text{m}^2/\text{g}$ ]

| Trial   | Dosage<br>Integration<br>$\text{g} \cdot \text{sec}/\text{m}^2$ | Wavelength $\lambda$ , $\mu\text{m}$ |           |           |           |
|---------|-----------------------------------------------------------------|--------------------------------------|-----------|-----------|-----------|
|         |                                                                 | 0.4-0.7                              | 1.06      | 3.8       | 8.4-12    |
| B4      | 264.                                                            | 0.21                                 | 0.18      | 0.15      | 0.16      |
| B5      | 1,910.                                                          | 0.14                                 | 0.15      | 0.11      | 0.08      |
| B6      | 104.                                                            | 0.21                                 | 0.14      | 0.12      | 0.12      |
| C4      | 149.                                                            | 0.28                                 | 0.26      | 0.19      | 0.24      |
| A7      | 156.                                                            | 0.17                                 | 0.18      | 0.12      | 0.12      |
| A8      | 192-250                                                         | 0.12-0.16                            | 0.13-0.17 | 0.10-0.14 | 0.11-0.15 |
| B10     | 186.                                                            | 0.16                                 | 0.14      | 0.11      | 0.11      |
| B13     | 388.                                                            | 0.16                                 | 0.18      | 0.12      | 0.11      |
| Average |                                                                 | 0.18                                 | 0.16      | 0.12      | 0.13      |

Table 7  
Mean Dust Cloud Heights for DOT 1, m

| Charge<br>Weight | Number<br>of Clouds | Video Tapes                  |                          | Number<br>of Clouds | Vertical Samplers |                          |
|------------------|---------------------|------------------------------|--------------------------|---------------------|-------------------|--------------------------|
|                  |                     | Visible<br>Mean<br>Height, m | Standard<br>Deviation, m |                     | Mean<br>Height, m | Standard<br>Deviation, m |
| A                | 3                   | 30.3                         | 12.7                     | -                   | -                 | -                        |
| B                | 6                   | 29.7                         | 14.5                     | 5                   | 14.5              | 2.3                      |
| C                | -                   | 27.9                         | 3.7                      | 8                   | 18.4              | 4.3                      |

Table 8  
Cloud Masses, g

| Shot | Hoock  | ASL Calculations  |        |                      | PEDCo, Inc. |
|------|--------|-------------------|--------|----------------------|-------------|
|      |        | Modified<br>Hoock | Bruce  | Rectangular<br>Bruce |             |
| A3   | 9,660  | -                 | -      | -                    | -           |
| A5   | 8,460  | -                 | -      | -                    | -           |
| A6   | 1,792  | -                 | -      | -                    | -           |
| B1   | 21,170 | -                 | -      | -                    | -           |
| B3   | 6,860  | -                 | -      | -                    | -           |
| B4   | 25,825 | 11,156            | 1,841  | 2,798                | -           |
| B5   | 51,375 | -                 | -      | -                    | -           |
| B6   | 7,218  | 6,015             | 5,756  | 8,908                | -           |
| B7   | 14,680 | 14,391            | 370    | 650                  | -           |
| B8   | 17,400 | -                 | -      | -                    | -           |
| B9   | 18,612 | -                 | -      | -                    | -           |
| B11  | -      | -                 | 4,060  | 6,675                | -           |
| B15  | -      | -                 | 7,209  | 5,807                | -           |
| C1   | 25,740 | 17,846            | 7,976  | 2,439                | -           |
| C3   | -      | -                 | 4,494  | 2,665                | -           |
| C4   | 14,390 | 11,427            | 5,934  | 12,812               | -           |
| C5   | 45,210 | 23,392            | 8,941  | 16,264               | -           |
| C6   | 22,734 | 15,830            | 4,076  | 5,953                | -           |
| C7   | 17,870 | -                 | -      | -                    | -           |
| C8   | 19,068 | 10,555            | 11,426 | 4,990                | -           |
| C9   | 40,545 | 22,426            | 4,520  | 4,881                | -           |
| C10  | -      | -                 | 1,645  | 8,393                | -           |
| 01B  | -      | -                 | -      | -                    | 6,396       |
| 02B  | -      | -                 | -      | -                    | 4,354       |
| 03C  | -      | -                 | -      | -                    | 7,167       |
| 07C  | -      | -                 | -      | -                    | 5,625       |

Table 9  
Cloud Mass Means, g

| Method                      | Shots            |                   |                   |
|-----------------------------|------------------|-------------------|-------------------|
|                             | A*               | B                 | C                 |
| Modified Hooek              | 6,600<br>(4,200) | 10,500<br>(4,200) | 16,800<br>(5,400) |
| Bruce                       | -                | 3,900<br>(2,000)  | 6,100<br>(3,100)  |
| Rectangular Bruce           | -                | 6,100<br>(3,100)  | 7,300<br>(4,900)  |
| PEDCo                       | -                | 5,400<br>(1,400)  | 6,400<br>(1,100)  |
| Average of means            | -                | 6,500             | 9,200             |
| Mean for individual shots** | -                | 6,600<br>(3,400)  | 9,200<br>(6,122)  |

NOTE: Masses for B7 and B15 shots have been omitted from all calculations in Table 10. Standard deviations are in parentheses, and all table values have been rounded to the nearest hundred grams.

\* Unmodified Hooek values. No A shots passed through the vertical sampler.

\*\* The following shots were used to calculate the means for individual shots:

B: Modified Hooek—B4, B6, B7

Bruce, Rectangular Bruce—B4, B6, B11

PEDCo—01B, 02B

C: Modified Hooek—C1, C4, C5, C6, C8, C9

Bruce, Rectangular Bruce—C1, C3, C4, C5, C6, C8, C9, C10

PEDCo—03C, 07C

Table 10  
Sustained Cloud Dust

| Shot | Excavated<br>Mass Means, kg | Cloud<br>Mass Means, kg | Percent<br>Excavated<br>in Clouds |
|------|-----------------------------|-------------------------|-----------------------------------|
| A*   | 142                         | 6.6**                   | 4.6                               |
| B    | 284                         | 6.6                     | 2.3                               |
| C    | 591                         | 9.2                     | 1.6                               |

\* Calculated from DOT 1 data only.

\*\* Unmodified Hooek method.

Table 11  
Density Radii

| Shot                  | 2.5-m<br>Density<br>g/cm <sup>3</sup> | Radii, m          |                    |                   |                      |       | Mean  | Bruce<br>Mean |
|-----------------------|---------------------------------------|-------------------|--------------------|-------------------|----------------------|-------|-------|---------------|
|                       |                                       | Wavelength        |                    |                   |                      |       |       |               |
|                       |                                       | Visible           | 1.06 $\mu\text{m}$ | 3.4 $\mu\text{m}$ | 8.4–12 $\mu\text{m}$ |       |       |               |
| B4                    | 1.864                                 | 11.62<br>(0.001)* | 10.99<br>(0.003)   | 13.04<br>(0.0057) | 13.30<br>(0.0038)    | 12.24 | 6.54  |               |
| B6                    | 1.782                                 | 12.85<br>(0.001)  | 5.50<br>(0.0623)   | 5.08<br>(0.1459)  | 6.39<br>(0.0727)     | 7.28  | 10.20 |               |
| B11                   | 2.601                                 | 6.72<br>(0.0038)  | 7.59<br>(0.0037)   | 6.85<br>(0.0227)  | 11.53<br>(0.001)     | 8.17  | 7.14  |               |
| B15                   | 6.002                                 | 3.00<br>(0.0032)  | 3.48<br>(0.0027)   | 3.15<br>(0.0180)  | 4.87<br>(0.0012)     | 3.63  | 4.74  |               |
| Means for 15-lb shots |                                       |                   |                    |                   |                      | 7.83  | 7.16  |               |
| C1                    | 1.795                                 | 12.06<br>(0.001)  | 12.10<br>(0.0021)  | 13.89<br>(0.005)  | 13.61<br>(0.0036)    | 12.91 | 6.30  |               |
| C3                    | 1.042                                 | 18.69<br>(0.002)  | 23.37<br>(0.001)   | 31.17<br>(0.001)  | 28.77<br>(0.001)     | 25.50 | 8.34  |               |
| C4                    | 1.267                                 | 17.09<br>(0.001)  | 16.56<br>(0.0026)  | 16.63<br>(0.0113) | 23.66<br>(0.001)     | 19.17 | 13.26 |               |
| C5                    | 1.093                                 | 19.81<br>(0.001)  | 22.28<br>(0.001)   | 29.71<br>(0.001)  | 27.43<br>(0.001)     | 24.81 | 16.14 |               |
| C8                    | 4.186                                 | 5.17<br>(0.001)   | 4.42<br>(0.0053)   | 4.65<br>(0.0161)  | 6.89<br>(0.0013)     | 5.28  | 7.44  |               |
| C9                    | 1.412                                 | 15.33<br>(0.001)  | 12.85<br>(0.0058)  | 13.59<br>(0.0169) | 11.31<br>(0.0252)    | 13.27 | 7.92  |               |
| C10                   | 1.740                                 | 12.44<br>(0.001)  | 11.04<br>(0.0043)  | 10.55<br>(0.201)  | 17.23<br>(0.001)     | 12.81 | 6.66  |               |
| Means for 25-lb shots |                                       |                   |                    |                   |                      | 16.25 | 9.44  |               |

\* Minimum transmission is given in parentheses.

Table 12  
Obscuration Widths (Visible)

| Shot | WSP<br>m/sec | WSP (⊥) | PASQ | Cloud<br>Age, sec | Percent<br>Transmission Widths, m |                          |                |                |
|------|--------------|---------|------|-------------------|-----------------------------------|--------------------------|----------------|----------------|
|      |              |         |      |                   | 50                                | 37<br>(e <sup>-1</sup> ) | 10             | 2              |
| A3   | 8.16         | 4.56    | D    | 14.5              | 50.2                              | 18.2                     | 0.0            | 0.0            |
| A5   | 2.33         | 2.13    | C    | 14.5              | 12.8                              | 0.0                      | 0.0            | 0.0            |
| A6   | 6.29         | 3.42    | D    | 7.9               | 13.7                              | 10.3                     | 0.0            | 0.0            |
| A7   | 5.71         | 4.16    | C    | 8.5               | 33.3                              | 33.3                     | 16.7           | 4.6            |
| A9   | 2.61         | 2.61    | A    | 7.3               | 28.7                              | 23.5                     | 13.1           | 7.8            |
| B1   | 3.03         | 2.93    | A    | 11.8              | 64.4                              | 44.0                     | 20.5           | 2.9            |
| B2   | 2.98         | 2.73    | B    | 13.0              | 57.3                              | 43.7                     | 2.7            | 0.0            |
| B3   | 6.66         | 2.71    | C    | 14.1              | 27.1                              | 24.4                     | 16.3           | 5.4            |
| B4   | 6.76         | 4.32    | C    | 11.3              | 51.8                              | 43.2                     | 30.2           | 25.9           |
| B6   | 6.20         | 3.13    | D    | 10.5              | 25.0                              | 18.8                     | 6.3            | 3.1            |
| B7   | 8.79         | 4.83    | D    | 6.1               | 53.1                              | 48.3                     | 33.8           | 29.0           |
| B8   | 3.99         | 3.12    | B    | 6.9               | 56.1                              | 34.3                     | 12.5           | 9.4            |
| B9   | 3.61         | 1.92    | C    | 21.1              | 23.1                              | 21.2                     | 7.7            | 3.9            |
| C1   | 2.81         | 2.02    | D    | 12.7              | 68.6                              | 58.5                     | 30.3           | 14.1           |
| C4   | 7.02         | 4.33    | D    | 9.1               | 43.3                              | 43.3                     | 26.0           | 8.7            |
| C5   | 8.82         | 1.62    | C    | 19.2              | 48.7                              | 47.0                     | 34.1           | 21.1           |
| C7   | 5.32         | 4.32    | D    | 8.5               | 60.5                              | 34.6                     | 17.3           | 4.3            |
| C8   | 4.60         | 3.76    | B    | 6.0               | 41.4                              | 37.6                     | 22.6           | 11.3           |
| C9   | 4.85         | 4.73    | D    | 11.4              | 71.0                              | 61.5                     | 37.9           | 18.9           |
| (A)* | 5.02         | 3.38    | -    | 10.5              | 27.7<br>(15.5)**                  | 17.1<br>(12.7)           | 6.0<br>(8.3)   | 2.5<br>(3.6)   |
| (B)  | 5.25         | 3.21    | -    | 11.9              | 44.7<br>(16.7)                    | 34.7<br>(11.7)           | 16.3<br>(11.3) | 10.0<br>(11.2) |
| (C)  | 5.57         | 3.46    | -    | 11.2              | 55.6<br>(12.9)                    | 47.2<br>(11.0)           | 28.0<br>(7.6)  | 13.1<br>(6.3)  |

NOTE: WSP = wind speed, WSP (⊥) = wind speed perpendicular to the transmissometer line-of-sight, PASQ = Pasquill Stability Category.

\* Mean values for charge weight.

\*\* Standard deviations are displayed in parentheses.

Table 13  
Obscuration Widths (1.06  $\mu\text{m}$ )

| Shot | WSP<br>m/sec | WSP ( $\perp$ ) | PASQ | Cloud<br>Age, sec | Percent<br>Transmission Widths, m |                          |                |               |
|------|--------------|-----------------|------|-------------------|-----------------------------------|--------------------------|----------------|---------------|
|      |              |                 |      |                   | 50                                | 37<br>(e <sup>-1</sup> ) | 10             | 2             |
| A3   | 8.16         | 4.56            | D    | 14.5              | 54.7                              | 18.2                     | 0.0            | 0.0           |
| A5   | 2.33         | 2.13            | C    | 14.5              | 10.7                              | 0.0                      | 0.0            | 0.0           |
| A6   | 6.29         | 3.42            | D    | 7.9               | 20.5                              | 13.7                     | 0.0            | 0.0           |
| A7   | 5.71         | 4.16            | C    | 8.5               | 33.3                              | 33.3                     | 16.6           | 8.3           |
| A9   | 2.61         | 2.61            | A    | 7.3               | 28.7                              | 20.9                     | 13.1           | 10.4          |
| B1   | 3.03         | 2.93            | A    | 11.8              | 61.5                              | 44.0                     | 20.5           | 0.0           |
| B2   | 2.98         | 2.73            | B    | 13.0              | 57.3                              | 43.7                     | 5.5            | 0.0           |
| B3   | 6.66         | 2.71            | C    | 14.1              | 27.1                              | 24.4                     | 16.3           | 10.8          |
| B4   | 6.76         | 4.32            | C    | 11.3              | 51.8                              | 43.2                     | 34.6           | 21.6          |
| B6   | 6.20         | 3.13            | D    | 10.5              | 25.0                              | 21.9                     | 3.1            | 0.0           |
| B7   | 8.79         | 4.83            | D    | 6.1               | 53.1                              | 48.3                     | 33.8           | 29.0          |
| B8   | 3.99         | 3.12            | B    | 6.9               | 56.1                              | 31.2                     | 12.5           | 6.2           |
| B9   | 3.61         | 1.92            | C    | 21.1              | 25.0                              | 19.2                     | 5.8            | 1.9           |
| C1   | 2.81         | 2.02            | D    | 12.7              | 72.7                              | 60.6                     | 34.3           | 24.2          |
| C4   | 7.02         | 4.33            | D    | 9.1               | 47.6                              | 43.3                     | 30.3           | 17.3          |
| C5   | 8.82         | 1.62            | C    | 19.2              | 50.2                              | 47.0                     | 35.6           | 22.7          |
| C7   | 5.32         | 4.32            | D    | 8.5               | 60.5                              | 34.6                     | 25.9           | 8.6           |
| C8   | 4.60         | 3.76            | B    | 6.0               | 41.4                              | 37.6                     | 26.3           | 15.0          |
| C9   | 4.85         | 4.73            | D    | 11.4              | 71.0                              | 61.5                     | 42.6           | 9.5           |
| (A)* | 5.02         | 3.38            | -    | 10.5              | 29.6<br>(16.5)**                  | 13.6<br>(13.3)           | 5.9<br>(8.2)   | 3.7<br>(5.2)  |
| (B)  | 5.25         | 3.21            | -    | 11.9              | 44.6<br>(15.9)                    | 34.5<br>(11.6)           | 16.5<br>(12.4) | 8.7<br>(11.1) |
| (C)  | 5.57         | 3.46            | -    | 11.2              | 57.2<br>(12.9)                    | 47.4<br>(11.4)           | 32.5<br>(6.4)  | 16.2<br>(6.5) |

NOTE: WSP = wind speed, WSP ( $\perp$ ) = wind speed perpendicular to the transmissometer line-of-sight, PASQ = Pasquill Stability Category.

\* Mean values for charge weight.

\*\* Standard deviations are displayed in parentheses.

Table 14  
Obscuration Widths (3.8  $\mu\text{m}$ )

| Shot | WSP<br>m/sec | WSP ( $\perp$ ) | PASQ | Cloud<br>Age, sec | Percent<br>Transmission Widths, m |                    |                |              |
|------|--------------|-----------------|------|-------------------|-----------------------------------|--------------------|----------------|--------------|
|      |              |                 |      |                   | 50                                | 37<br>( $e^{-1}$ ) | 10             | 2            |
| A3   | 8.16         | 4.56            | D    | 14.5              | 36.5                              | 4.6                | 0.0            | 0.0          |
| A5   | 2.33         | 2.13            | C    | 14.5              | 6.4                               | 0.0                | 0.0            | 0.0          |
| A6   | 6.29         | 3.42            | D    | 7.9               | 13.7                              | 10.3               | 0.0            | 0.0          |
| A7   | 5.71         | 4.16            | C    | 8.5               | 33.3                              | 29.1               | 12.5           | 0.0          |
| A9   | 2.61         | 2.61            | A    | 7.3               | 26.1                              | 20.9               | 10.4           | 2.6          |
| B1   | 3.03         | 2.93            | A    | 11.8              | 55.7                              | 44.0               | 20.5           | 0.0          |
| B2   | 2.98         | 2.73            | B    | 13.0              | 49.1                              | 38.2               | 0.0            | 0.0          |
| B3   | 6.66         | 2.71            | C    | 14.1              | 27.1                              | 24.4               | 13.6           | 5.4          |
| B4   | 6.76         | 4.32            | C    | 11.3              | 51.8                              | 43.2               | 30.2           | 17.3         |
| B6   | 6.20         | 3.13            | D    | 10.5              | 21.9                              | 18.8               | 0.0            | 0.0          |
| B7   | 8.79         | 4.83            | D    | 6.1               | 53.1                              | 48.3               | 29.0           | 0.0          |
| B8   | 3.99         | 3.12            | B    | 6.9               | 49.9                              | 25.0               | 9.4            | 3.1          |
| B9   | 3.61         | 1.92            | C    | 21.1              | 25.0                              | 19.2               | 5.8            | 0.0          |
| C1   | 2.81         | 2.02            | D    | 12.7              | 64.6                              | 58.5               | 30.3           | 20.2         |
| C4   | 7.02         | 4.33            | D    | 9.1               | 47.6                              | 39.0               | 21.7           | 8.7          |
| C5   | 8.82         | 1.62            | C    | 19.2              | 48.7                              | 47.0               | 29.2           | 14.6         |
| C7   | 5.32         | 4.32            | D    | 8.5               | 51.8                              | 34.6               | 25.9           | 0.0          |
| C8   | 4.60         | 3.76            | B    | 6.0               | 41.4                              | 37.6               | 18.8           | 3.8          |
| C9   | 4.85         | 4.73            | D    | 11.4              | 71.0                              | 61.5               | 33.1           | 4.7          |
| (A)* | 5.02         | 3.38            | -    | 10.5              | 23.2<br>(12.8)**                  | 13.0<br>(11.9)     | 4.6<br>(6.3)   | 0.5<br>(1.2) |
| (B)  | 5.25         | 3.21            | -    | 11.9              | 41.7<br>(14.3)                    | 32.6<br>(12.0)     | 13.6<br>(12.0) | 3.2<br>(6.0) |
| (C)  | 5.57         | 3.46            | -    | 11.2              | 54.2<br>(11.3)                    | 46.4<br>(11.4)     | 26.5<br>(5.4)  | 8.7<br>(7.5) |

NOTE: WSP = wind speed, WSP ( $\perp$ ) - wind speed perpendicular to the transmissometer line-of-sight, PASQ = Pasquill Stability Category.

\* Mean values for charge weight.

\*\* Standard deviations are displayed in parentheses.

Table 15  
Obscuration Widths (8.4-12  $\mu\text{m}$ )

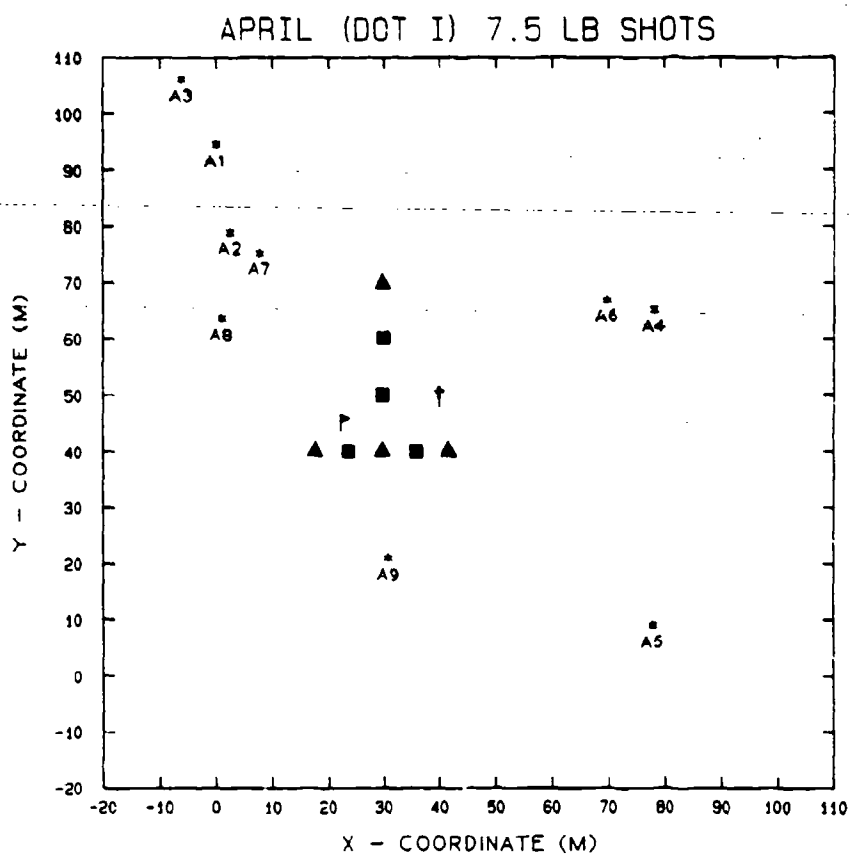
| Shot | WSP<br>m/sec | WSP ( $\perp$ ) | PASQ | Cloud<br>Age, sec | Percent<br>Transmission Widths, m |                    |                |               |
|------|--------------|-----------------|------|-------------------|-----------------------------------|--------------------|----------------|---------------|
|      |              |                 |      |                   | 50                                | 37<br>( $e^{-1}$ ) | 10             | 2             |
| A3   | 8.16         | 4.56            | D    | 14.5              | 18.2                              | 0.0                | 0.0            | 0.0           |
| A5   | 2.33         | 2.13            | C    | 14.5              | 2.1                               | 0.0                | 0.0            | 0.0           |
| A6   | 6.29         | 3.42            | D    | 7.9               | 13.7                              | 3.4                | 0.0            | 0.0           |
| A7   | 5.71         | 4.16            | C    | 8.5               | 33.3                              | 29.1               | 12.5           | 0.0           |
| A9   | 2.61         | 2.61            | A    | 7.3               | 23.5                              | 20.9               | 13.1           | 2.6           |
| B1   | 3.03         | 2.93            | A    | 11.8              | 46.9                              | 35.2               | 14.7           | 0.0           |
| B2   | 2.98         | 2.73            | B    | 13.0              | 43.7                              | 21.8               | 0.0            | 0.0           |
| B3   | 6.66         | 2.71            | C    | 14.1              | 24.4                              | 21.7               | 13.6           | 8.1           |
| B4   | 6.76         | 4.32            | C    | 11.3              | 43.2                              | 43.2               | 30.2           | 21.6          |
| B6   | 6.20         | 3.13            | D    | 10.5              | 21.9                              | 15.7               | 6.3            | 0.0           |
| B7   | 8.79         | 4.83            | D    | 6.1               | 48.3                              | 43.5               | 29.0           | 14.5          |
| B8   | 3.99         | 3.12            | B    | 6.9               | 31.2                              | 18.7               | 12.5           | 9.4           |
| B9   | 3.61         | 1.92            | C    | 21.1              | 21.1                              | 19.2               | 5.8            | 0.0           |
| C1   | 2.81         | 2.02            | D    | 12.7              | 58.6                              | 46.5               | 26.3           | 12.1          |
| C4   | 7.02         | 4.33            | D    | 9.1               | 39.0                              | 39.0               | 26.0           | 17.3          |
| C5   | 8.82         | 1.62            | C    | 19.2              | 47.0                              | 43.7               | 24.3           | 11.3          |
| C7   | 5.32         | 4.32            | D    | 8.5               | 34.6                              | 34.6               | 17.3           | 13.0          |
| C8   | 4.60         | 3.76            | B    | 6.0               | 37.6                              | 37.6               | 22.6           | 7.5           |
| C9   | 4.85         | 4.73            | D    | 11.4              | 66.2                              | 56.8               | 23.7           | 0.0           |
| (A)* | 5.02         | 3.38            | -    | 10.5              | 18.5<br>(11.6)**                  | 10.7<br>(13.5)     | 5.1<br>(7.0)   | 0.5<br>(1.2)  |
| (B)  | 5.25         | 3.21            | -    | 11.9              | 35.1<br>(11.7)                    | 27.4<br>(11.4)     | 14.0<br>(10.8) | 6.7<br>(8.2)  |
| (C)  | 5.57         | 3.46            | -    | 11.2              | 47.2<br>(12.7)                    | 43.0<br>(8.0)      | 23.4<br>(3.3)  | 10.2<br>(5.9) |

NOTE: WSP = wind speed, WSP ( $\perp$ ) = wind speed perpendicular to the transmissometer line-of-sight, PASQ = Pasquill Stability Category.

\* Mean values for charge weight.

\*\* Standard deviations are displayed in parentheses.

APPENDIX A: DATA COLLECTED IN DOT I  
AND DOT II EXERCISES



- — HI-VOL SAMPLERS
- ▲ — NEPHELOMETER AND HI-VOL SAMPLERS
- ★ — POINT OF BURST FOR 7.5-LB SHOTS
- ┆ — 2-M MET TOWER
- ┆ — 16-M MET TOWER

# EVENT SUMMARY DATA

Test Number: REA1  
 Date: 19 APRIL 83  
 Detonation Coordinates (M):  
 X: 0.0  
 Y: 94.5  
 Surface Tangent  
 Charge Shape: BLOCK  
 Charge Wt: 7.5 LB  
 Event Time: 11:18:59

## METEOROLOGICAL DATA:

Pacquiil Category: B  
 Richardson Number: -0.361

15 Meter Tower (Means)  
 Start Time: 11:18:24 End Time: 11:20:29

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 5.42  | 5.98  | 6.13  | 6.94  |
| Wind Dir. (DEG)  | 230.3 | 230.4 | 231.2 | 229.4 |
| Sigma WSP        | 1.09  | 1.03  | 0.99  | 1.04  |
| Sigma WDIR       | 15.9  | 15.2  | 15.8  | 15.5  |
| UVM Components   |       |       |       |       |
| U (N-S) (M/S)    | 3.31  | 3.64  | 3.64  | 4.27  |
| V (E-W) (M/S)    | 4.03  | 4.49  | 4.66  | 5.17  |
| W (Vert) (M/S)   | 0.15  | 0.51  | 0.21  | •     |
| Sigma U          | 1.27  | 1.20  | 1.16  | 1.19  |
| Sigma V          | 1.33  | 1.43  | 1.57  | 1.73  |
| Sigma W          | 0.21  | 0.32  | 0.41  | •     |
| Temperature (C)  | 27.4  | 19.4  | 19.0  | 18.4  |

Soil Temperature (°): 30.7 Solar Flux (W/M²): 1017.0  
 Dew Point (C): -5.8 Visual Range (M): 30480.0  
 Temperature (C): 18.8 Vista Ranger Voltages:  
 Rel. Hum. (%): 17.3 Sky: •  
 Target: •  
 Abs. Hum. (C/M³): 2.79 Sky-Target Contrast: •  
 Rain Accumulation (mm): 0.00

## CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45   |
|-----------|---------------|-----|-----|-----|------|
| Pre-Shot  | 3.0 90.0      | 62  | 192 | 545 | 750+ |
| Post-Shot | 3.0 90.0      | 38  | 96  | 367 | 750+ |

## CRATER DATA

Moisture Content: 11.5

CRATER VOLUMES (M³):  
 True Crater: 0.420  
 Apparent Crater: 0.118  
 Flow: 0.303

DENSITIES (G/CM³):  
 Pre-Shot: •  
 Flow: 1.002  
 Bottom: •  
 Side: •

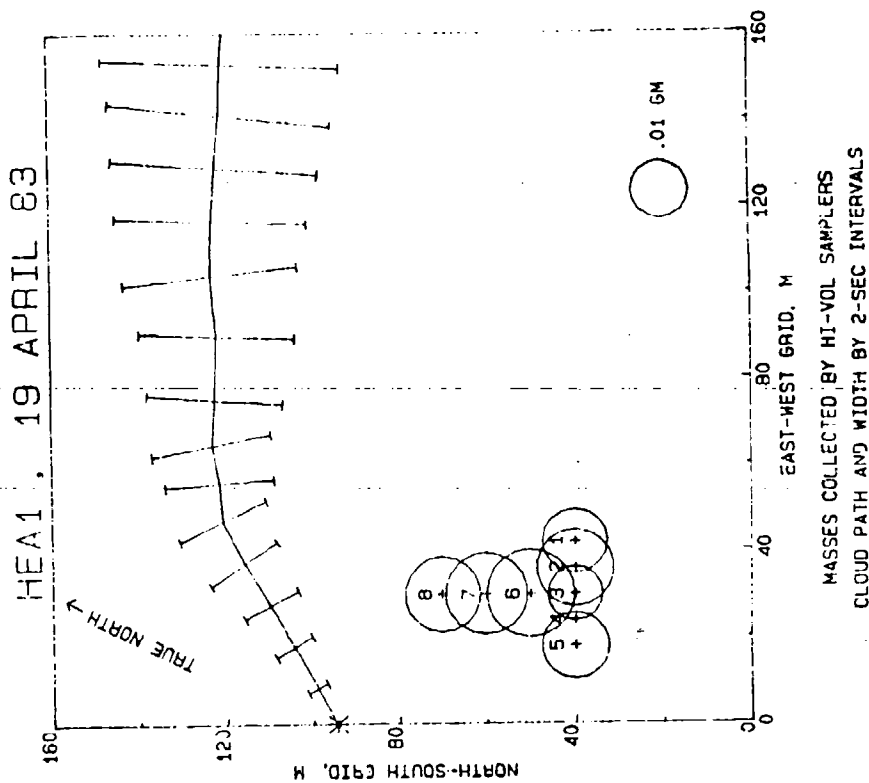
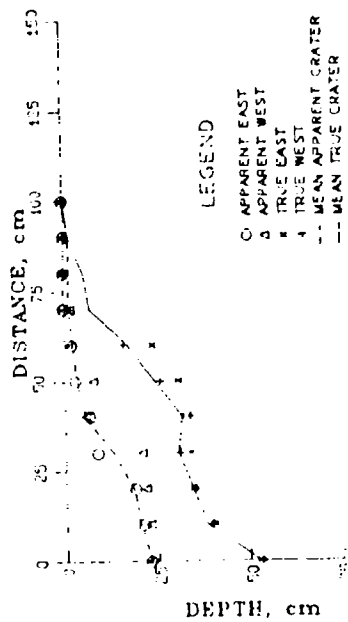
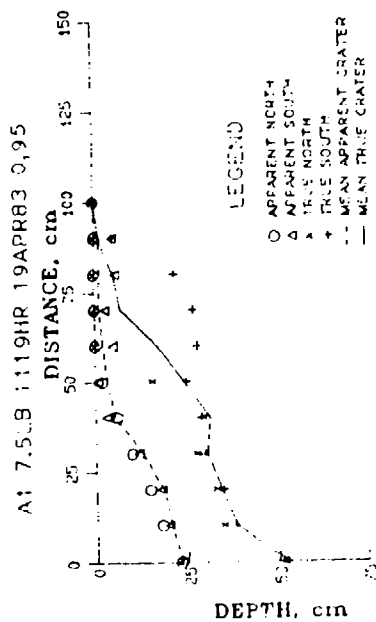
## HI VOL DATA (G):

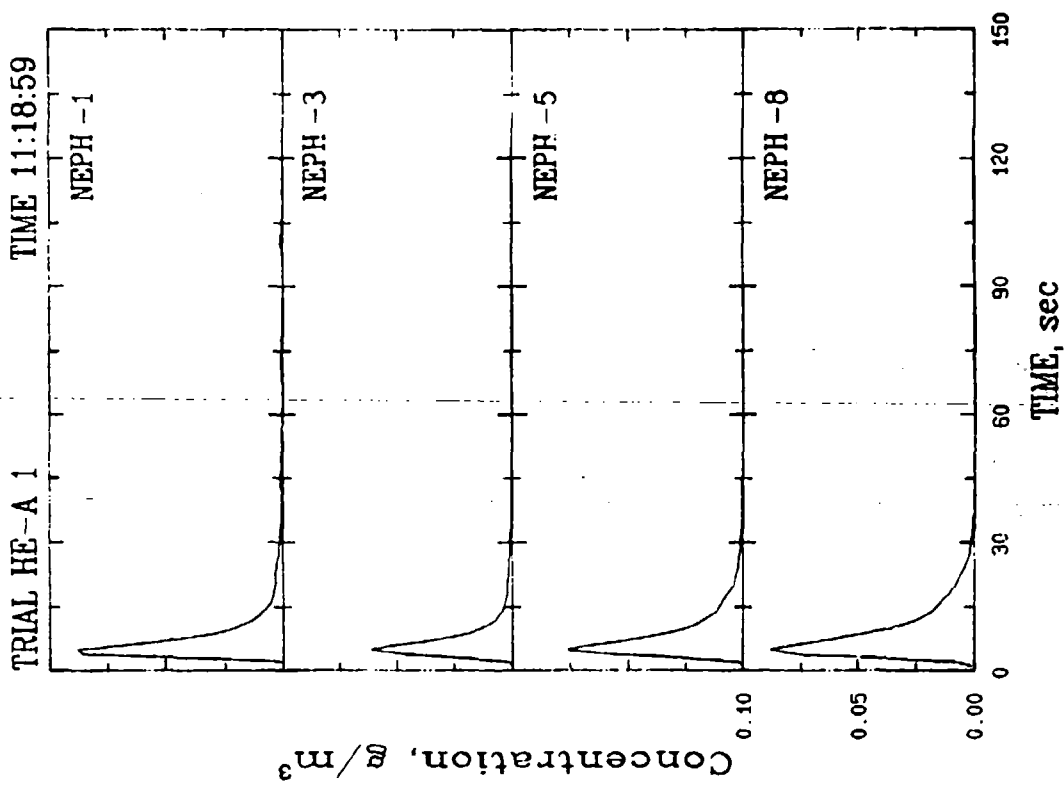
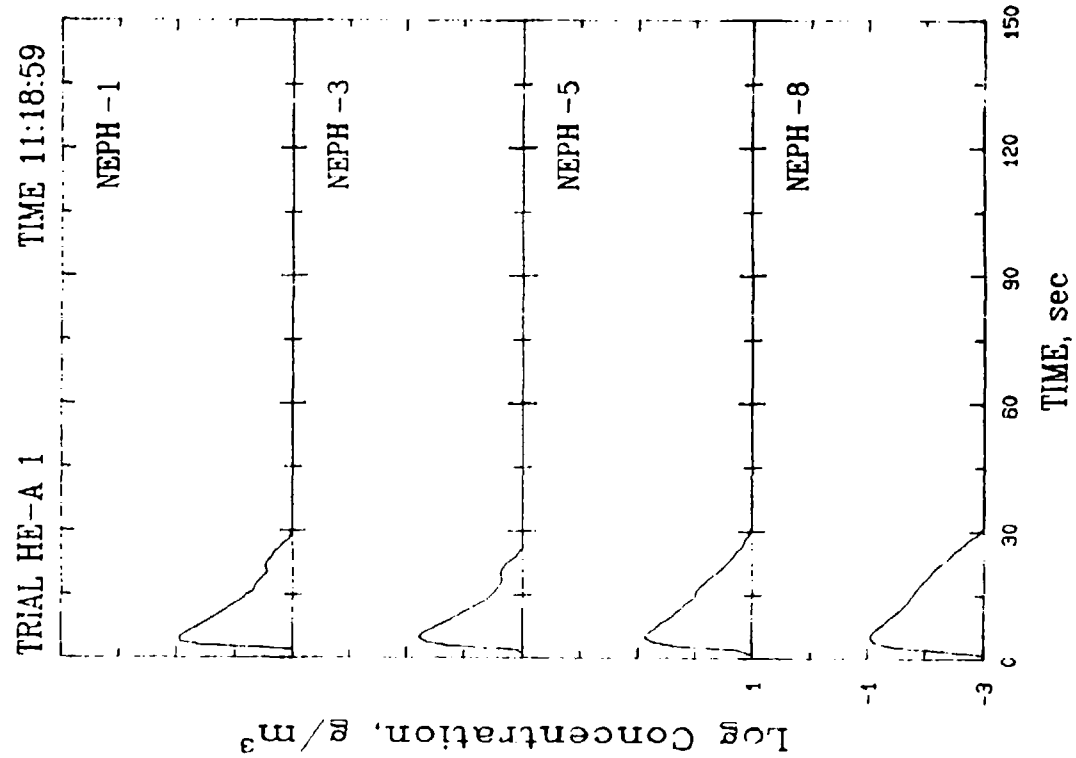
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0129 | 0.0177 | 0.0088 | 0.0000 | 0.0139 | 0.0233 | 0.0203 | 0.0171 |

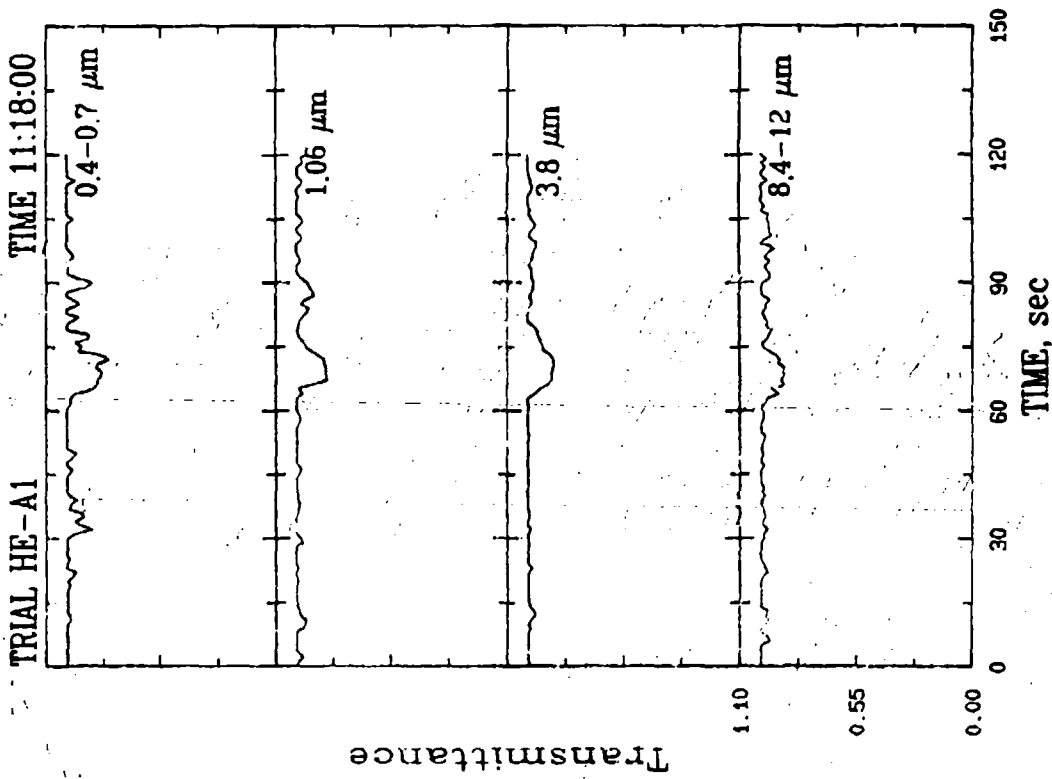
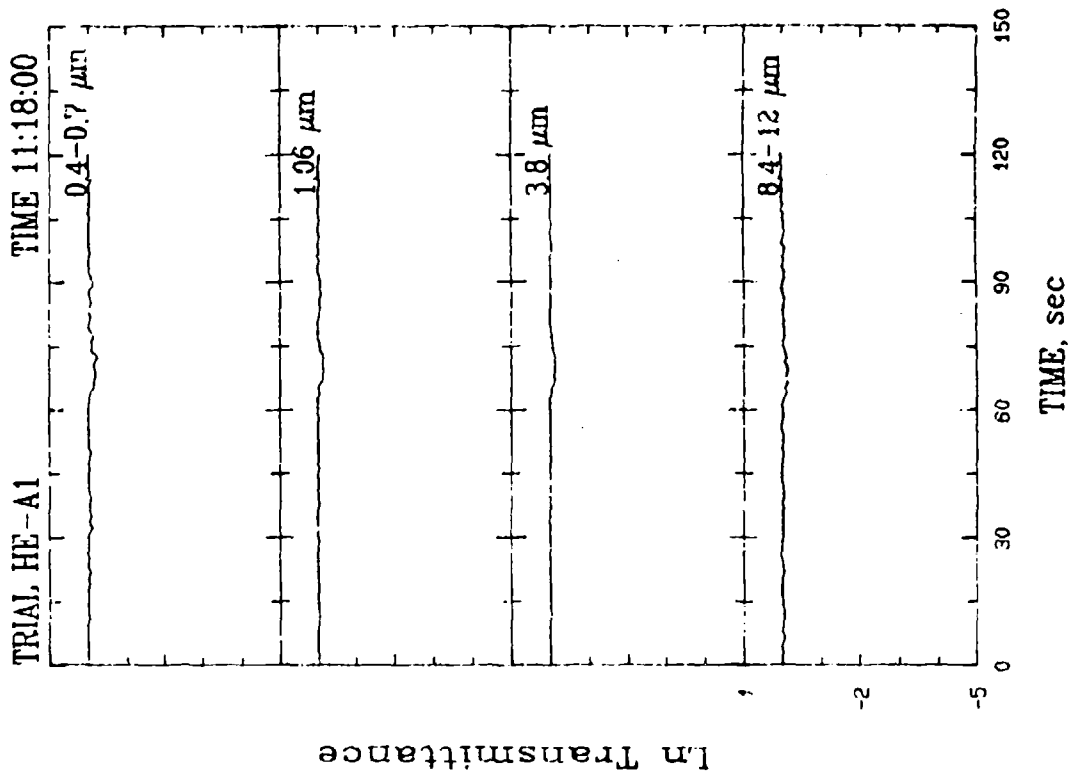
SUM: 0.1140

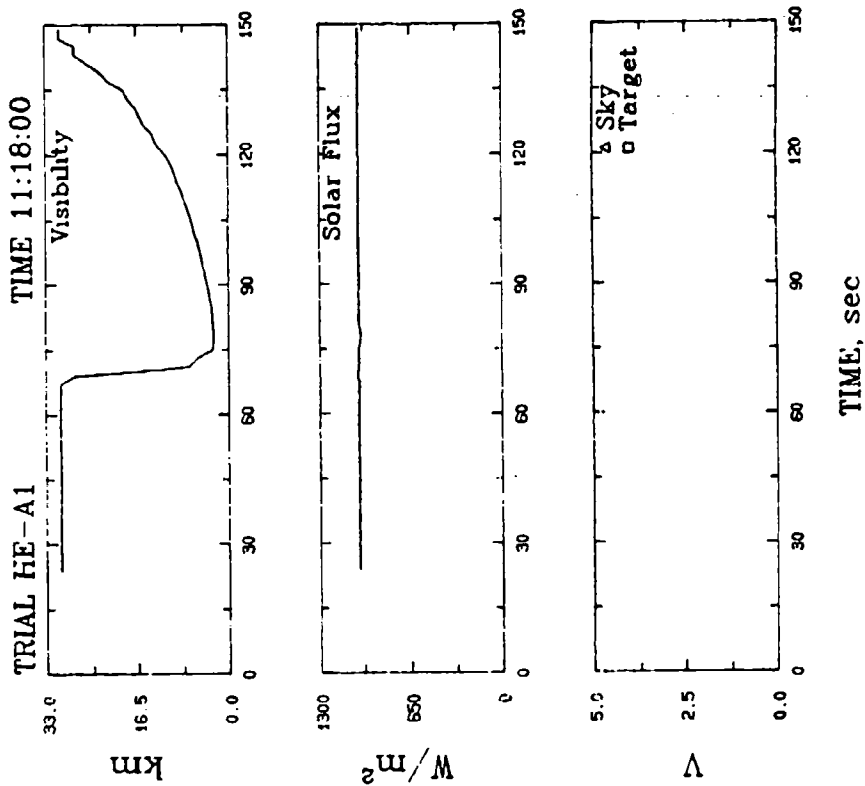
## GELMAN DOSAGE (G S/M³):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 0.000    | 0.000    |









# EVENT SUMMARY DATA

Test Number: HEA2  
 Date: 19 APRIL 83  
 Detonation Coordinates (M):  
 X: 2.4  
 Y: 78.9  
 Surface Tangent:  
 Charge Shape: SPHERICAL  
 Charge Wt: 7.5 LB  
 Event Time: 13:57:01

## METEOROLOGICAL DATA:

Pasquill Category: B  
 Richardson Number: -0.222

16 Meter Tower (Means)  
 Start Time: 13:56:16 End Time: 13:59:15

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 5.89  | 6.46  | 6.76  | 7.67  |
| Wind Dir. (DEG)  | 259.3 | 258.2 | 258.7 | 253.7 |
| Sigma WSP        | 2.32  | 2.51  | 2.51  | 2.74  |
| Sigma WDIR       | 15.1  | 13.7  | 12.6  | 10.3  |
| UTW Components   |       |       |       |       |
| U (N-S) (M/S)    | 1.41  | 1.64  | 1.62  | 2.39  |
| V (E-W) (M/S)    | 5.50  | 6.03  | 6.38  | 7.15  |
| W (Vert) (M/S)   | 0.04  | 0.36  | 0.22  | •     |
| Sigma U          | 2.07  | 2.21  | 2.12  | 2.09  |
| Sigma V          | 1.90  | 2.02  | 2.06  | 2.26  |
| Sigma W          | 0.20  | 0.45  | 0.46  | •     |
| Temperature (C)  | 22.6  | 21.7  | 21.5  | 20.6  |

Soil Temperature (C): 35.3 Solar Flux (W/M<sup>2</sup>): 871.9  
 Dew Point (C): -6.9 Visual Range (M): 30480.0  
 Temperature (C): 20.8 Vista Ranger Voltages:  
 Rel. Hum. (%): 13.8 Sky: 3.28  
 Target: 0.78  
 Abs. Hum. (G/M<sup>3</sup>): 2.51 Sky-Target Contrast: -0.76  
 Rain Accumulation (MM): 0.00

## CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45   |
|-----------|---------------|-----|-----|-----|------|
| Pre-Shot  | 3.0 77.0      | 50  | 190 | 515 | 750+ |
| Post-Shot | 3.0 77.0      | 50  | 100 | 433 | 750+ |

## CRATER DATA

Moisture Content: 13.1

## CRATER VOLUMES (M<sup>3</sup>):

True Crater: 0.493  
 Apparent Crater: 0.151  
 Flow: 0.342

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.430  
 Flow: 0.933  
 Bottom: •  
 Side: •

## HI VOL DATA (G):

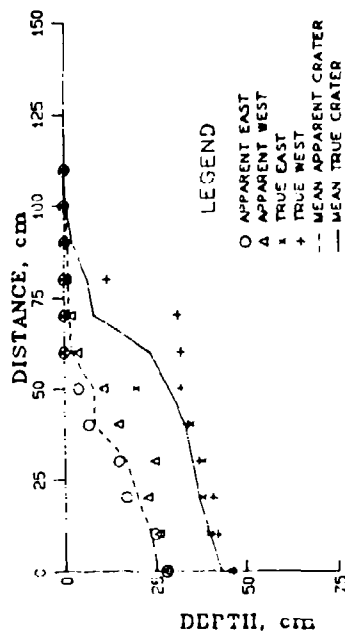
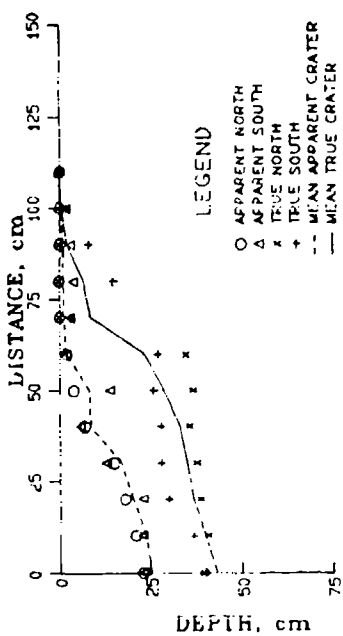
|  | HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--|--------|--------|--------|--------|--------|--------|--------|--------|
|  | 0.0375 | 0.0370 | 0.0294 | 0.0464 | 0.0461 | 0.0590 | 0.0767 | 0.1768 |

SUM: 0.5089

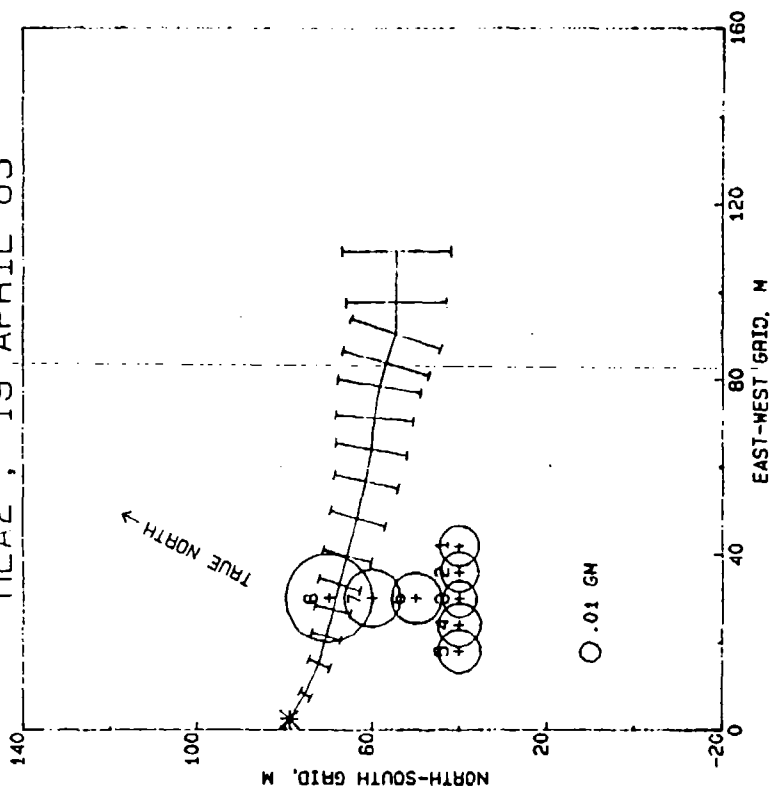
## GELMAN DOSAGE (G S/M<sup>3</sup>):

|  | GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|--|----------|----------|----------|----------|
|  | 60.948   | 0.000    | 5.978    | 0.000    |

A2 7.5LB 1357HR 19APR83 2,79 (SP)



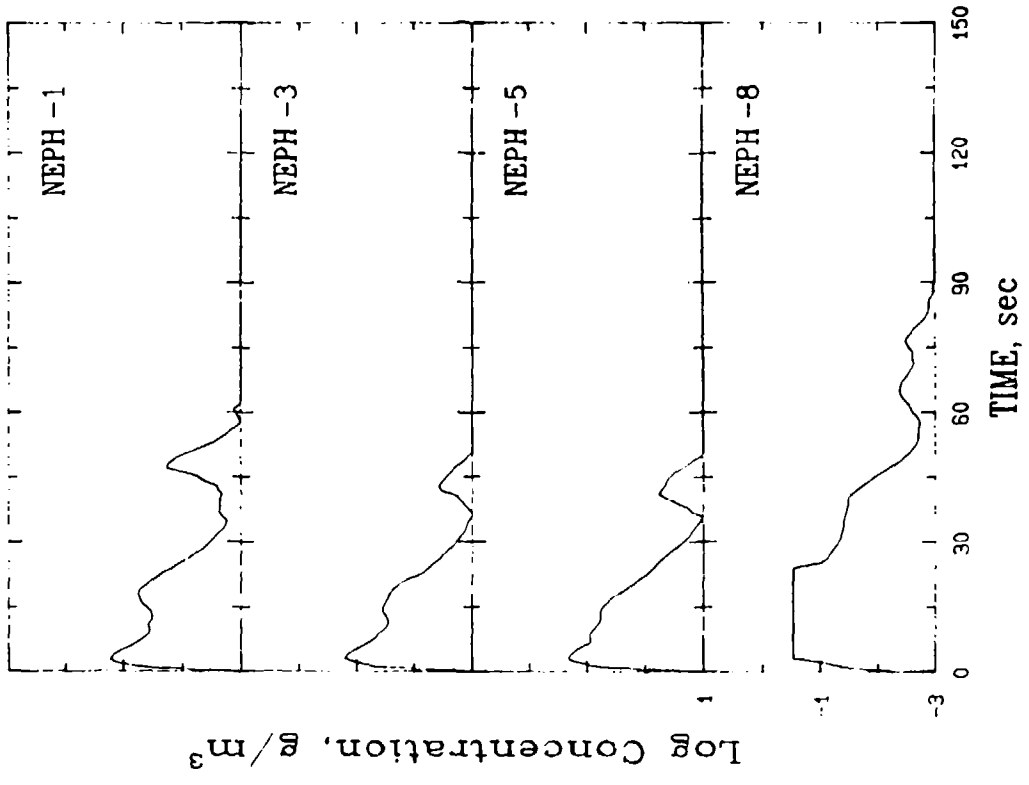
HEA2, 19 APRIL 83



MASSSES COLLECTED BY M1-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS

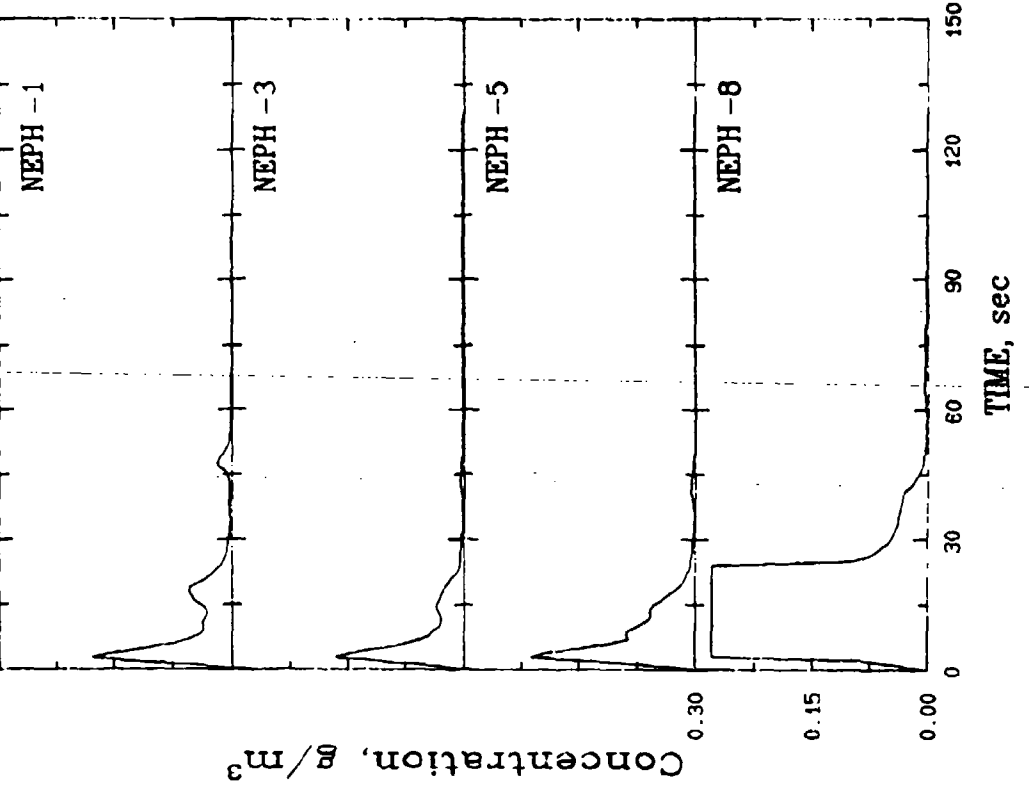
TRIAL HE-A 2

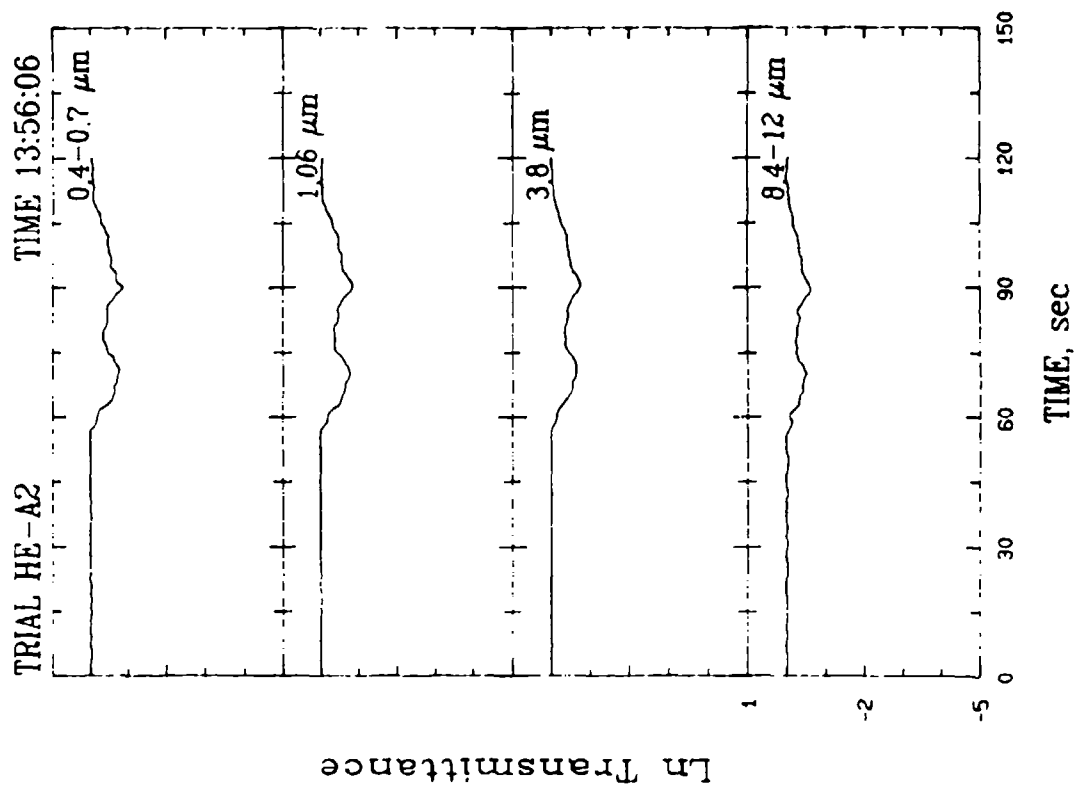
TIME 13:57:01



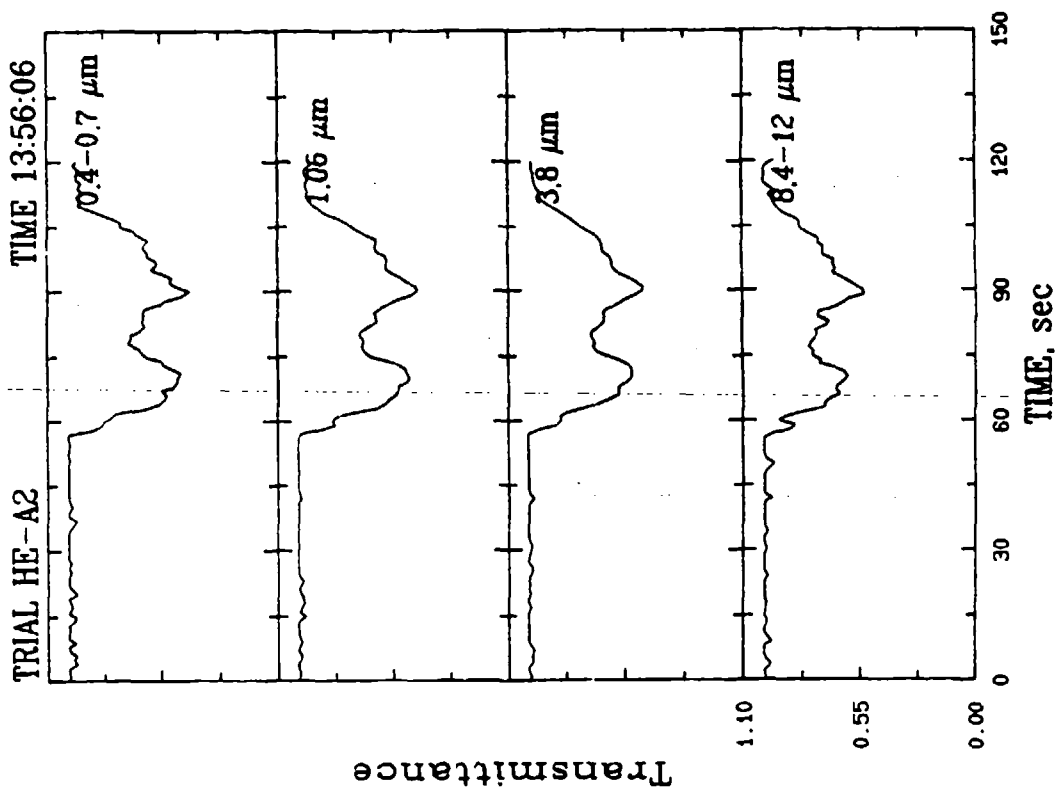
TRIAL HE-A 2

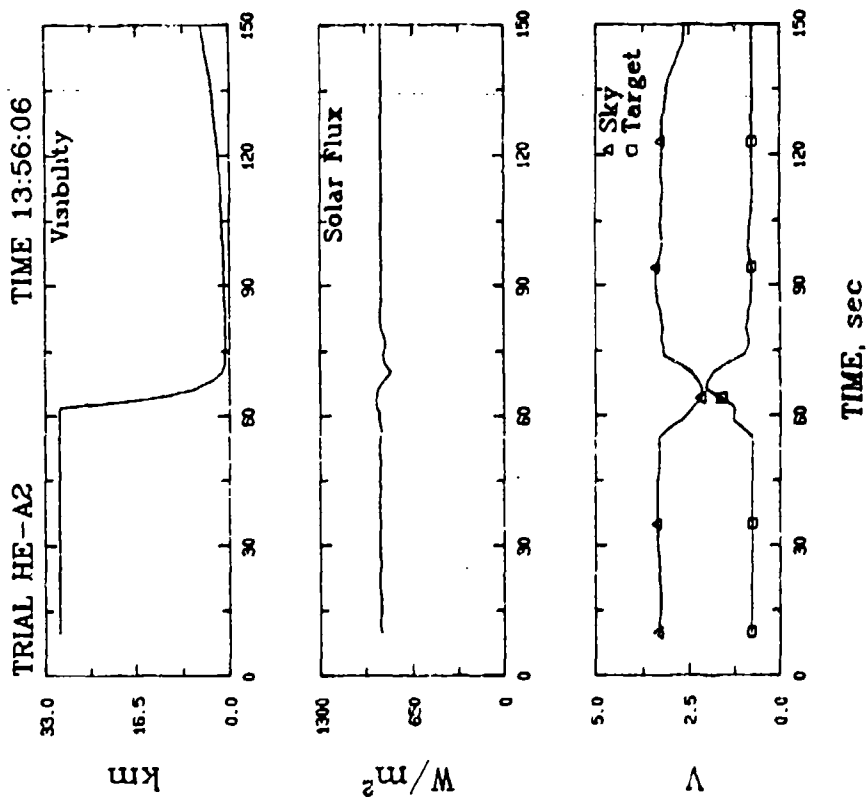
TIME 13:57:01





A12





# EVENT SUMMARY DATA

Test Number: BEA3  
 Date: 19 APRIL 83  
 Detonation Coordinates (N):  
 X: -6.1  
 Y: 106.1  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 7.5 LB  
 Event Time: 13:17:01

## METEOROLOGICAL DATA:

Pasquill Category: D  
 Richardson Number: -0.291

16 Meter Tower (Means)  
 Start Time: 15:15:50 End Time: 15:18: 6

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 8.16  | 8.64  | 9.06  | 9.60  |
| Wind Dir. (DEG)  | 278.0 | 275.5 | 273.8 | 271.7 |
| Sigma WSP        | 1.53  | 1.47  | 1.47  | 1.57  |
| Sigma WDIR       | 5.9   | 5.6   | 5.0   | 5.8   |
| UTV Components   |       |       |       |       |
| U (N-S) (M/S)    | -1.14 | -0.84 | -0.60 | -0.25 |
| V (E-W) (M/S)    | 8.04  | 8.56  | 9.00  | 9.55  |
| W (Vert) (M/S)   | 0.18  | 0.50  | 0.53  | •     |
| Sigma U          | 0.86  | 0.83  | 0.77  | 0.95  |
| Sigma V          | 1.51  | 1.47  | 1.47  | 1.57  |
| Sigma W          | 0.32  | 0.44  | 0.47  | •     |
| Temperature (C)  | 22.9  | 22.5  | 22.3  | 21.0  |

Soil Temperature (C): 30.6 Solar Flux (W/M<sup>2</sup>): 696.5  
 Dew Point (C): -7.7 Visual Range (M): 30480.0  
 Temperature (C): 21.8 Vista Ranger Voltages:  
 Rel. Hum. (%): 12.2 Sky: 2.48  
 Target: 0.77  
 Ats. Hum. (G/M<sup>3</sup>): 2.35 Sky-Target Contrast: -0.69  
 Rain Accumulation (M): 0.00

## CRATER INDEX:

|           | X,Y Coord (N) | SFC | 15  | 30  | 45   |
|-----------|---------------|-----|-----|-----|------|
| Pre-Shot  | -3.0 195.0    | 100 | 150 | 443 | 750+ |
| Post-Shot | -3.0 195.0    | •   | •   | •   | •    |

## CRATER DATA

Moisture Content: 10.4

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.242  
 Apparent Crater: 0.063  
 Flow: 0.176

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: •  
 Flow: 1.131  
 Bottom: •  
 Side: •

## HI VOL DATA (G):

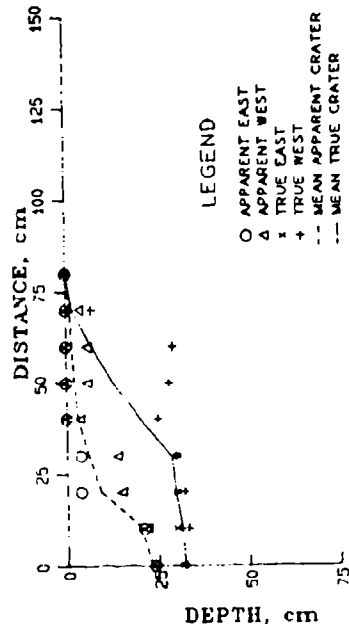
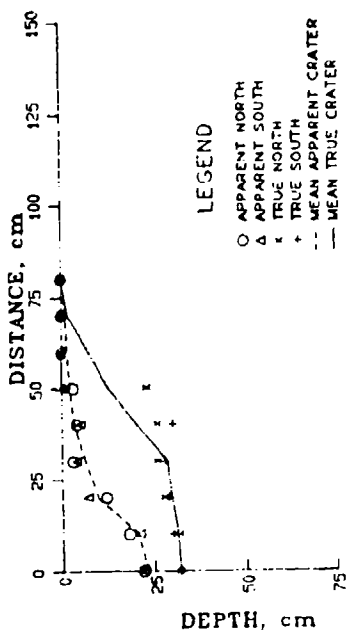
|  | HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--|--------|--------|--------|--------|--------|--------|--------|--------|
|  | 0.0332 | 0.0158 | 0.0188 | 0.0066 | 0.0080 | 0.0134 | 0.0378 | 0.0236 |

SUM: 0.1792

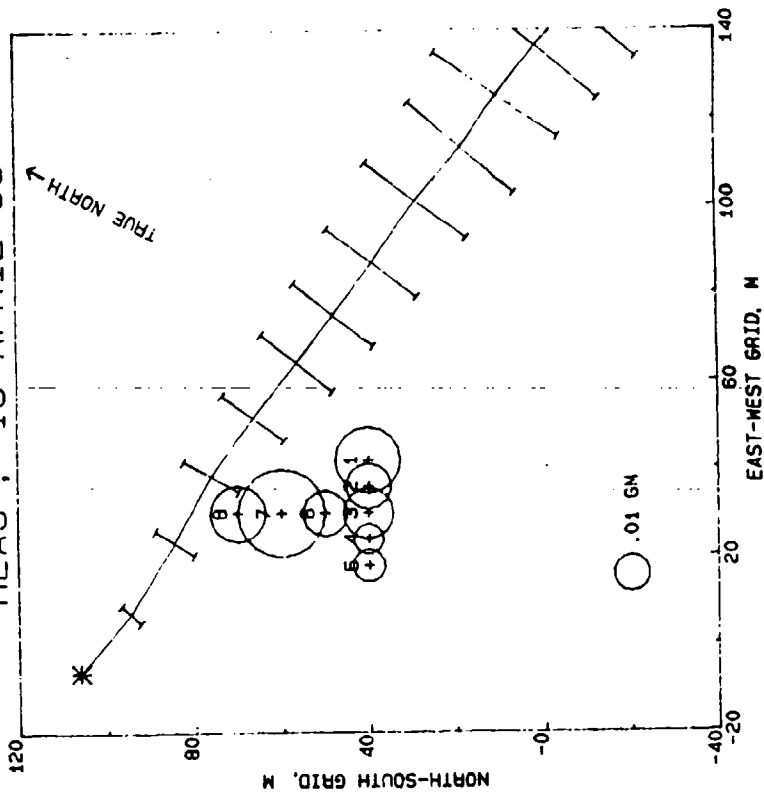
## GELMAN DOSAGE (G S/M<sup>3</sup>):

|  | GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|--|----------|----------|----------|----------|
|  | 4.063    | 0.000    | 0.000    | 0.000    |

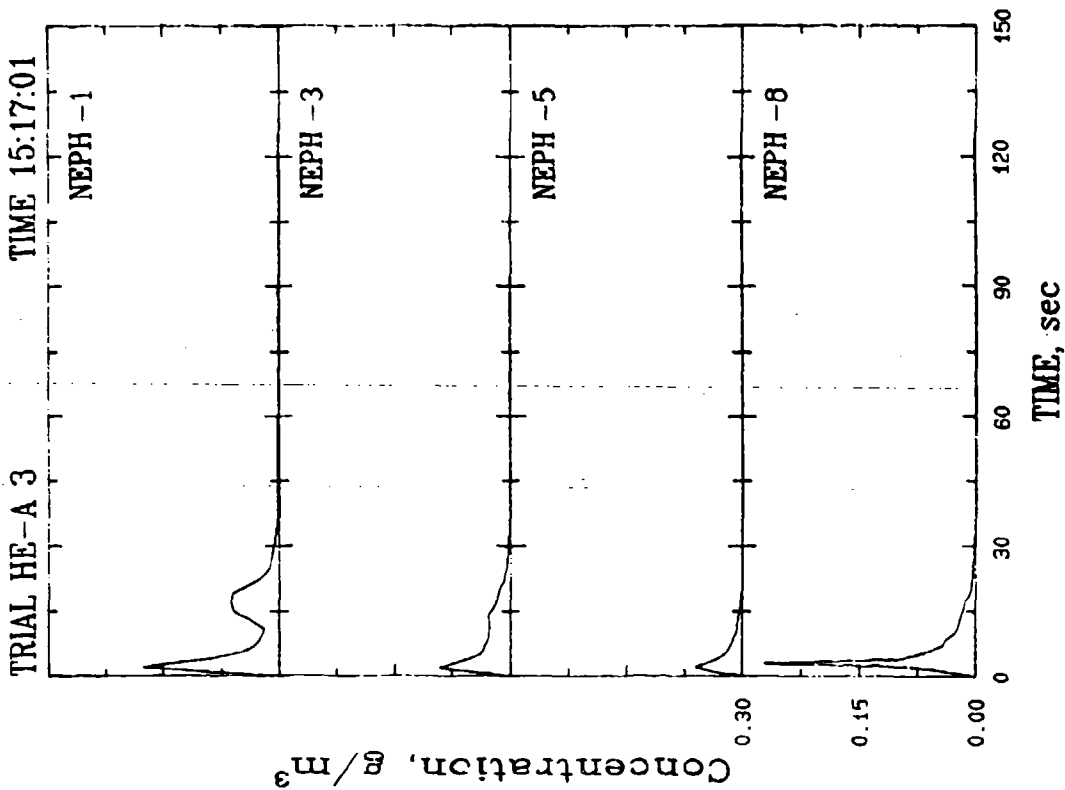
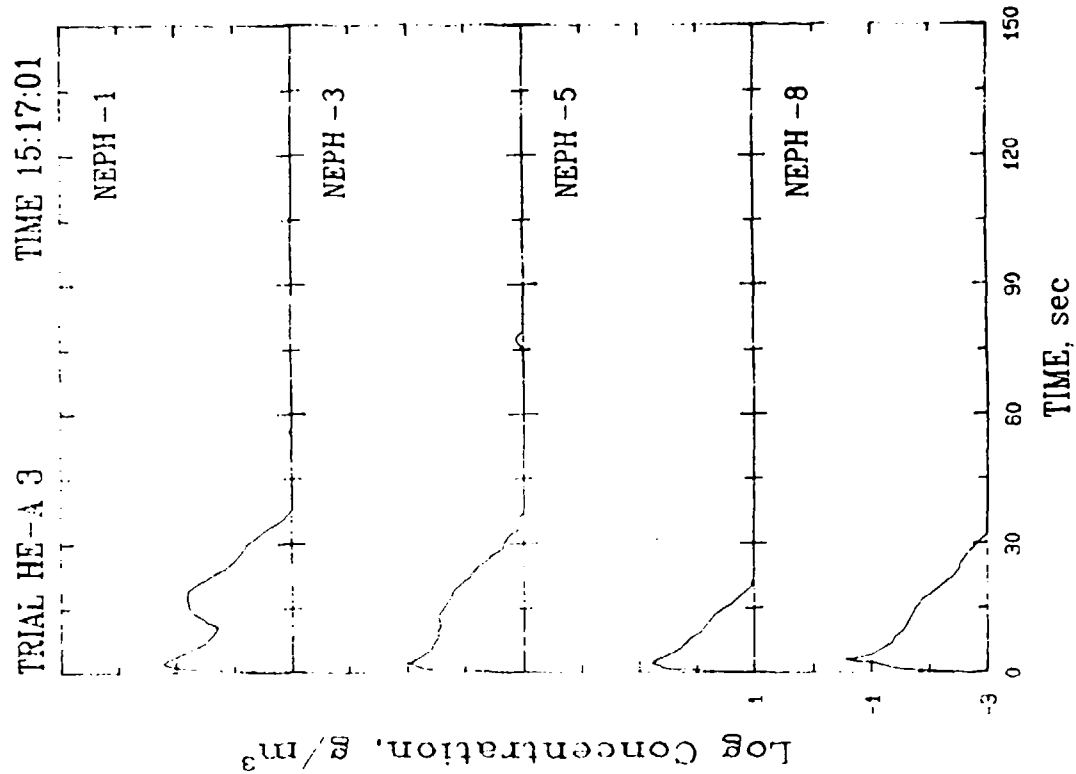
A3 7.5LB 1517HR 19APR83 -6,106

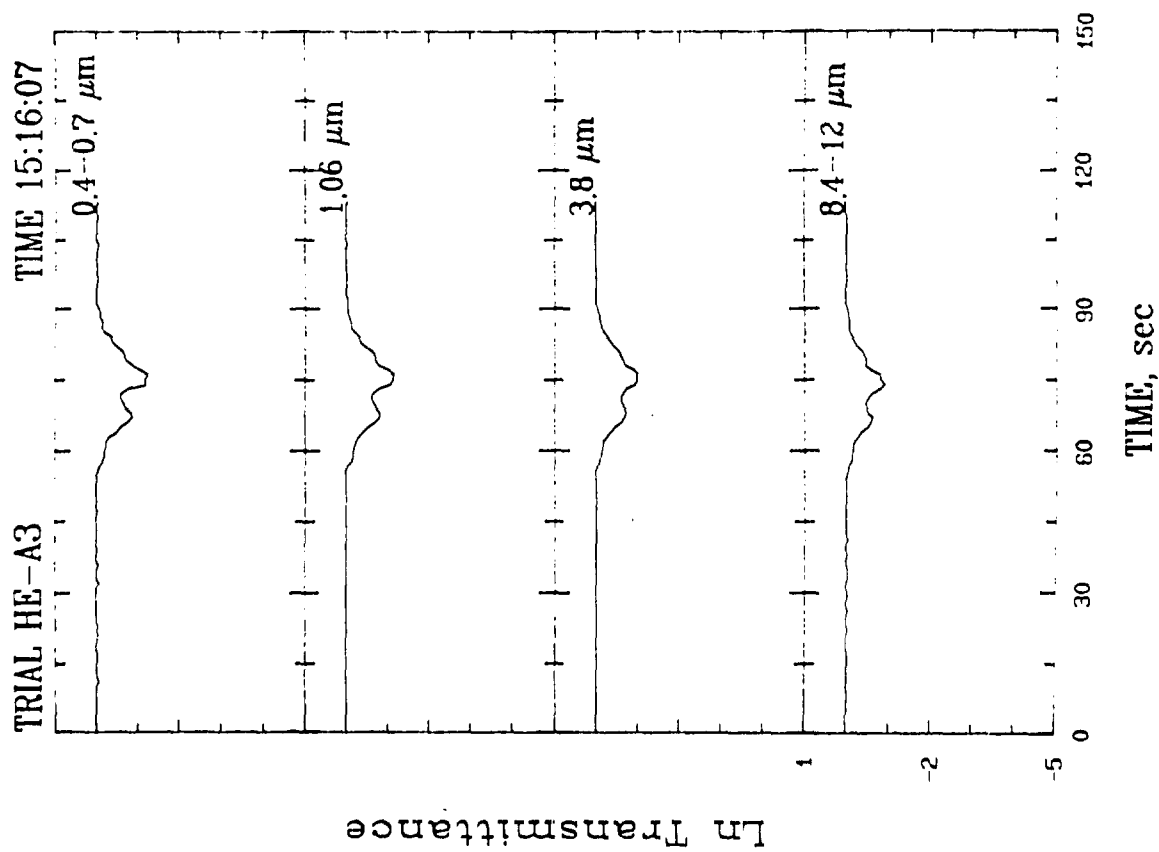
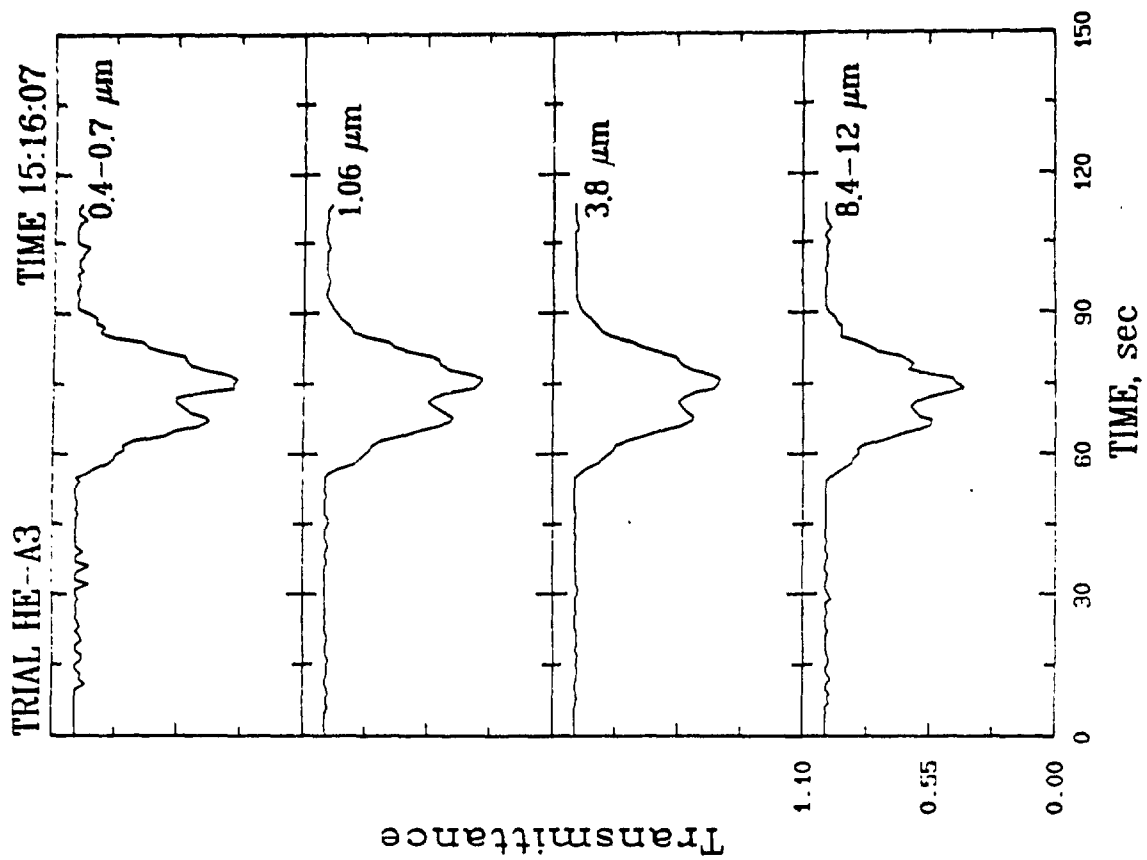


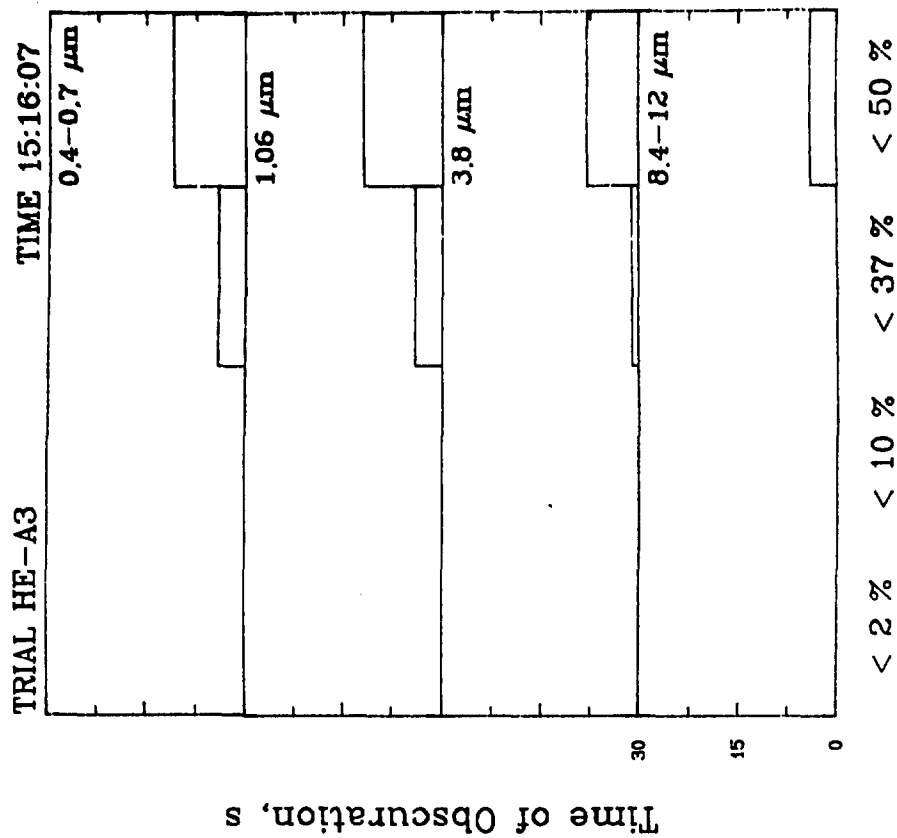
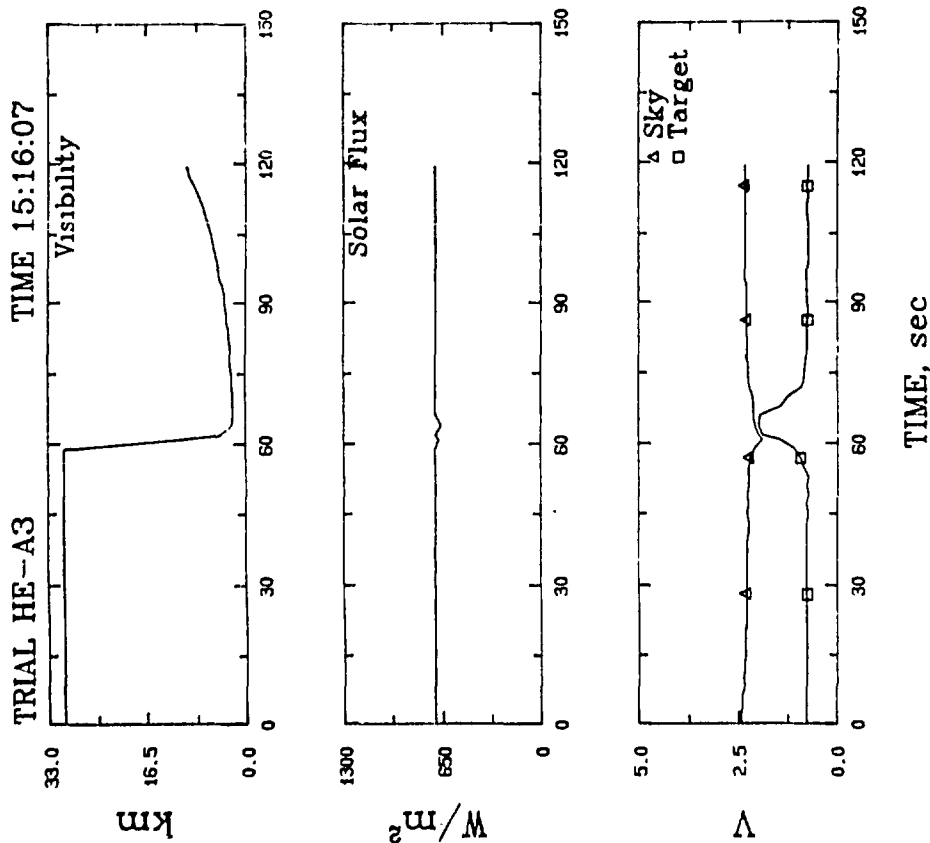
HEA3 . 19 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEA4  
 Date: 20 APRIL 83  
 Detonation Coordinates (M):  
 X: 78.1  
 Y: 65.1  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 7.5 LB  
 Event Time: 09:22:01

## METEOROLOGICAL DATA:

Pasquill Category: B  
 Richardson Number: -19.806

16 Meter Tower (Means)  
 Start Time: 9:19:31 End Time: 9:23:43

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 3.32  | 3.41  | 3.52  | 3.59  |
| Wind Dir. (DEG)  | 93.5  | 91.8  | 94.9  | 100.1 |
| Sigma WSP        | 1.30  | 1.33  | 1.39  | 1.54  |
| Sigma WDIR       | 19.5  | 19.8  | 18.1  | 14.3  |
| UVW Components   |       |       |       |       |
| U (N-S) (M/S)    | 0.40  | 0.29  | 0.45  | 0.56  |
| V (E-W) (M/S)    | -3.14 | -3.23 | -3.34 | -3.45 |
| W (Vert) (M/S)   | 0.22  | 0.16  | 0.24  | 0.3   |
| Sigma U          | 1.02  | 1.05  | 1.01  | 0.83  |
| Sigma V          | 1.29  | 1.34  | 1.39  | 1.55  |
| Sigma W          | 0.19  | 0.29  | 0.37  | 0.4   |
| Temperature (C)  | 15.5  | 14.3  | 13.8  | 13.5  |

Soil Temperature (C): 21.2 Solar Flux (W/M\*\*2): 892.4  
 Dew Point (C): 0.4 Visual Range (M): 30480.0  
 Temperature (C): 14.1 Vista Ranger Voltages:  
 Rel. Hum. (%): 39.2 Sky: 1.89  
 Target: 1.27  
 Abs. Hum. (G/M\*\*3): 4.76 Sky-Target Contrast: -0.33  
 Rain Accumulation (MM): 0.00

## CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 75.0 60.0     | 25  | 119 | 458 | 710 |
| Post-Shot | 75.0 60.0     | 90  | 130 | 350 | 705 |

## CRATER DATA

Moisture Content: 33.3

CRATER VOLUMES (M\*\*3):  
 True Crater: 0.204  
 Apparent Crater: 0.110  
 Flow: 0.094

DENSITIES (G/CM\*\*3):  
 Pre-Shot: 1.540  
 Flow: 1.087  
 Bottom: \*  
 Side: \*

## HI VOL DATA (G):

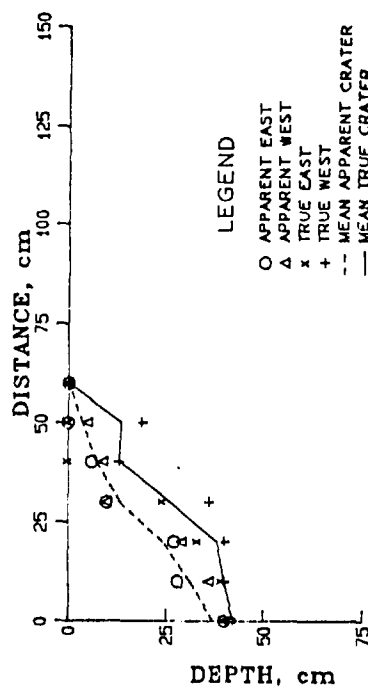
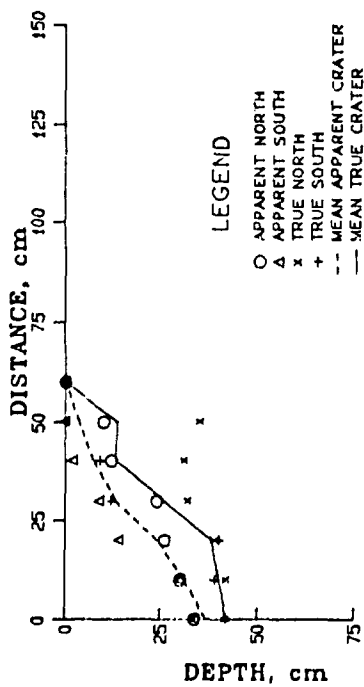
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0166 | 0.0086 | 0.0126 | 0.0183 | 0.0221 | 0.0329 | 0.0302 | 0.0205 |

SUM: 0.1618

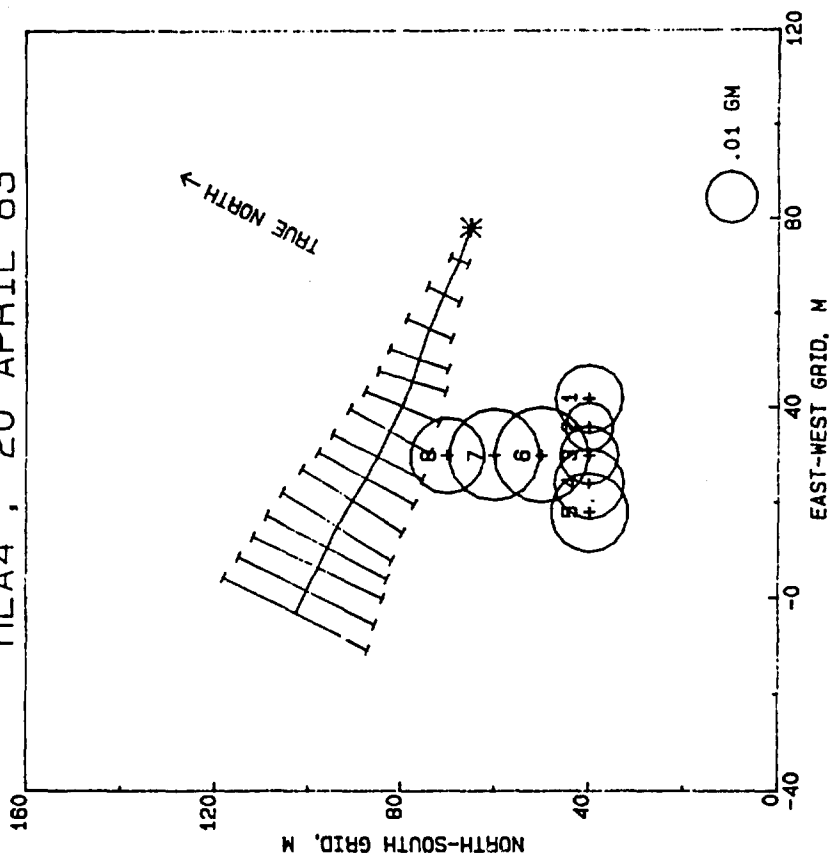
## GELMAN DOSAGE (G S/M\*\*3):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 1.600    | 0.000    | 0.000    |

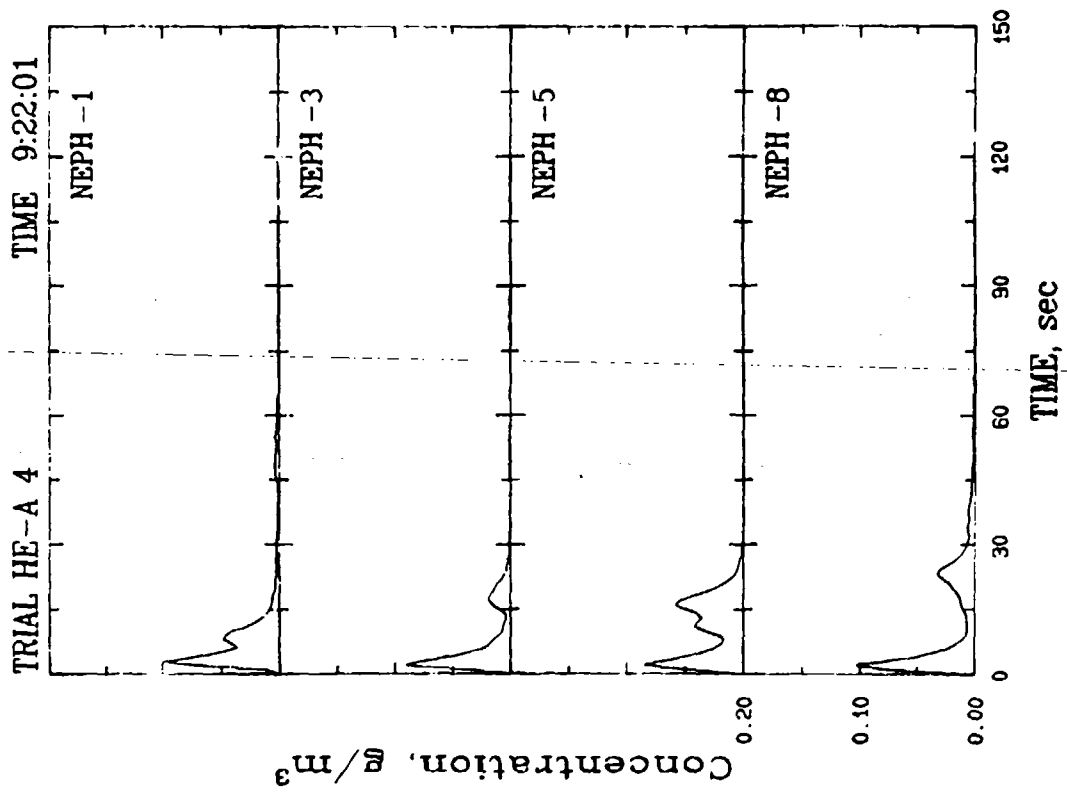
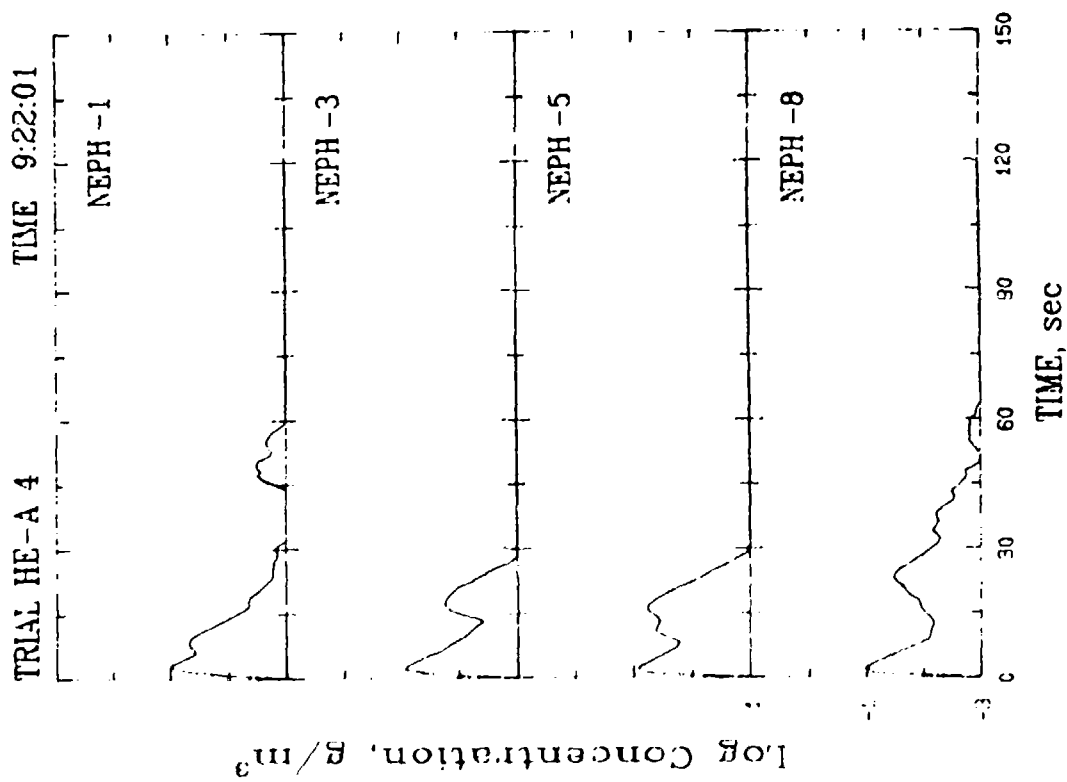
A4 7.5LB 0922HR 20APR83 78,65

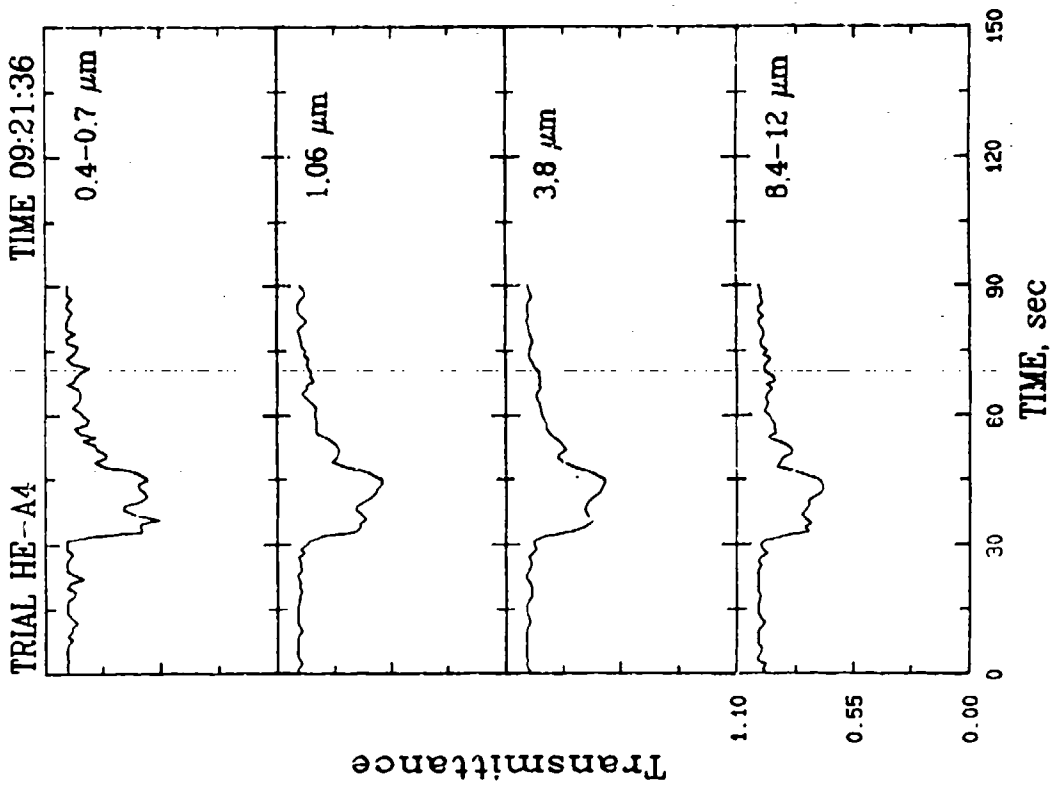
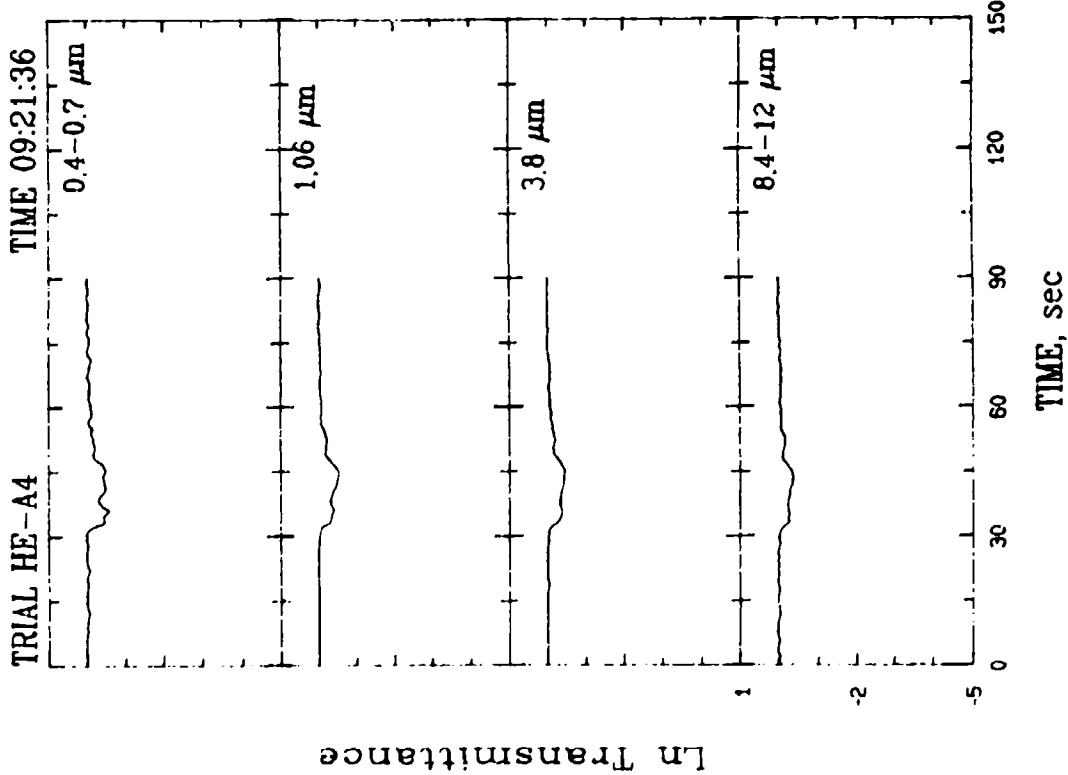


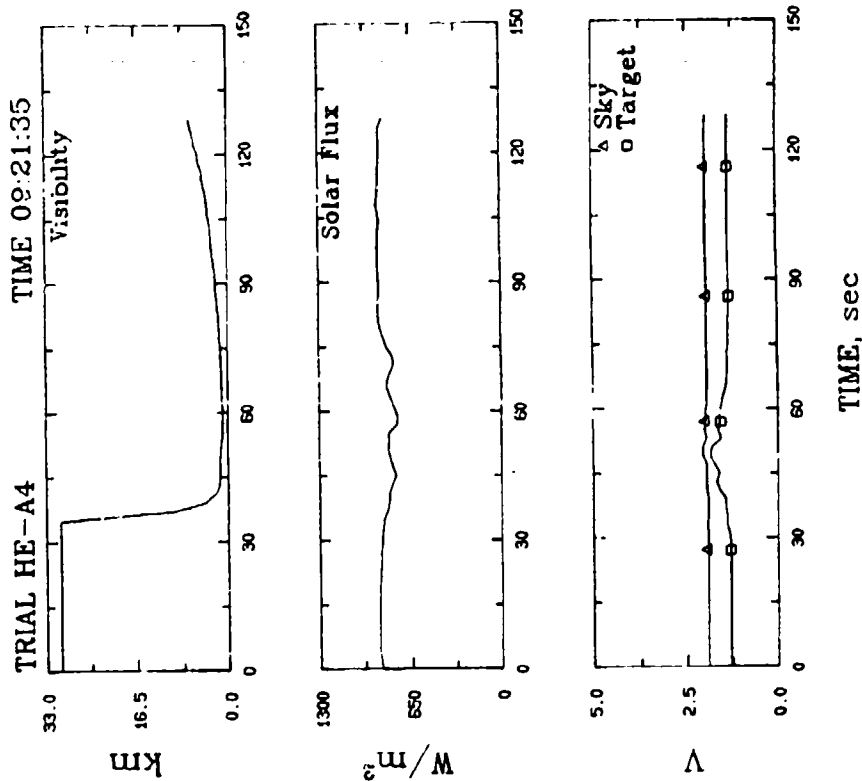
HEA4 , 20 APRIL 83



MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: IIRAS  
 Date: 20 APRIL 83  
 Detonation Coordinates (M):  
     X: 77.7  
     Y: 9.0  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 7.5 Lb  
 Event Time: 10:34:01

# CONF INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45   |
|-----------|---------------|-----|-----|-----|------|
| Pre-Shot  | 78.0 5.0      | 25  | 255 | 635 | 750+ |
| Post-Shot | 78.0 5.0      | 40  | 212 | 492 | 700  |

# CRATER DATA

Moisture Content: 26.7

Parquill Category: A  
 Richardson Number: -6.263

16 Meter Tower (Mean):  
 Start Time: 10:34: 4      End Time: 10:36: 2

CRATER VOLUMES (M\*\*3):  
 True Crater: 0.178  
 Apparent Crater: 0.095  
 Flow: 0.083  
 DENSITIES (G/CM\*\*3):  
 Pre-Shot: 1.320  
 Flow: 1.068  
 Bottom: •  
 Side: •

# METEOROLOGICAL DATA:

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 2.33  | 2.41  | 2.60  | 2.92  |
| Wind Dir. (DEG)  | 128.3 | 125.7 | 124.7 | 118.2 |
| Sigma WSP        | 0.72  | 0.73  | 0.84  | 0.99  |
| Sigma WDIR       | 29.0  | 26.1  | 23.4  | 15.5  |
| UVW ComponentLa  |       |       |       |       |
| U (N-S) (M/S)    | 1.22  | 1.21  | 1.29  | 1.47  |
| V (E-W) (M/S)    | -1.69 | -1.83 | -2.05 | -2.41 |
| W (Vert) (M/S)   | 0.18  | 0.21  | 0.16  | •     |
| Sigma U          | 0.93  | 0.90  | 0.85  | 0.96  |
| Sigma V          | 0.86  | 0.84  | 0.95  | 0.76  |
| Sigma W          | 0.23  | 0.30  | 0.29  | •     |
| Temperature (C)  | 18.1  | 16.8  | 16.1  | 15.7  |

# HI VOL DATA (G):

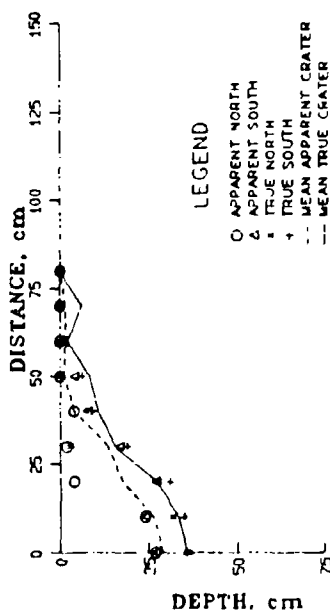
| HV1         | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|-------------|--------|--------|--------|--------|--------|--------|--------|
| 0.0260      | 0.0341 | 0.0244 | 0.0198 | 0.0157 | 0.0163 | 0.0108 | 0.0092 |
| SUM: 0.1563 |        |        |        |        |        |        |        |

# GELMAN DOSAGE (G S/M\*\*3):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 0.000    | 0.000    |

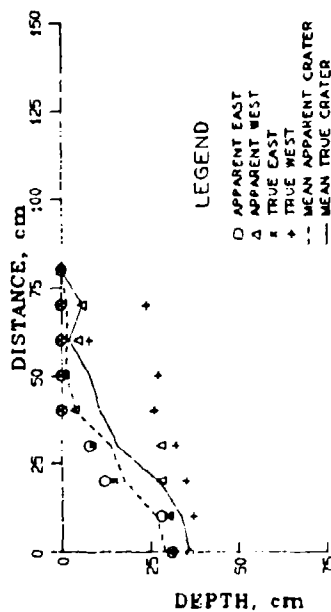
Soil Temperature (C): 28.0      Solar Flux (W/M\*\*2): 986.4  
 Dew Point (C): 0.1      Visual Range (M): 30480.0  
 Temperature (C): 15.9      Vista Ranger Voltages:  
     Sky: 2.10  
 Rel. Hum. (%): 34.0      Target: 1.35  
 Abs. Hum. (G/M\*\*3): 4.63      Sky-Target Contrast: -0.36  
 Rain Accumulation (MM): 0.00

AS 7.5LB 1034HR 20APR83 78.9



LEGEND

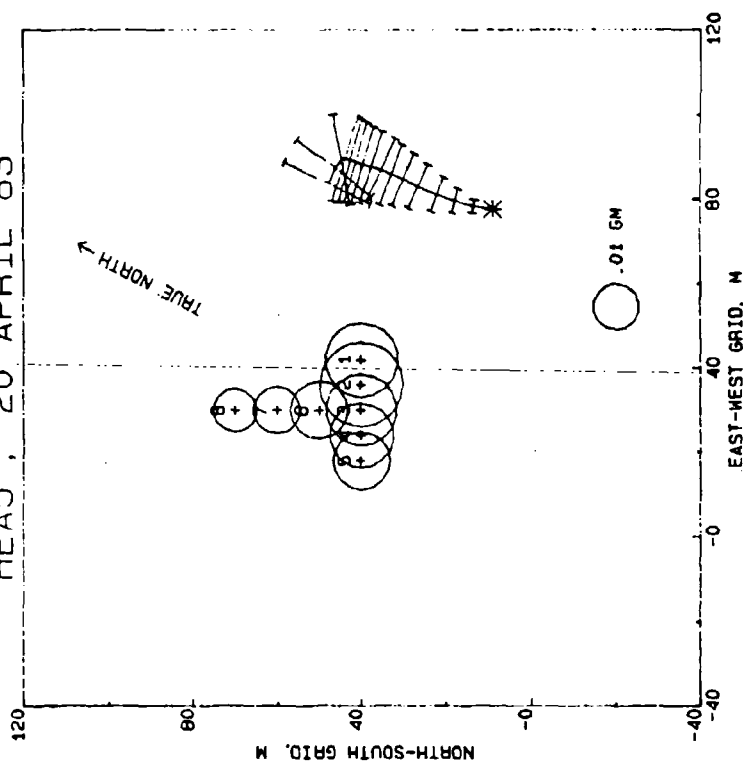
- APPARENT NORTH
- △ APPARENT SOUTH
- ✱ TRUE NORTH
- ✱ TRUE SOUTH
- MEAN APPARENT CRATER
- MEAN TRUE CRATER



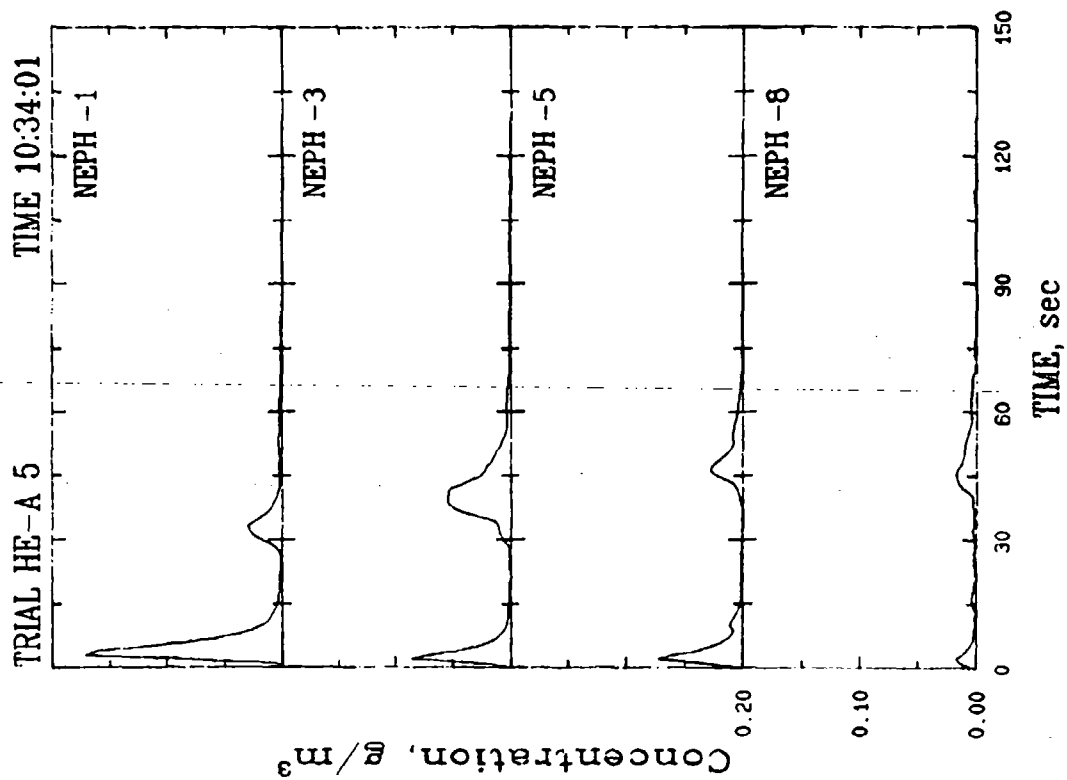
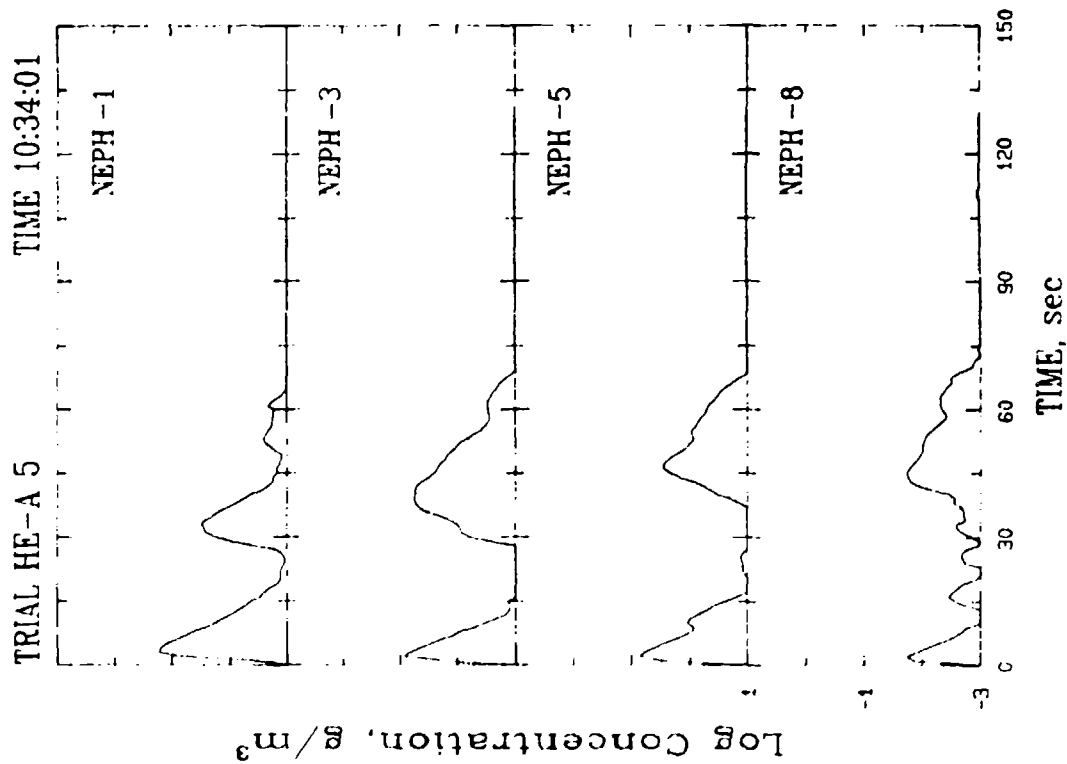
LEGEND

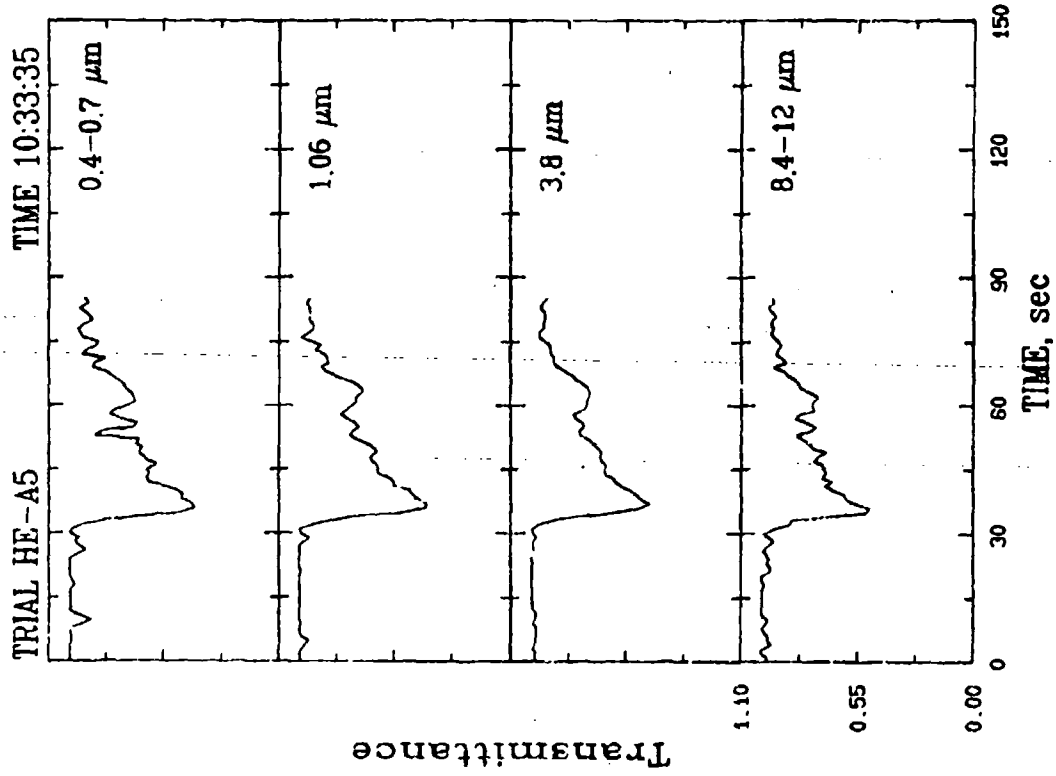
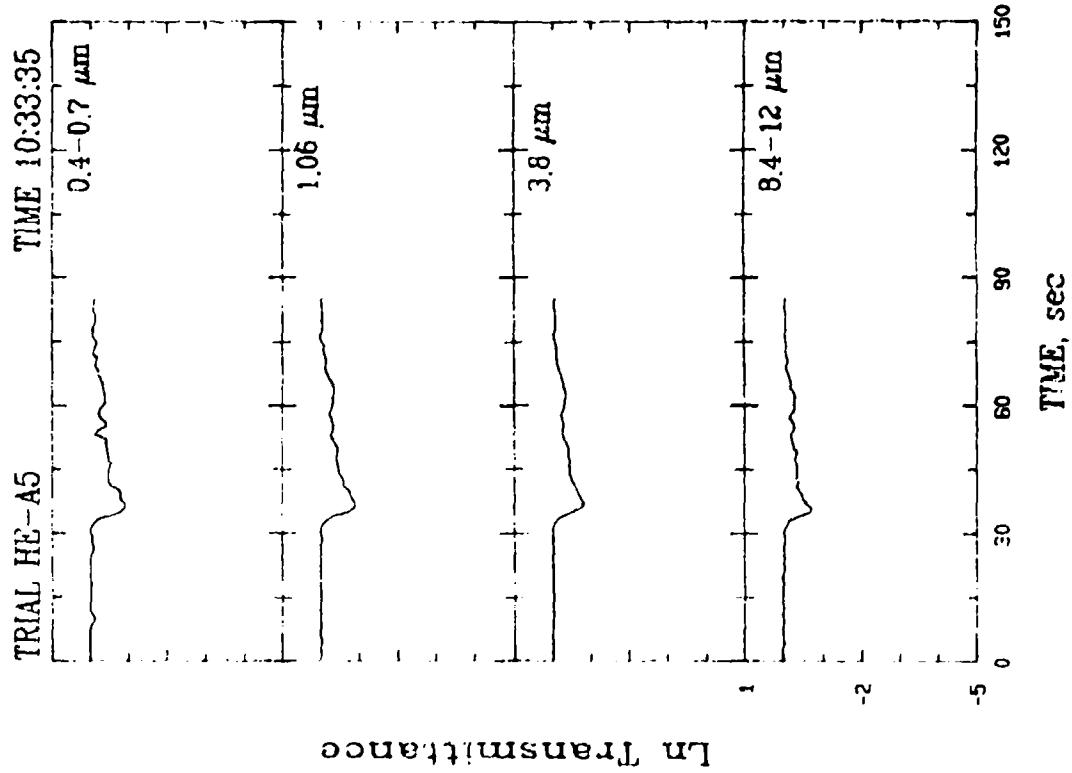
- APPARENT EAST
- △ APPARENT WEST
- ✱ TRUE EAST
- ✱ TRUE WEST
- MEAN APPARENT CRATER
- MEAN TRUE CRATER

HEA5 , 20 APRIL 83

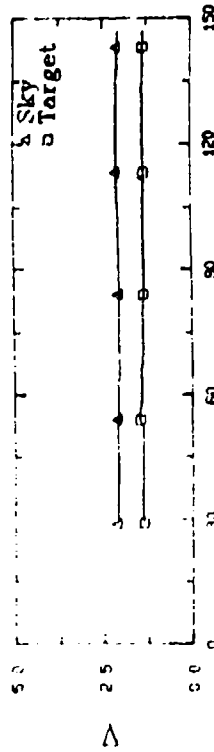
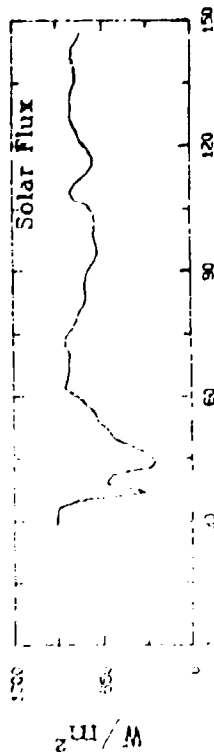
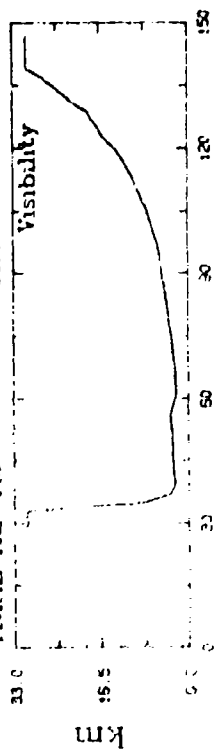


MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS





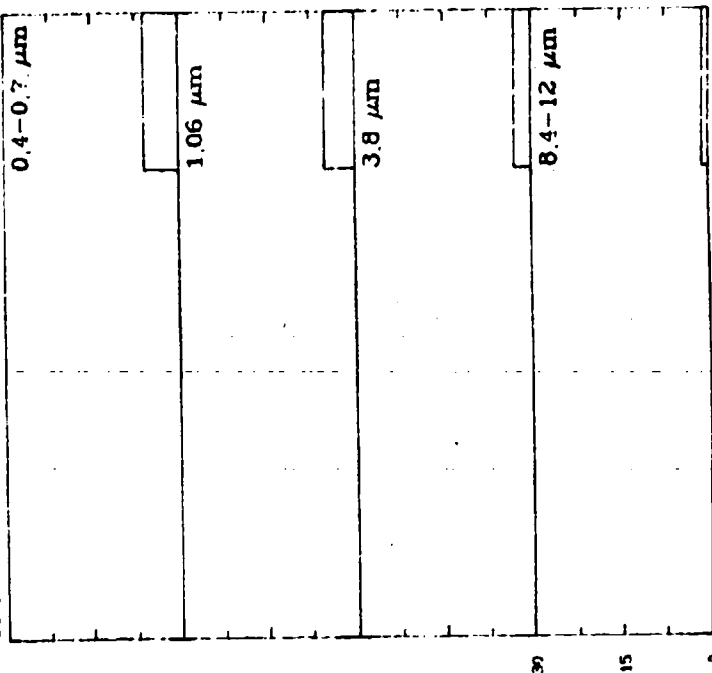
TRIAL HE-A5 TIME 10:33:35



TIME, sec

TRIAL HE-A5

TIME 10:33:35



< 2 % < 10 % < 37 % < 50 %

# EVENT SUMMARY DATA

Test Number: HEAG  
 Date: 22 APRIL 83  
 Detonation Coordinates (M):  
     X: 69.7  
     Y: 66.3  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 7.5 LB  
 Event Time: 09:43:31

## METEOROLOGICAL DATA:

Pasquill Category: D  
 Richardson Number: -0.021

16 Meter Tower (Means)  
 Start Time: 9:39:43      End Time: 9:45:37

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 6.29  | 7.26  | 7.34  | 8.95  |
| Wind Dir. (DEC)  | 31.5  | 29.2  | 32.5  | 27.2  |
| Sigma WSP        | 0.99  | 0.99  | 0.96  | 0.95  |
| Sigma WDIR       | 7.5   | 7.1   | 8.3   | 6.2   |
| UVN Components   |       |       |       |       |
| U (N-S) (M/S)    | -5.34 | -6.31 | -6.16 | -7.94 |
| V (E-W) (M/S)    | -3.22 | -3.48 | -3.86 | -4.02 |
| W (Vert) (M/S)   | 0.44  | 0.01  | 0.76  | •     |
| Sigma U          | 1.08  | 1.11  | 1.15  | 1.10  |
| Sigma V          | 0.68  | 0.74  | 0.82  | 0.79  |
| Sigma W          | 0.22  | 0.28  | 0.29  | •     |
| Temperature (C)  | 10.3  | 10.1  | 10.0  | 9.8   |

Soil Temperature (C): 11.2      Solar Flux (W/M<sup>2</sup>): 205.7  
 Dew Point (C): 3.5      Visual Range (M): 30480.0  
 Temperature (C): 9.5      Vista Ranger Voltages:  
     Sky: 0.54  
     Target: 0.30  
 Rel. Hum. (%): 66.0      Sky-Target Contrast: -0.43  
 Abs. Hum. (G/M<sup>3</sup>): 6.03  
 Rain Accumulation (MM): 0.00

## CONE INDEX:

|           | X, Y Coord (M) | SPC | 15  | 30  | 45  |
|-----------|----------------|-----|-----|-----|-----|
| Pre-Shot  | 70.0 67.0      | 25  | 200 | 217 | 300 |
| Post-Shot | 70.0 67.0      | 25  | 75  | 108 | 233 |

## CRATER DATA

Moisture Content: 13.9

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.383  
 Apparent Crater: 0.126  
 Flow: 0.257

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.380  
 Flow: 1.044  
 Bottom: 1.011  
 Side: 1.077

## HI VOL DATA (G):

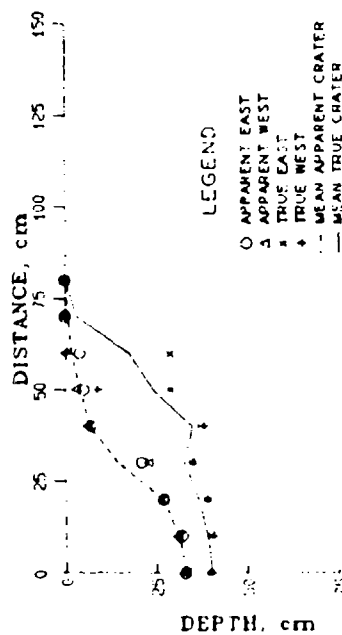
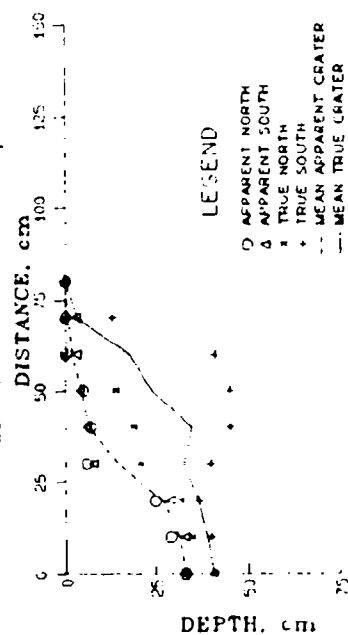
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0062 | 0.0193 | 0.0165 | 0.0457 | 0.0608 | 0.0555 | 0.0032 | 0.0028 |

SUM: 0.2100

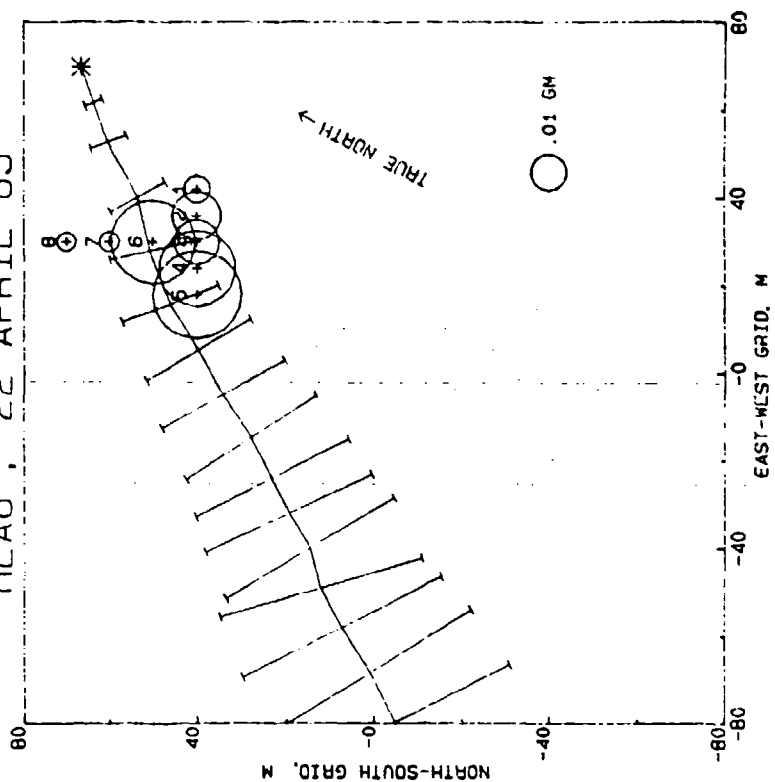
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 32.227   | 65.600   | 38.854   | 29.189   |

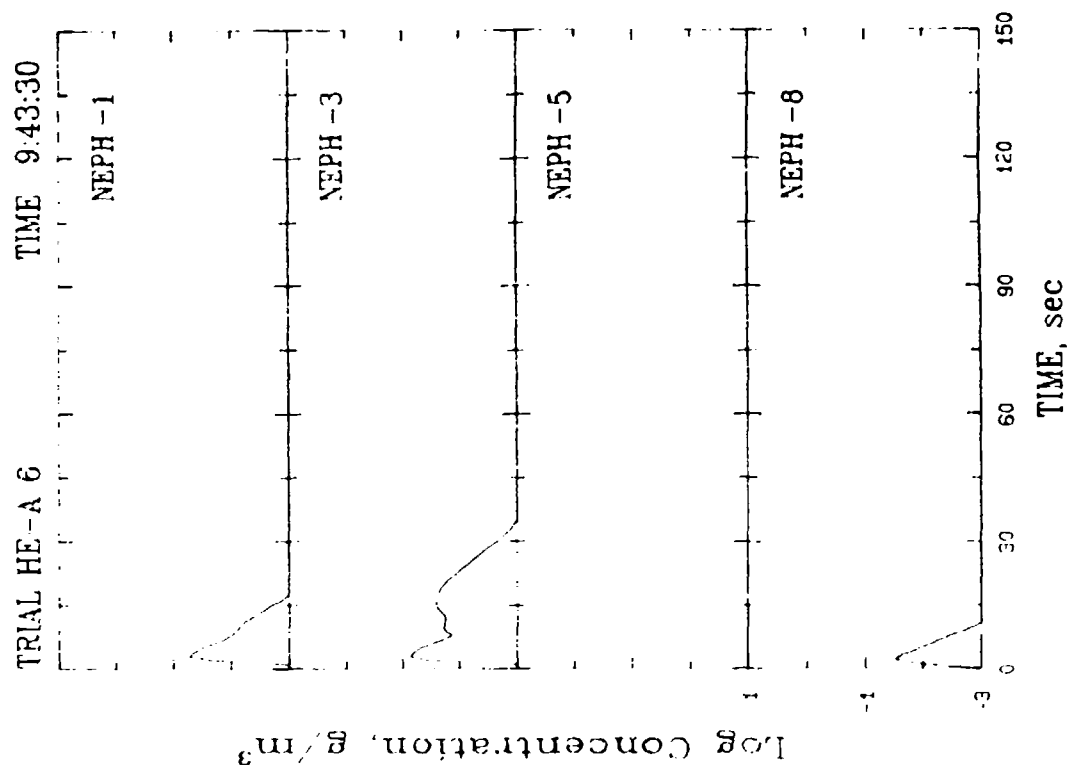
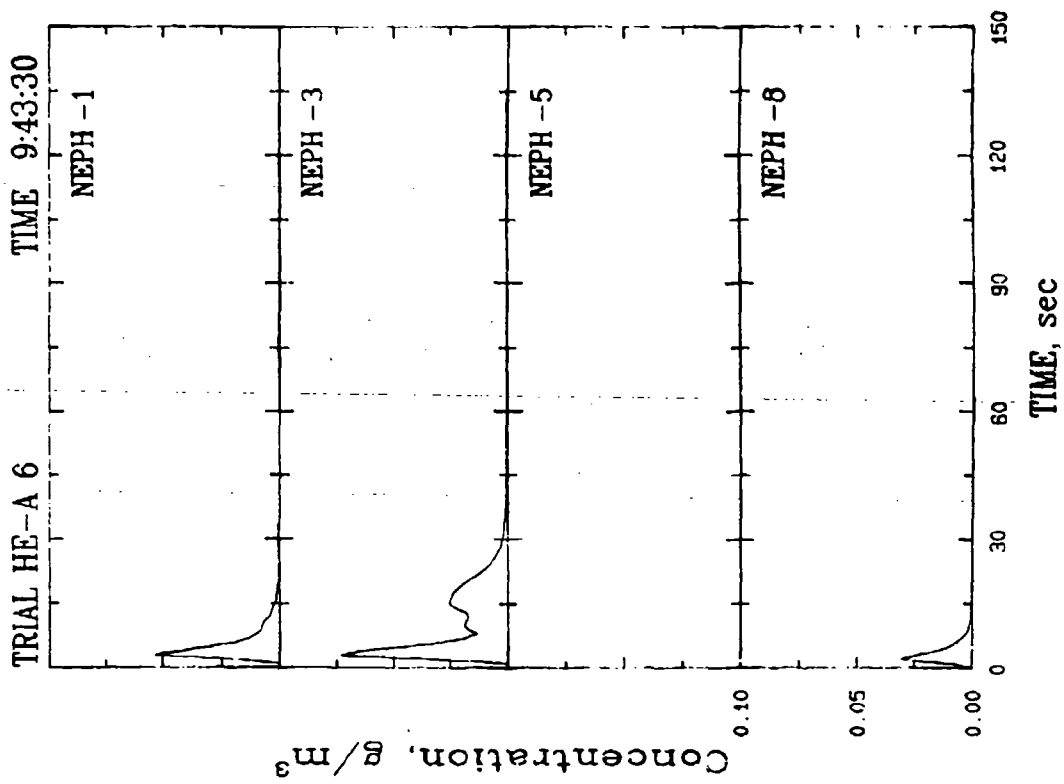
AG 7.5LR 0943HR 22APR83 70.67

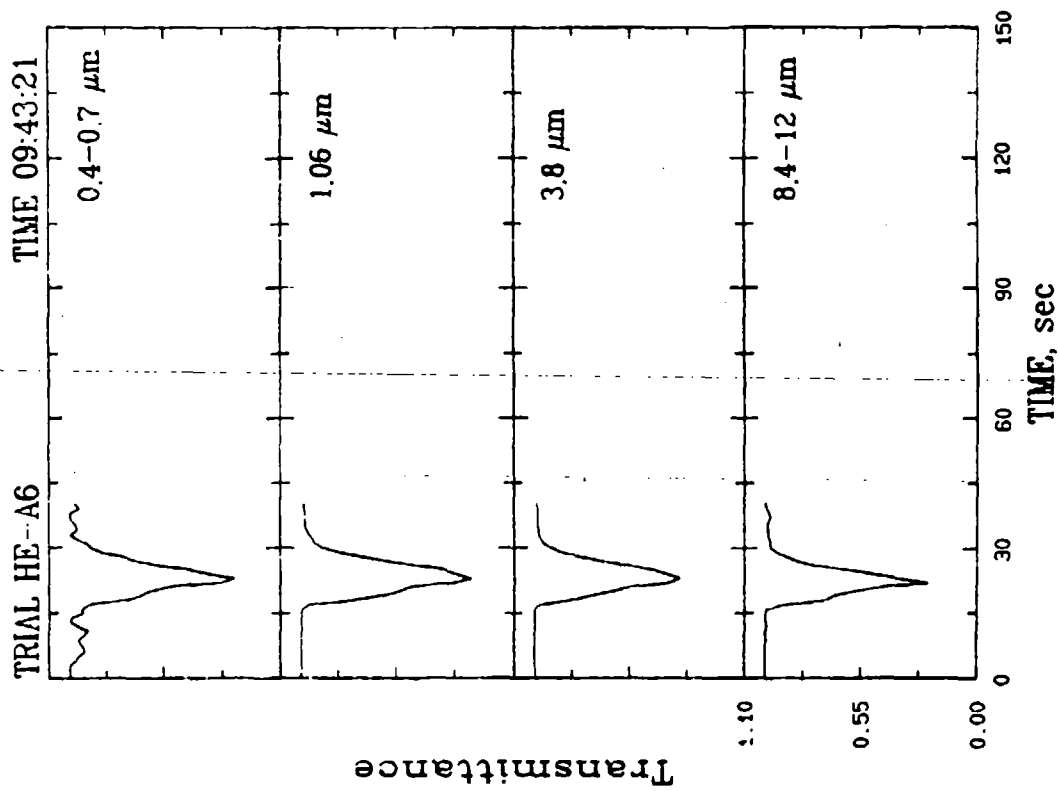
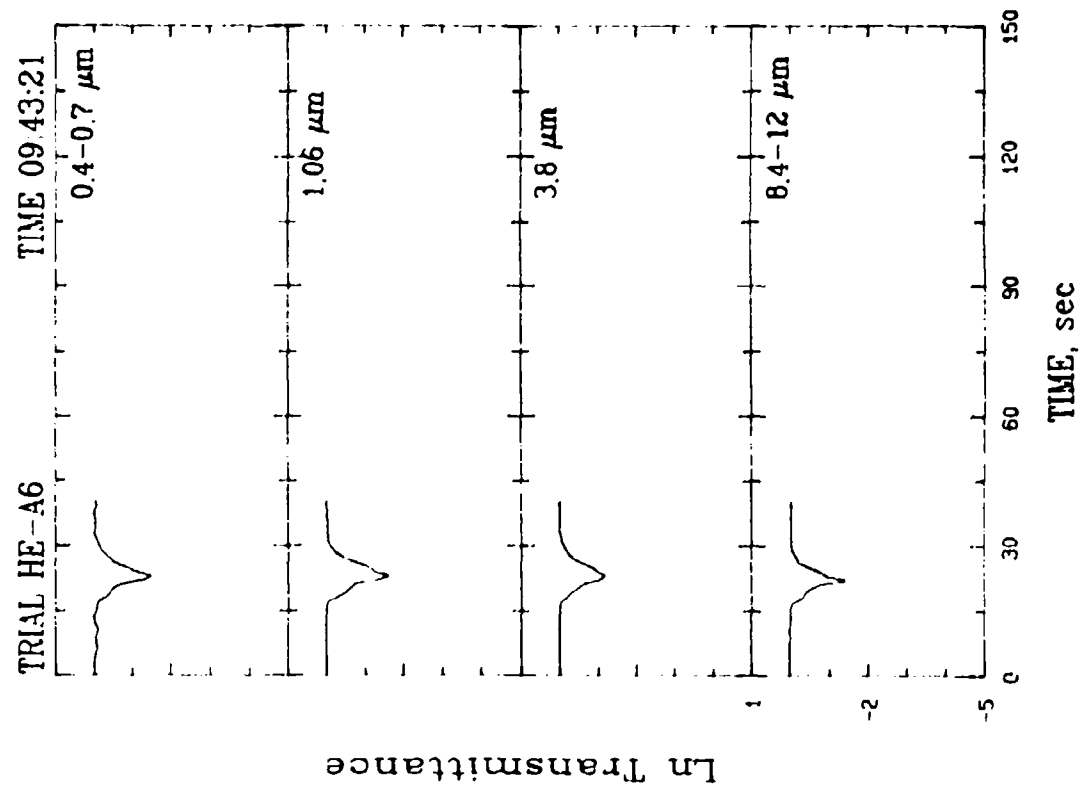


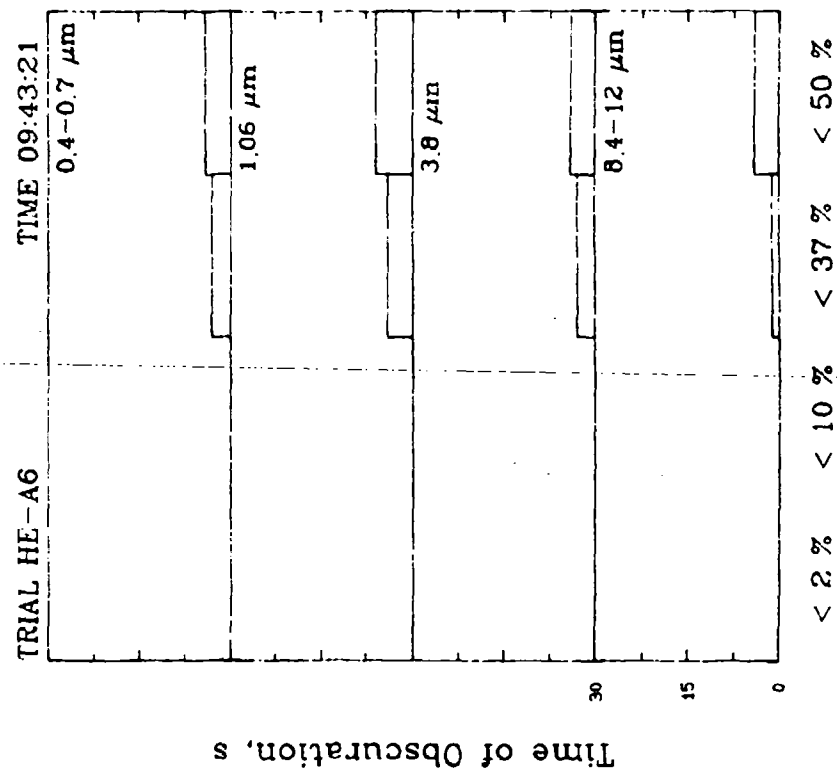
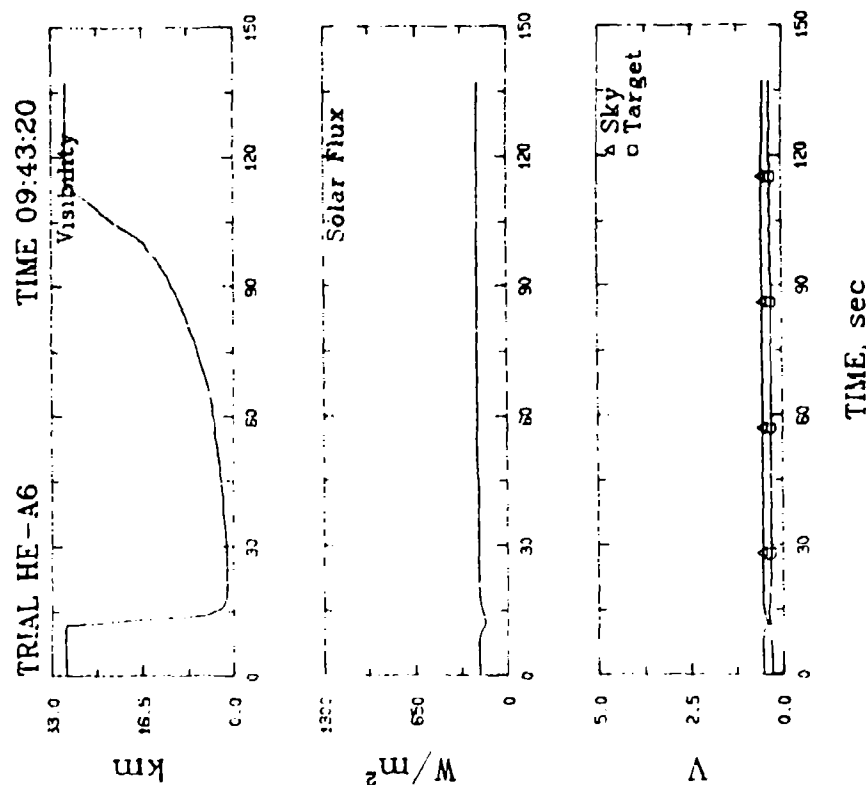
HEA6 . 22 APRIL 83



MASSES COLLECTED BY HI-VOL. SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







< 2 % < 10 % < 37 % < 50 %

# EVENT SUMMARY DATA

Test Number: HEAT7  
 Date: 25 APR 65  
 Detonation Coordinates (M):  
 X: 7.7  
 Y: 75.2  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 7.5 LB  
 Event Time: 09:44:42

## METEOROLOGICAL DATA:

Pacquil Category: C  
 Richardson Number: -0.194

16 Meter Tower (Means)  
 Start Time: 9:42:6 End Time: 9:46:44

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 5.71  | 6.22  | 6.47  | 6.85  |
| Wind Dir. (Deg)  | 289.8 | 288.3 | 287.0 | 286.4 |
| Sigma WSP        | 1.00  | 0.95  | 0.95  | 0.94  |
| Sigma WDIR       | 12.7  | 12.4  | 11.8  | 10.1  |
| U/W Components   |       |       |       |       |
| U (N-S) (M/S)    | -1.79 | -1.80 | -1.77 | -1.85 |
| V (E-W) (M/S)    | 5.28  | 5.80  | 6.08  | 6.48  |
| W (Vert) (M/S)   | 0.09  | 0.11  | 0.31  | •     |
| Sigma U          | 1.09  | 1.15  | 1.17  | 1.16  |
| Sigma V          | 1.16  | 1.15  | 1.12  | 1.03  |
| Sigma W          | 0.20  | 0.30  | 0.30  | •     |
| Temperature (C)  | 20.0  | 19.6  | 19.3  | 18.9  |

Soil Temperature (C): 21.0 Solar Flux (W/M<sup>2</sup>): 544.8  
 Dew Point (C): -9.5 Visual Range (M): 3040.0  
 Temperature (C): 19.0 Wisc Ranger Voltages:  
 Rel. Hum. (%): 12.3 Sky: 1.81  
 Target: 0.99  
 Abs. Hum. (G/M<sup>3</sup>): 2.02 Sky-Target Contrast: -0.45  
 Rain Accumulation (MM): 0.00

## CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45   |
|-----------|---------------|-----|-----|-----|------|
| Pre-Shot  | 24.0 48.0     | 88  | 330 | 485 | 750+ |
| Post-Shot | 8.0 75.0      | 75  | 410 | 715 | 750+ |

## CRATER DATA

Moisture Content: 13.0

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.378  
 Apparent Crater: 0.140  
 Flow: 0.238

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.380  
 Flow: •  
 Bottom: •  
 Side: •

## HI VOL DATA (G):

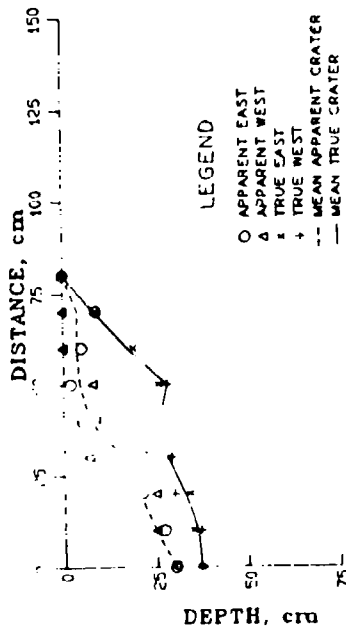
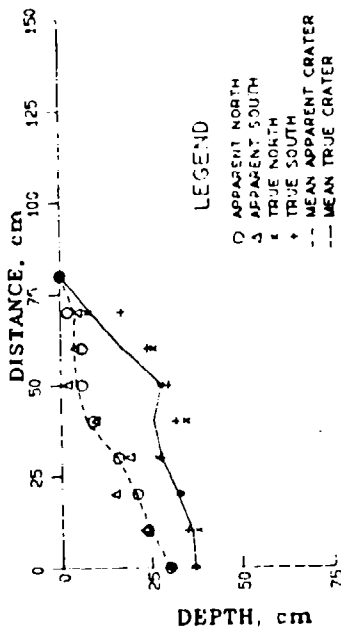
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0437 | 0.2330 | 0.3071 | 0.0394 | 0.0218 | 0.2851 | 0.0243 | 0.0122 |

SUM: 0.9666

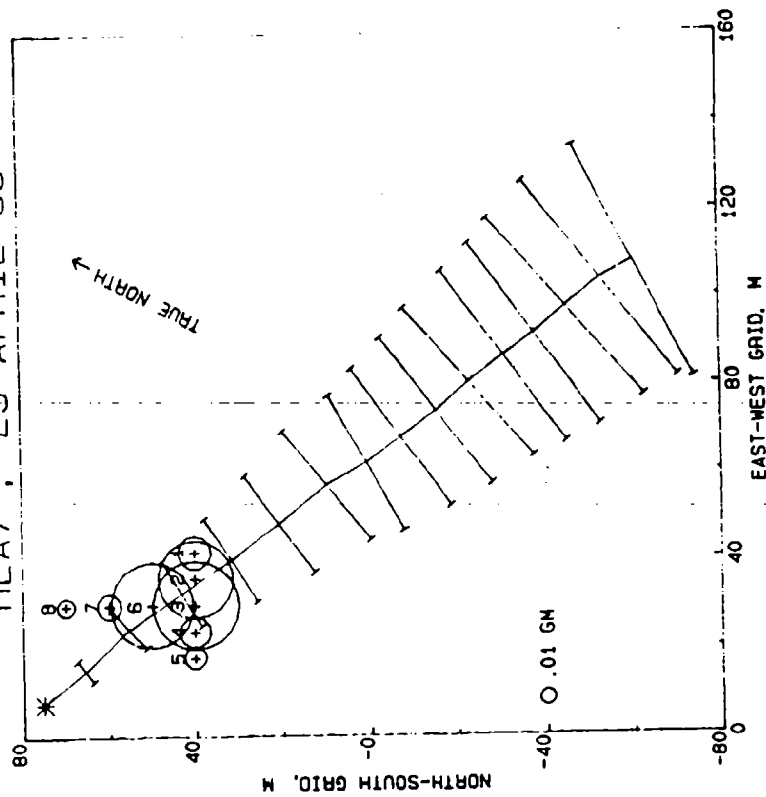
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 0.000    | 0.000    |

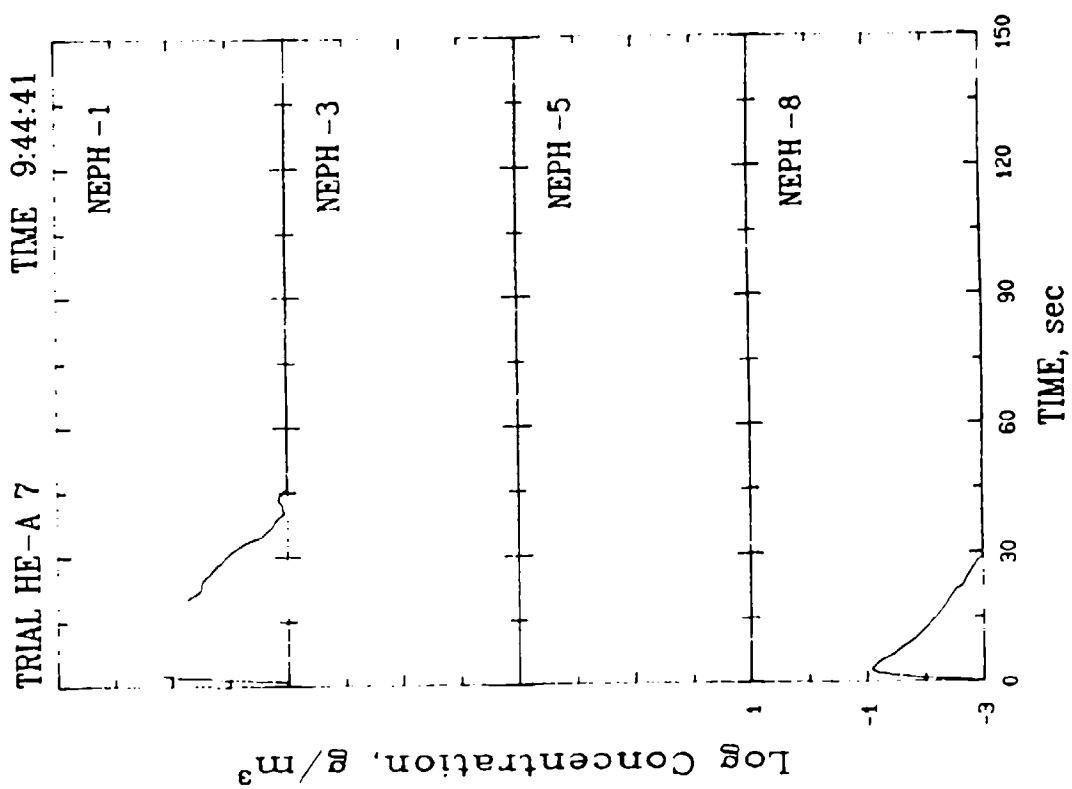
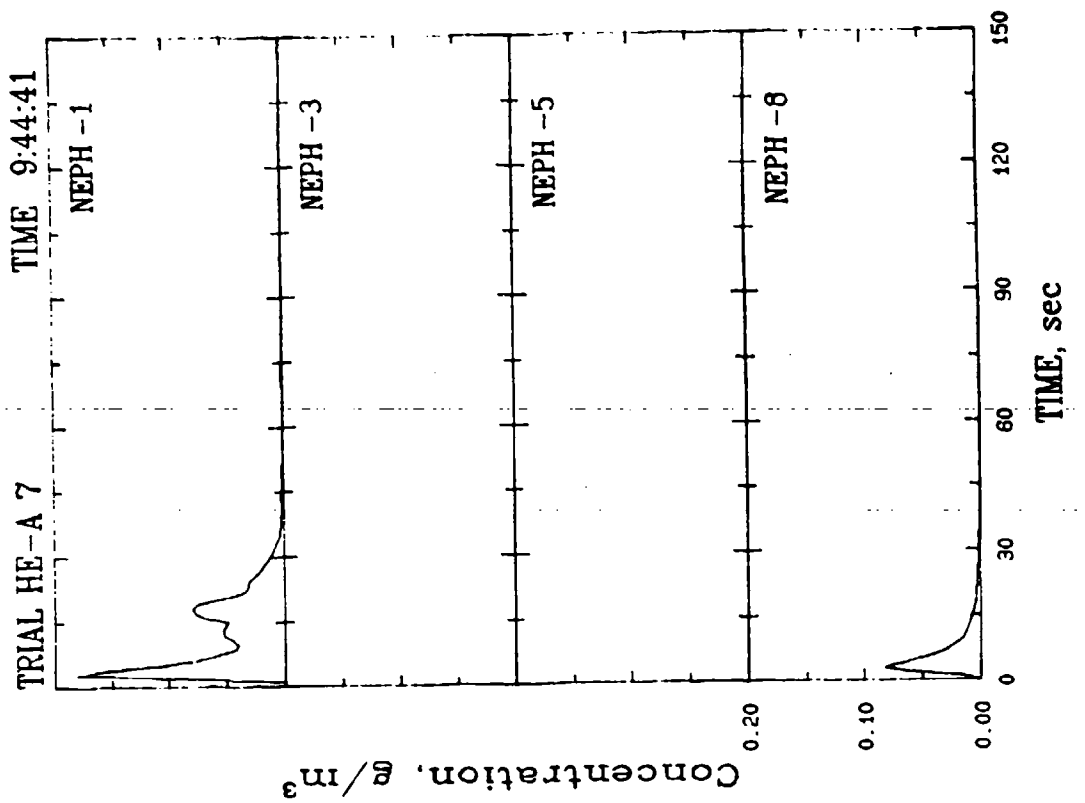
A7 7.5LB 0944HR 25APR83 8,75

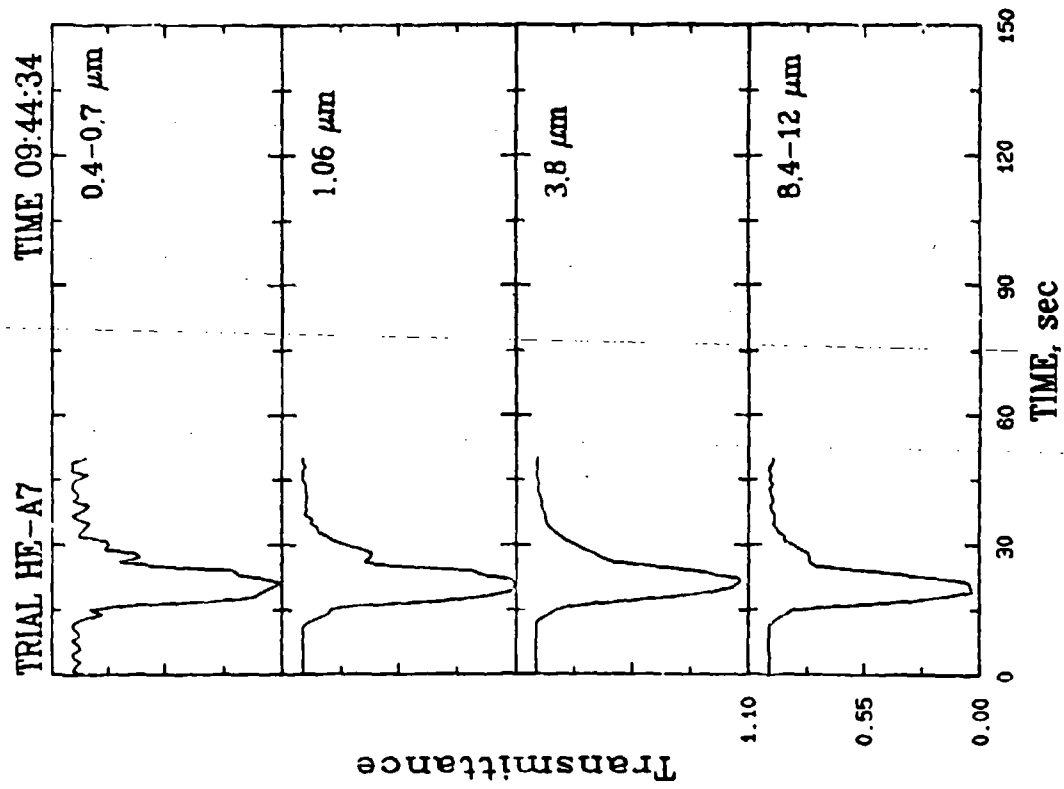
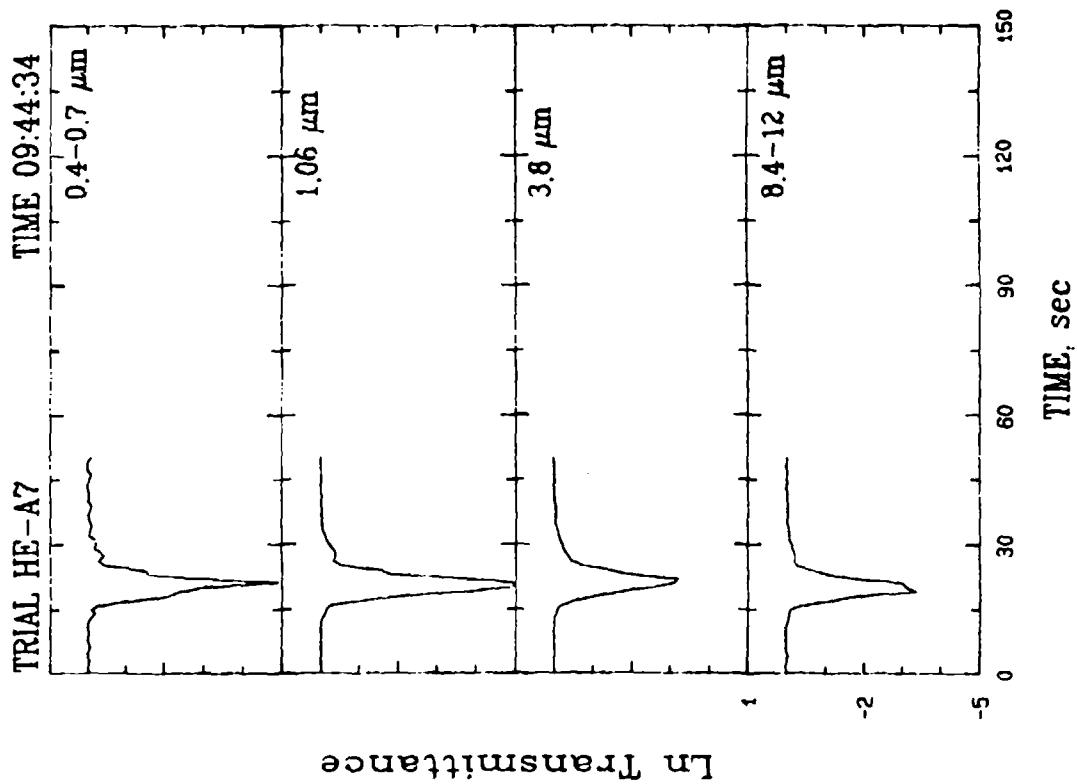


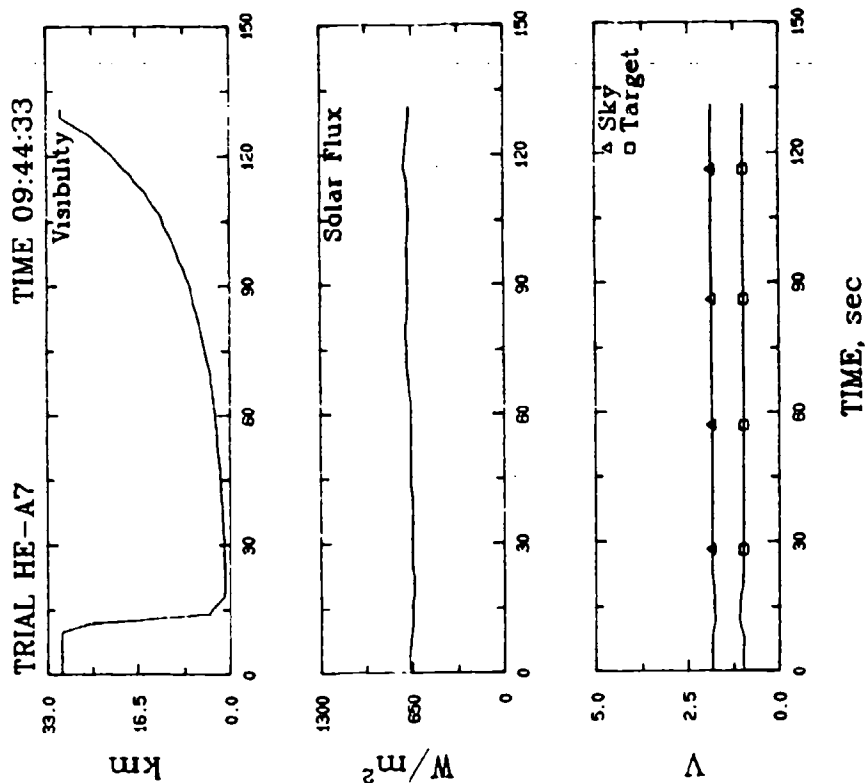
HEA7 . 25 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEA8  
 Date: 25 APRIL 83  
 D-tonation Coordinates (M):  
 X: 0.9  
 Y: 63.5  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 7.5 LB  
 Event Time: 11:10:00

## METEOROLOGICAL DATA:

Pasquill Category: A  
 Richardson Number: -0.688

16 Meter Tower (Means)  
 Start Time: 11: 2: 8 End Time: 11:11: 1

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 3.11  | 3.22  | 3.41  | 3.68  |
| Wind Dir. (DEG)  | 112.0 | 113.0 | 114.0 | 117.6 |
| Sigma WSP        | 1.26  | 1.27  | 1.28  | 1.26  |
| Sigma WDIR       | 31.2  | 30.7  | 29.4  | 31.7  |
| U/V Components   |       |       |       |       |
| U (N-S) (M/S)    | 1.26  | 1.33  | 1.41  | 1.58  |
| V (E-W) (M/S)    | -2.51 | -2.58 | -2.74 | -2.82 |
| W (Vert) (M/S)   | 0.14  | 0.12  | 0.09  | •     |
| Sigma U          | 1.34  | 1.44  | 1.46  | 1.66  |
| Sigma V          | 1.24  | 1.23  | 1.29  | 1.40  |
| Sigma W          | 0.26  | 0.37  | 0.46  | •     |
| Temperature (C)  | 21.4  | 20.3  | 19.9  | 19.6  |

Soil Temperature (C): 30.9 Solar Flux (W/M<sup>2</sup>): 883.6  
 Dew Point (C): -9.9 Visual Range (M): 30480.0  
 Temperature (C): 19.9 Vista Ranger Voltages:  
 Rel. Hum. (%): 11.3 Sky: 1.91  
 Target: 1.02  
 Abs. Hum. (G/M<sup>3</sup>): 1.95 Sky-Target Contrast: -0.46  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 0.9 63.5      | 60  | 255 | 290 | 540 |
| Post-Shot | 0.9 63.5      | 25  | 145 | 260 | 305 |

## CRATER DATA

Moisture Content: 11.4

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.161  
 Apparent Crater: 0.107  
 Flow: 0.531

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.360  
 Flow: •  
 Bottom: •  
 Side: •

## HI VOL DATA (G):

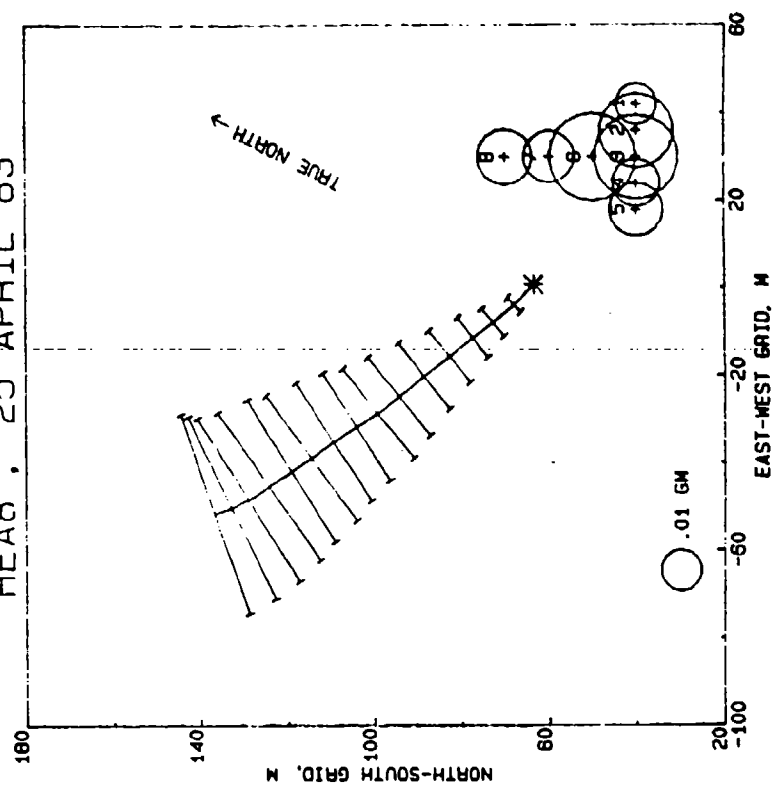
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0103 | 0.0335 | 0.0437 | 0.0145 | 0.0178 | 0.0472 | 0.0165 | 0.0188 |

SUM: 0.2023

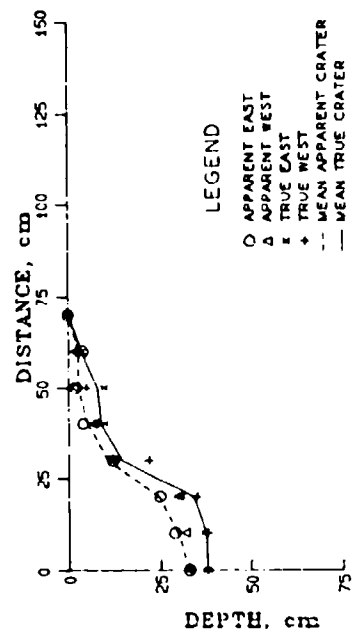
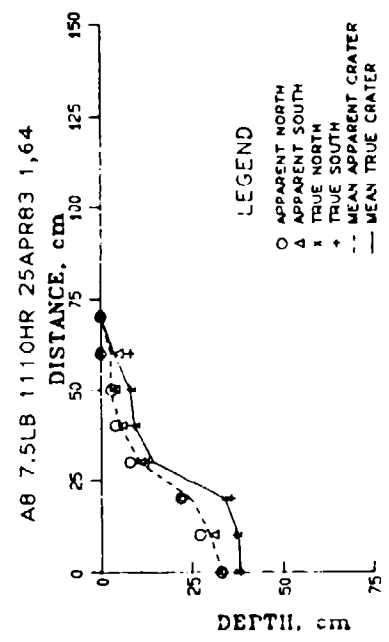
## GELMAN DOSAGE (G S/M<sup>3</sup>):

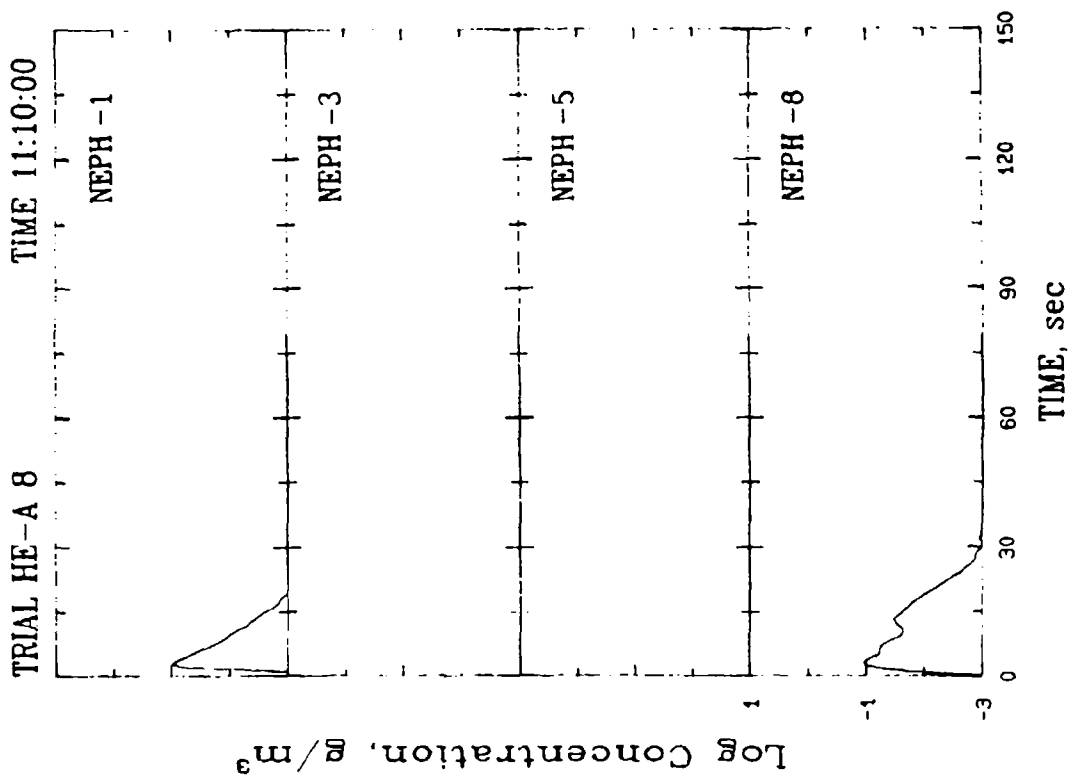
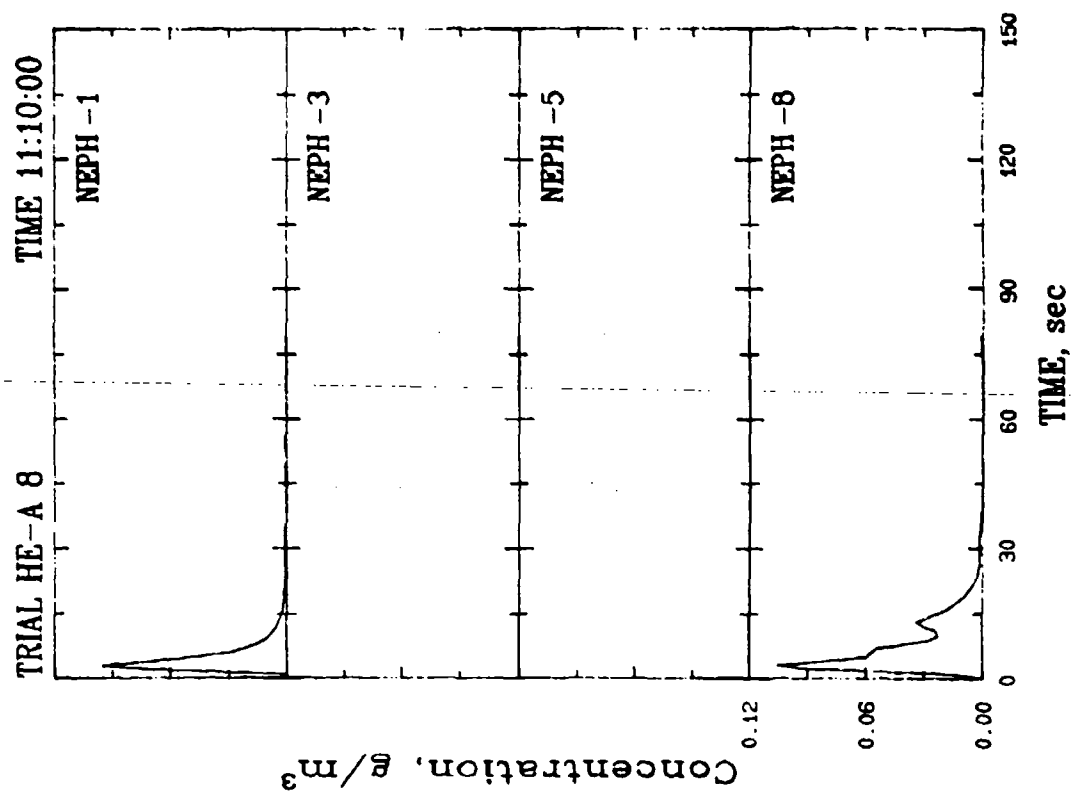
| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 0.000    | 0.000    |

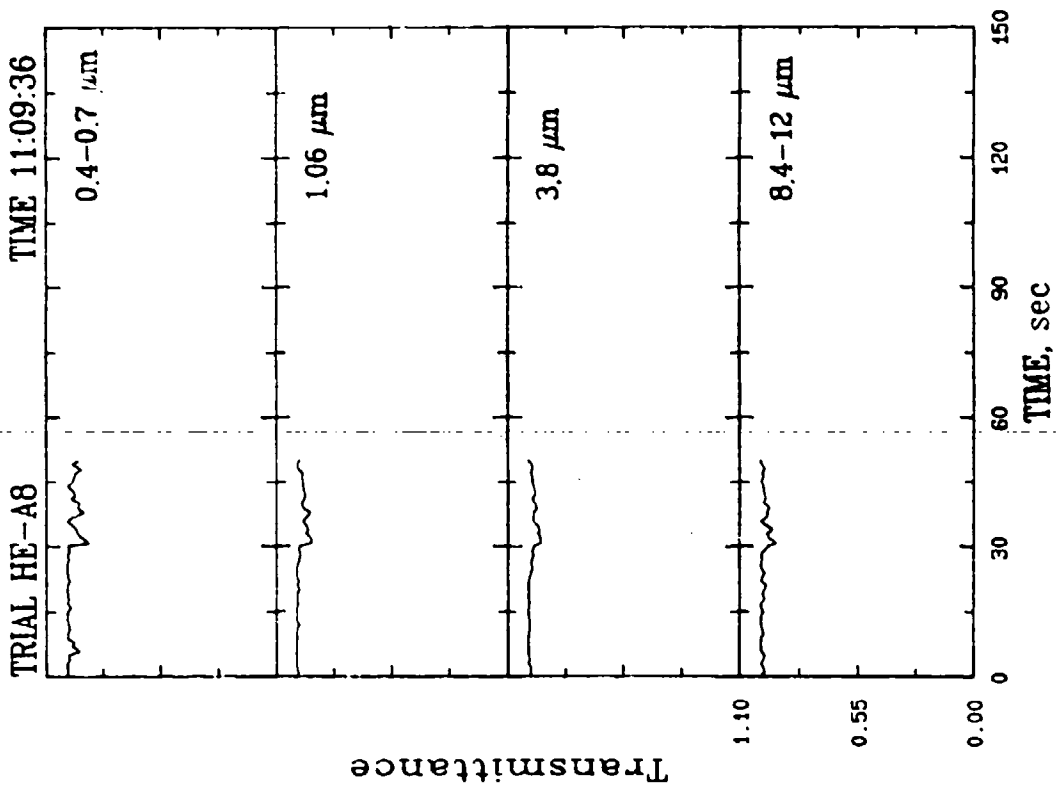
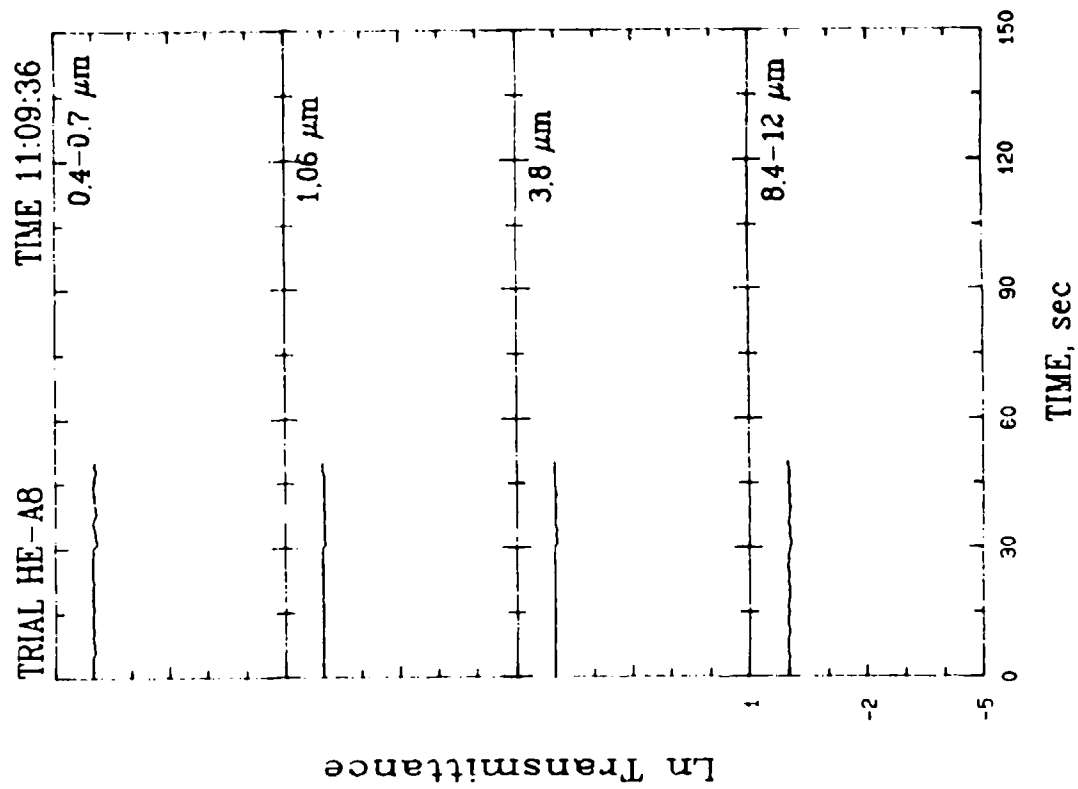
HEA8 . 25 APRIL 83

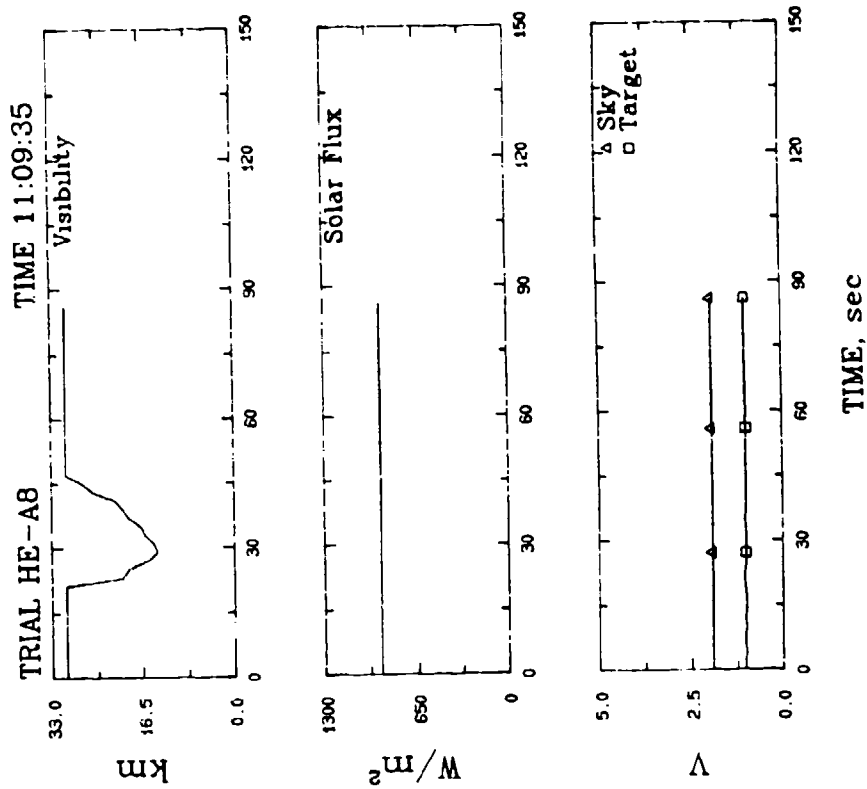


MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS









# EVENT SUMMARY DATA

Test Number: HEA9  
 Date: 25 APRIL 83  
 Detonation Coordinates (M):  
 X: 30.7  
 Y: 20.9  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 7.5 LB  
 Event Time: 12:41:11

## METEOROLOGICAL DATA:

Pasquill Category: A  
 Richardson Number: -0.901

16 Meter Tower (Means)  
 Start Time: 12:40:14 End Time: 12:43: 0

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 2.61  | 2.81  | 2.90  | 3.65  |
| Wind Dir. (DEG)  | 155.7 | 156.7 | 157.2 | 159.8 |
| Sigma WSP        | 0.75  | 0.82  | 0.80  | 1.02  |
| Sigma WDIR       | 21.2  | 18.3  | 16.8  | 15.1  |
| UVW Components   |       |       |       |       |
| U (N-S)          | 2.28  | 2.50  | 2.59  | 3.35  |
| V (E-W)          | -0.92 | -0.96 | -1.01 | -1.17 |
| W (Vert)         | 0.09  | 0.27  | 0.11  | 0     |
| Sigma U          | 0.87  | 0.93  | 0.87  | 1.09  |
| Sigma V          | 0.79  | 0.75  | 0.75  | 0.79  |
| Sigma W          | 0.21  | 0.35  | 0.34  | 0     |
| Temperature (C)  | 23.9  | 22.7  | 21.8  | 21.5  |

Soil Temperature (C): 38.8 Solar Flux (W/M<sup>2</sup>): 1004.6  
 Dew Point (C): -9.7 Visual Range (M): 30480.0  
 Temperature (C): 21.5 Vista Ranger Voltages:  
 Rel. Hum. (%): 10.4 Sky: 1.88  
 Target: 0.97  
 Abs. Hum. (G/M<sup>3</sup>): 1.97 Sky-Target Contrast: -0.48  
 Rain Accumulation (MM): 0.00

## CONE INDEX

|           | X,Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 31.0 21.0     | 38  | 210 | 240 | 250 |
| Post-Shot | 31.0 21.0     | 25  | 140 | 192 | 192 |

## CRATER DATA

Moisture Content: 9.3

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.429  
 Apparent Crater: 0.172  
 Flow: 0.257

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.390  
 Flow: 1.159  
 Bottom: 1.120  
 Side: 1.198

## HI VOL DATA (G):

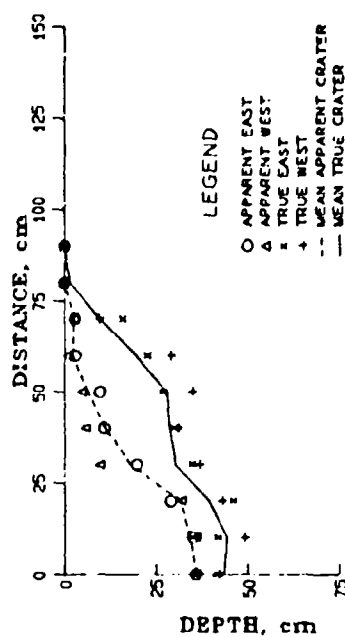
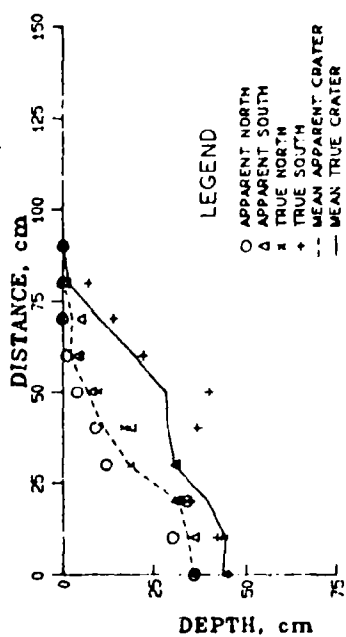
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0740 | 0.2598 | 0.6726 | 0.6809 | 0.0605 | 0.3353 | 0.1577 | 0.0724 |

SUM: 1.7132

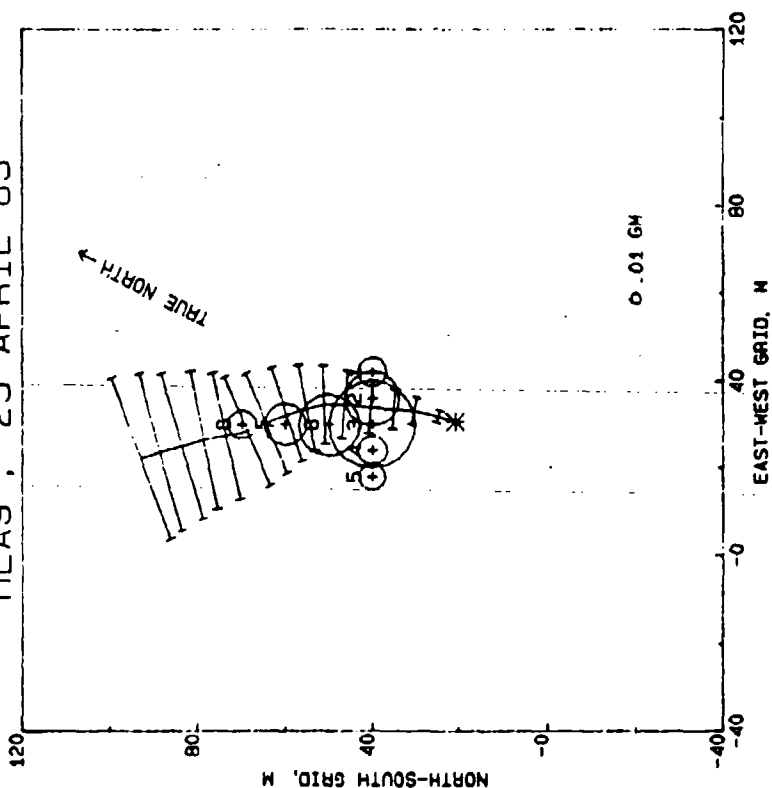
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 0.000    | 0.000    |

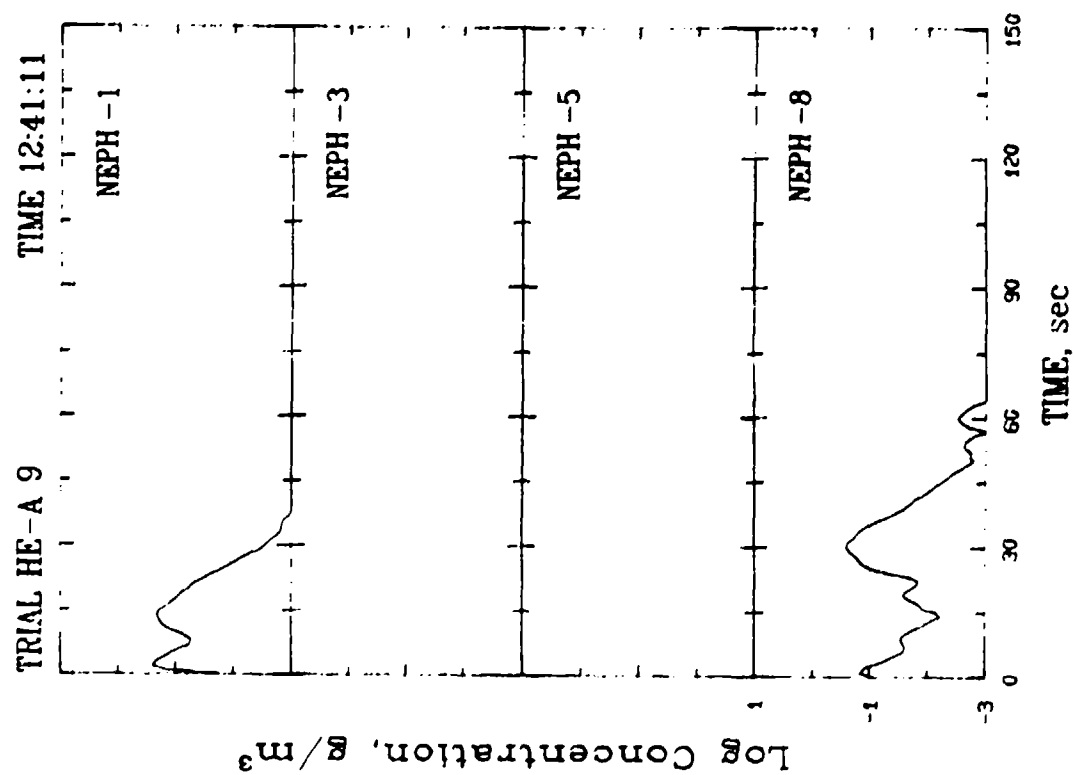
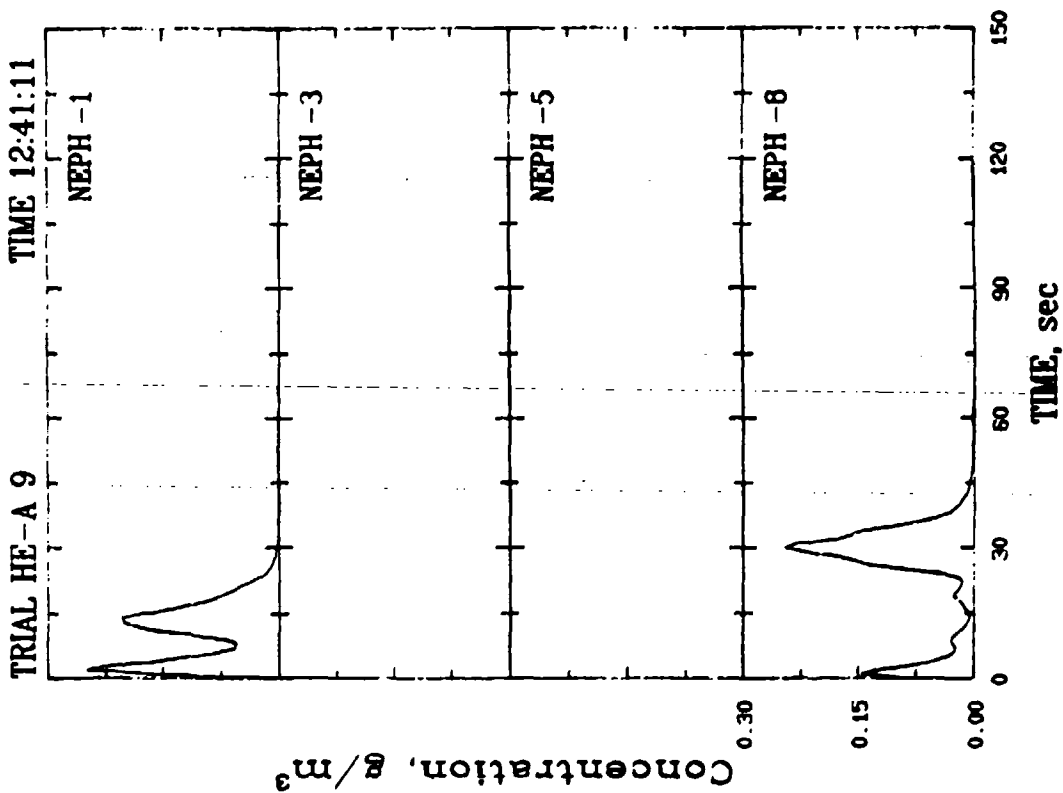
A9 7.5LB 1241HR 25APR83 31,21

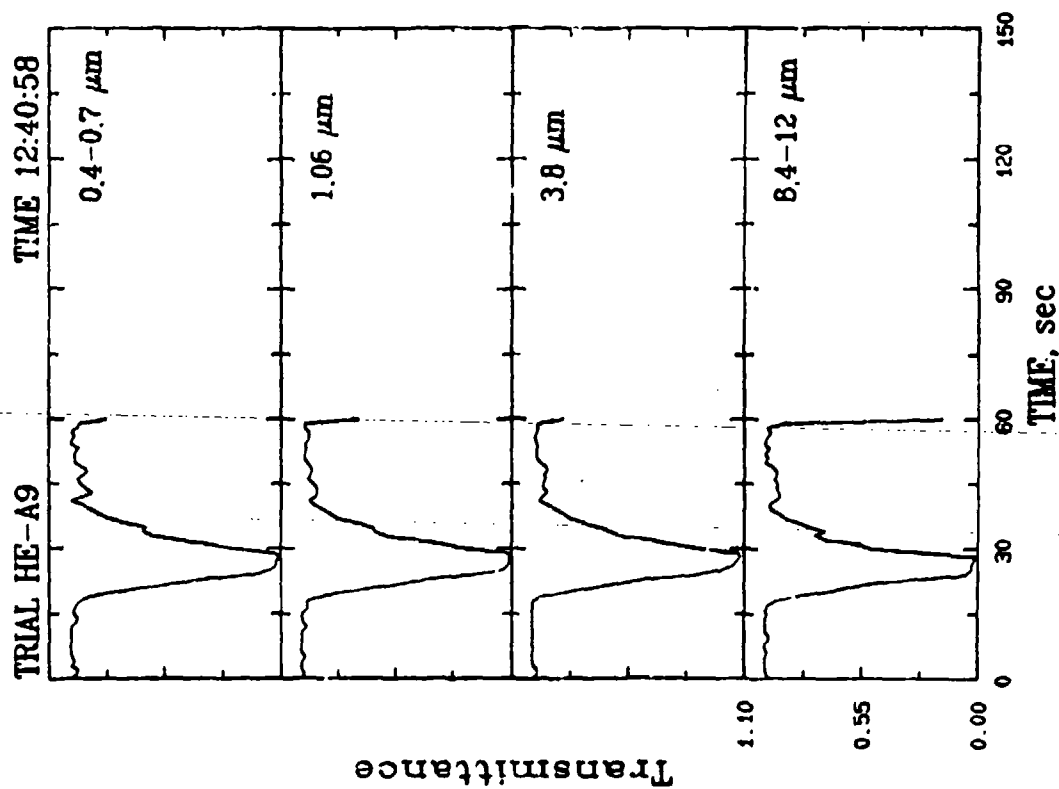
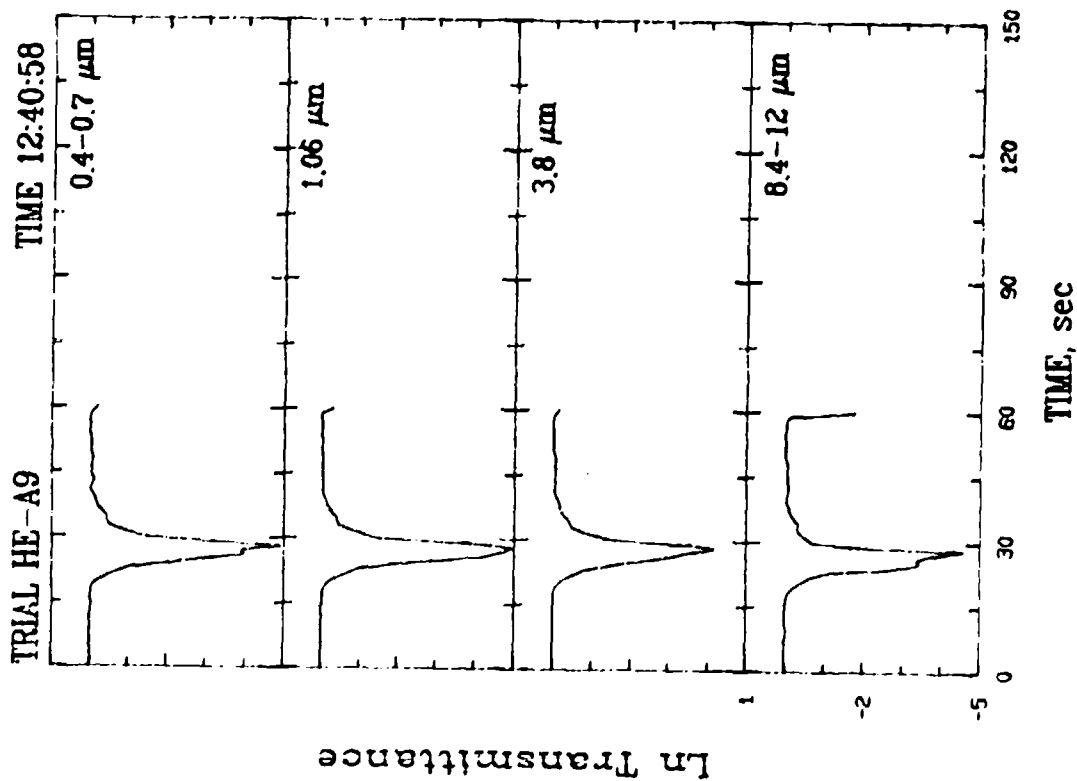


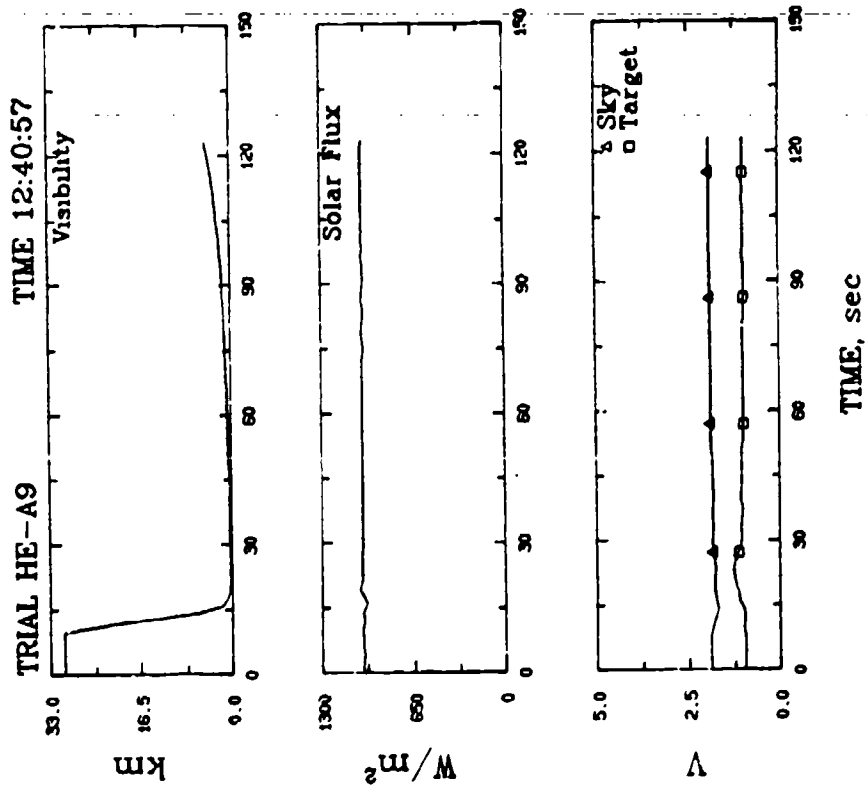
HEA9, 25 APRIL 83



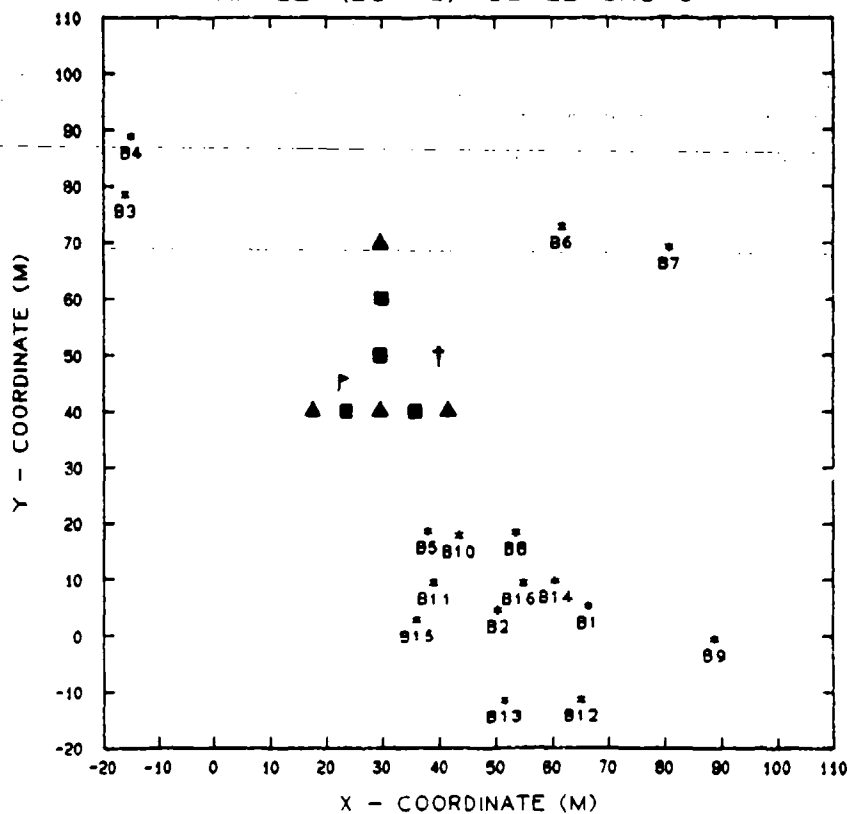
MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC. INTERVALS







# APRIL (DOT I) 15 LB SHOTS



- — HI-VOL SAMPLERS
- ▲ — NEPHELOMETER AND HI-VOL SAMPLERS
- — POINT OF BURST FOR 15-LB SHOTS
- ┌ — 2-M MET TOWER
- † — 16-M MET TOWER

# EVENT SUMMARY DATA

Test Number: HEB1  
 Date: 20 APRIL 83  
 Detonation Coordinates (M):  
 X: 66.3  
 Y: 5.2  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 15.0 LB  
 Event Time: 11:29:01

## METEOROLOGICAL DATA:

Pasquill Category: A  
 Richardson Number: -1.106  
 16 Meter Tower (Means)  
 Start Time: 11:26:58 End Time: 11:31: 9

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 3.03  | 3.12  | 3.27  | 3.67  |
| Wind Dir. (DEG)  | 136.1 | 132.7 | 132.7 | 136.1 |
| Sigma MSP        | 1.30  | 1.36  | 1.45  | 1.38  |
| Sigma WDIR       | 24.6  | 22.1  | 19.5  | 16.0  |
| UVW Components   |       |       |       |       |
| U (N-S) (M/S)    | 1.91  | 1.88  | 1.99  | 2.42  |
| V (E-W) (M/S)    | -2.07 | -2.25 | -2.38 | -2.56 |
| W (Vert) (M/S)   | 0.16  | 0.18  | 0.11  | 0     |
| Sigma U          | 0.91  | 0.93  | 0.87  | 0.78  |
| Sigma V          | 1.47  | 1.46  | 1.55  | 1.54  |
| Sigma W          | 0.22  | 0.27  | 0.31  | 0     |
| Temperature (C)  | 17.9  | 17.0  | 16.5  | 16.1  |

Soil Temperature (C): 29.0 Solar Flux (W/M<sup>2</sup>): 866.1  
 Dew Point (C): -0.8 Visual Range (M): 30480.0  
 Temperature (C): 16.3 Vista Ranger Voltages:  
 Rel. Hum. (%): 30.8 Sky: 2.04  
 Target: 1.22  
 Abs. Hum. (G/M<sup>3</sup>): 4.30 Sky-Target Contrast: -0.40  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45   |
|-----------|---------------|-----|-----|-----|------|
| Pre-Shot  | 66.0 5.0      | 50  | 200 | 575 | 750+ |
| Post-Shot | 66.0 5.0      | 25  | 92  | 467 | 750+ |

## CRATER DATA

Moisture Content: 19.5

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.750  
 Apparent Crater: 0.263  
 Flow: 0.488

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.360  
 Flow: 0.877  
 Bottom: 1.007  
 Side: 0.836

## HI VOL DATA (G):

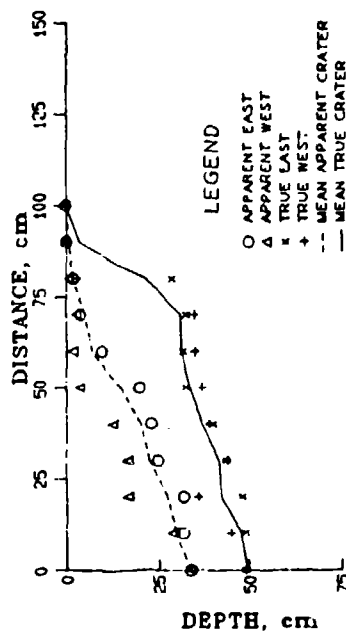
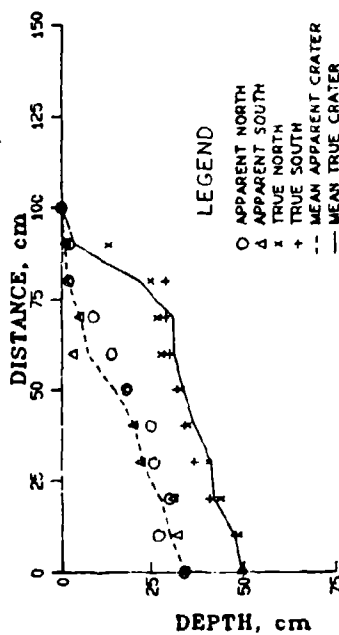
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.3222 | 0.0914 | 0.0247 | 0.0199 | 0.0170 | 0.0677 | 0.0756 | 0.0620 |

SUM: 0.6805

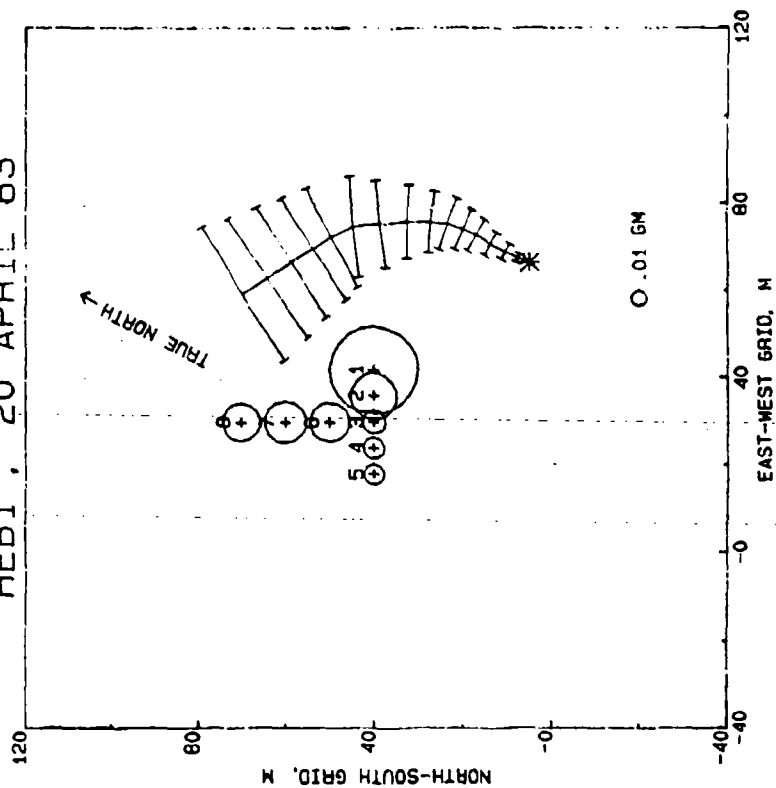
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 154.402  | 81.600   | 28.394   | 21.622   |

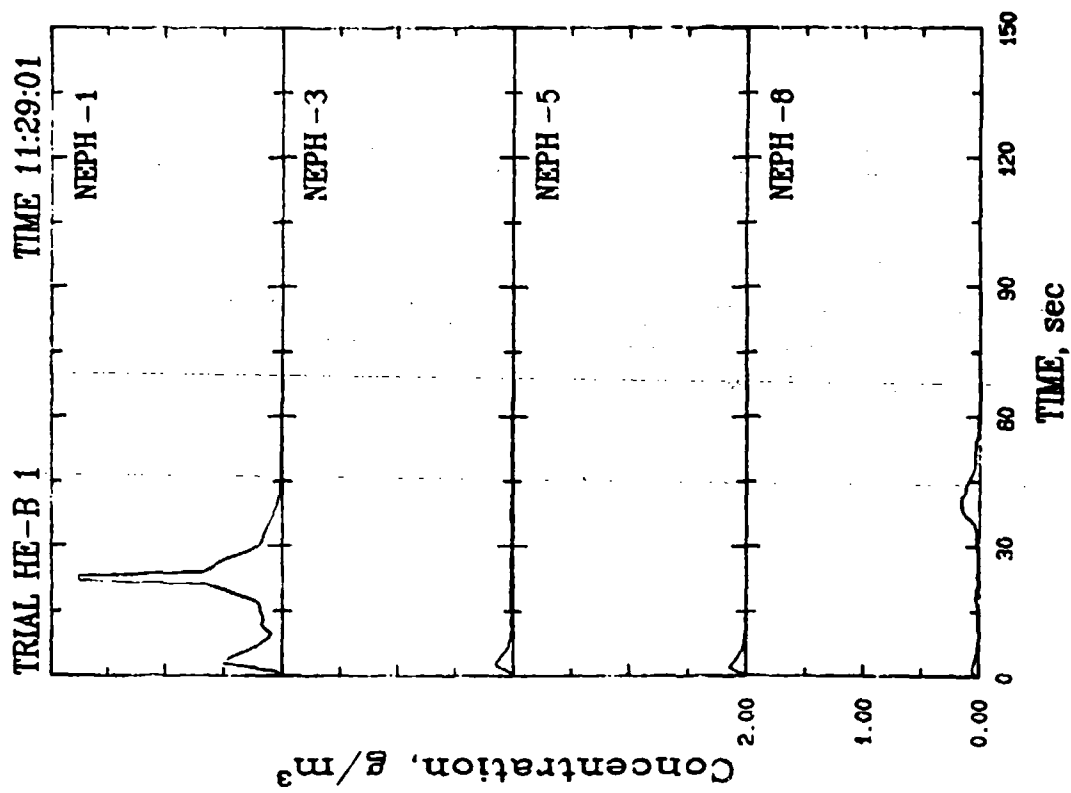
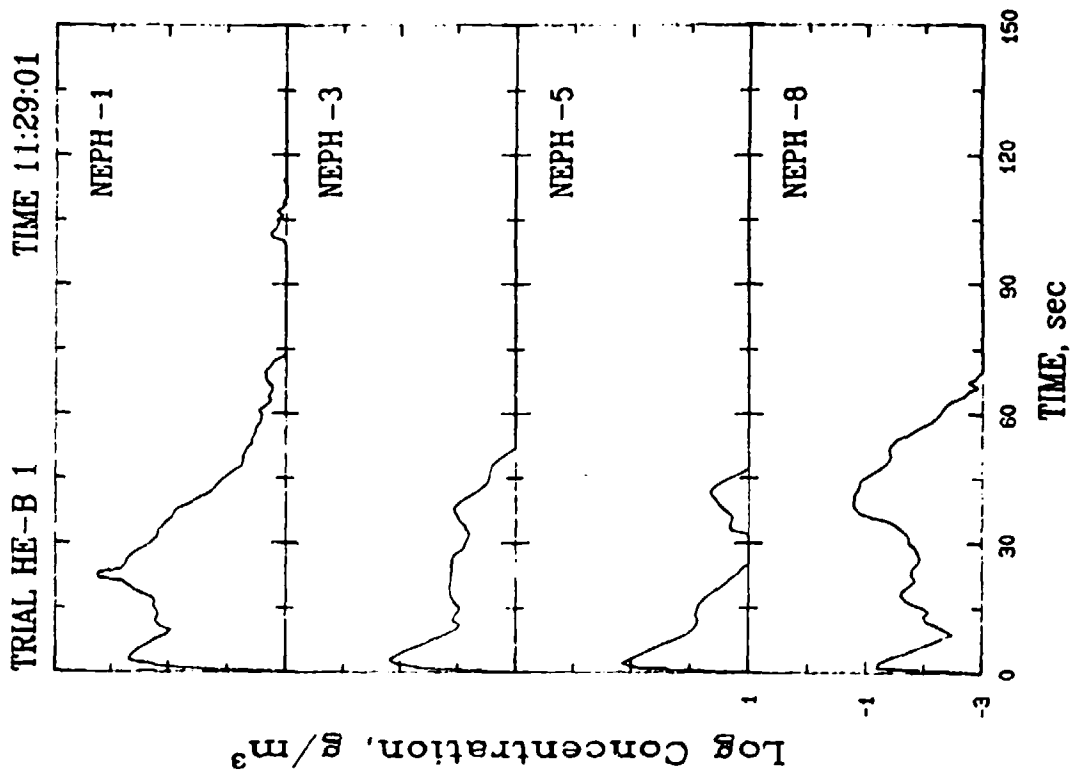
B1 15 LB 1129HR 20APR83 66,5

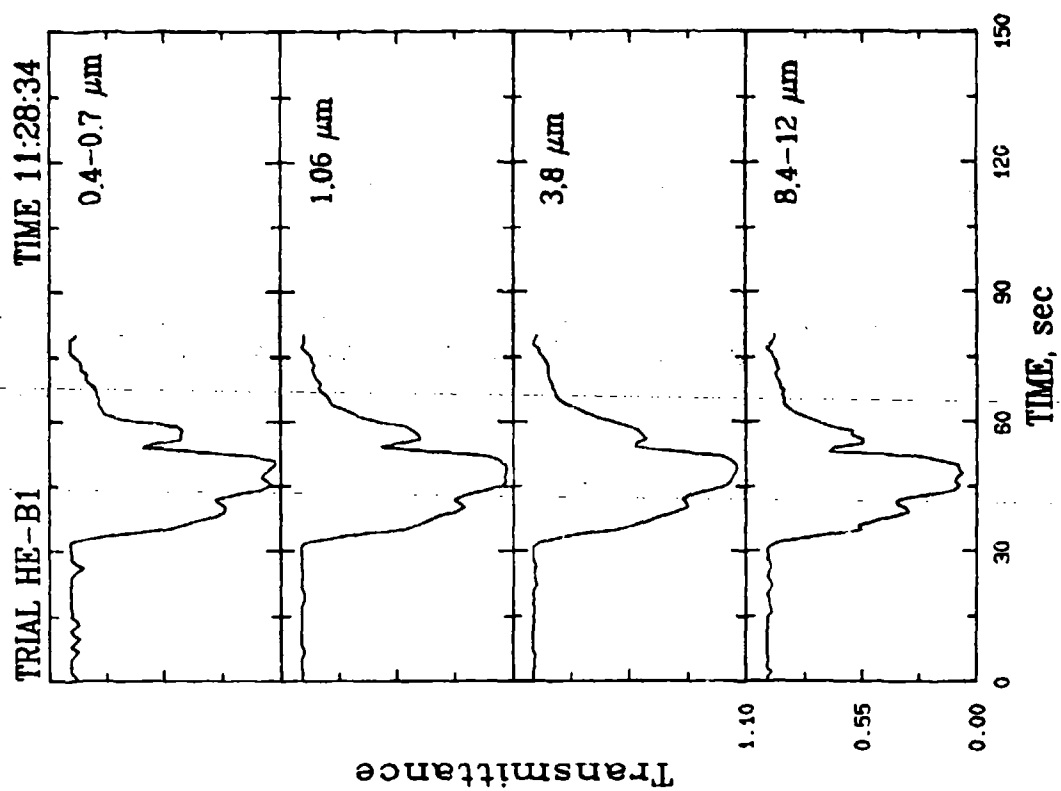
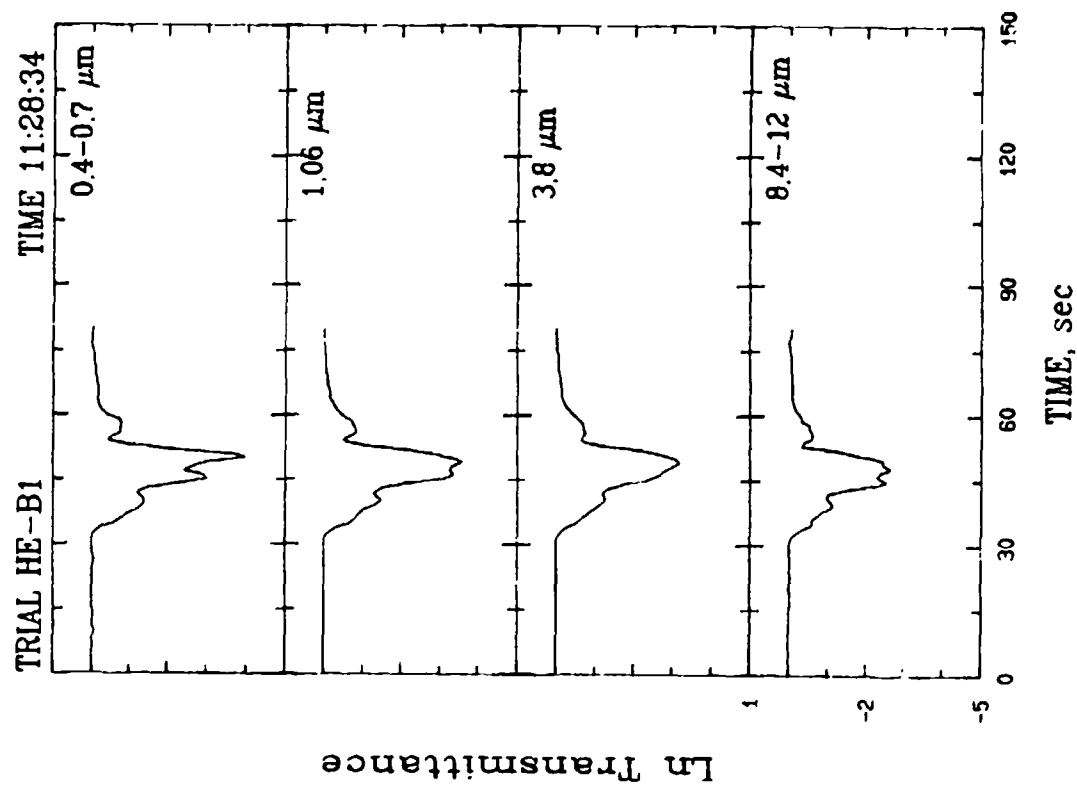


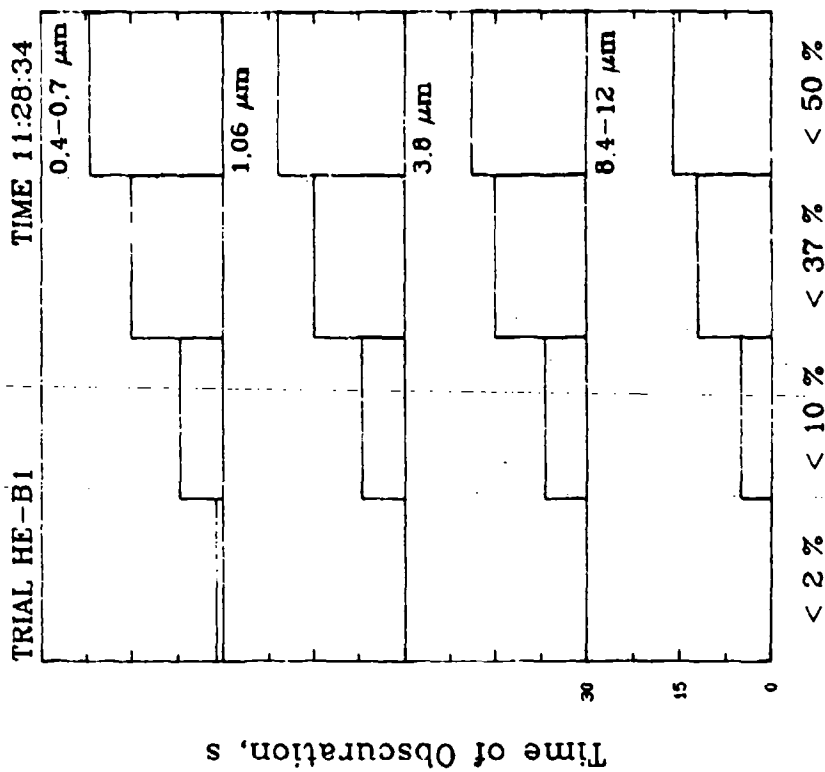
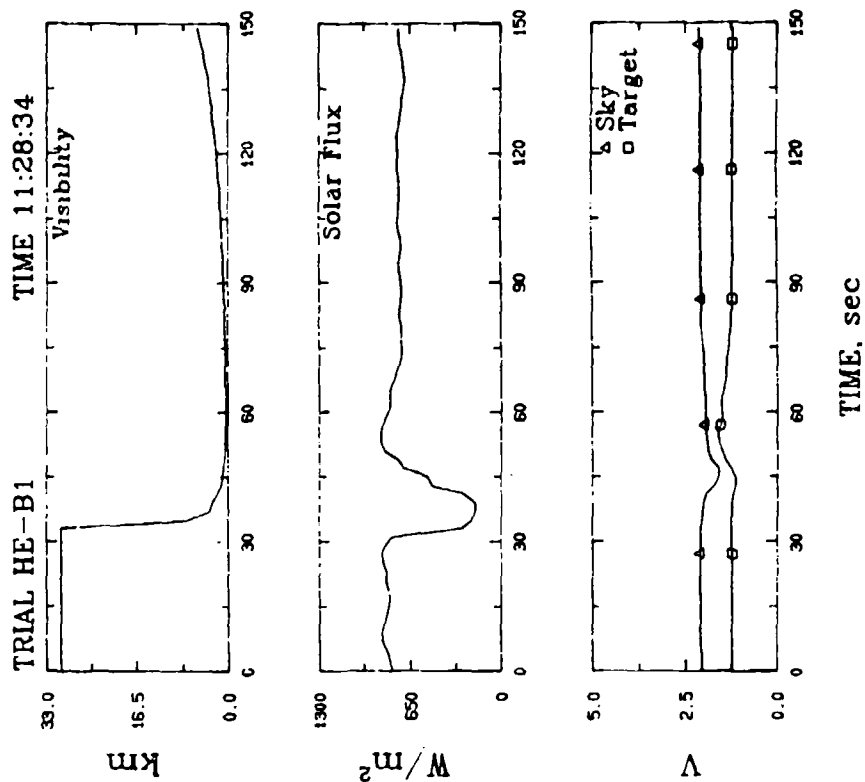
HEB1, 20 APRIL 83



MASSSES COLLECTED BY MI-VOL SAMPLERS  
CLOUD PAT. AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEB2  
 Date: 20 APRIL 83  
 Detonation Coordinates (M):  
 X: 50.4  
 Y: 4.5  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 15.0 LB  
 Event Time: 12:49:02

## METEOROLOGICAL DATA:

Pasquill Category: B  
 Richardson Number: -0.724  
 16 Meter Tower (Means)  
 Start Time: 12:46: 5      End Time: 12:51: 3

|                            | 2M    | 4M    | 6M    | 16M   |
|----------------------------|-------|-------|-------|-------|
| Wind Speed (M/S)           | 2.98  | 3.08  | 3.18  | 3.58  |
| Wind Dir. (DEG)            | 129.3 | 132.1 | 131.6 | 132.4 |
| Sigma WSP                  | 1.11  | 1.29  | 1.43  | 1.63  |
| Sigma WDIR                 | 18.3  | 17.3  | 19.2  | 18.8  |
| UV <sub>B</sub> Components |       |       |       |       |
| U (N-S) (M/S)              | 1.82  | 1.99  | 2.10  | 2.42  |
| V (E-W) (M/S)              | -2.15 | -2.13 | -2.17 | -2.40 |
| W (Vert) (M/S)             | 0.09  | 0.08  | -0.03 | •     |
| Sigma U                    | 1.05  | 1.14  | 1.19  | 1.43  |
| Sigma V                    | 1.05  | 1.15  | 1.26  | 1.37  |
| Sigma W                    | 0.18  | 0.32  | 0.37  | •     |
| Temperature (C)            | 19.6  | 18.6  | 18.1  | 17.8  |

Soil Temperature (C): 32.2      Solar Flux (W/m<sup>2</sup>): 831.5  
 Dew Point (C): -1.5      Visual Range (M): 30480.0  
 Temperature (C): 17.7      Vista Ranger Voltages:  
                                          Sky: 2.38  
                                          Target: 1.31  
 Rel. Hum. (%): 26.6      Sky-Target Contrast: -0.45  
 Abs. Hum. (G/M<sup>3</sup>): 4.03  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 46.0 5.0      | 45  | 178 | 163 | 512 |
| Post-Shot | 46.0 5.0      | 50  | 133 | 167 | 233 |

## CRATER DATA

Moisture Content: 22.0

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.848  
 Apparent Crater: 0.224  
 Flow: 0.123

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.520  
 Flow: 0.950  
 Bottom: •  
 Side: •

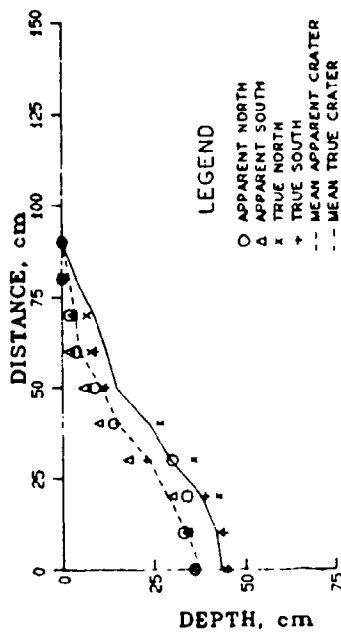
## HI VOL DATA (G):

|      | HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|------|--------|--------|--------|--------|--------|--------|--------|--------|
|      | 0.0904 | 0.0570 | 0.0617 | 0.0536 | 0.0598 | 0.0456 | 0.0621 | 0.0430 |
| SUM: | 0.4732 |        |        |        |        |        |        |        |

## GELMAN DOSAGE (G S/M<sup>3</sup>):

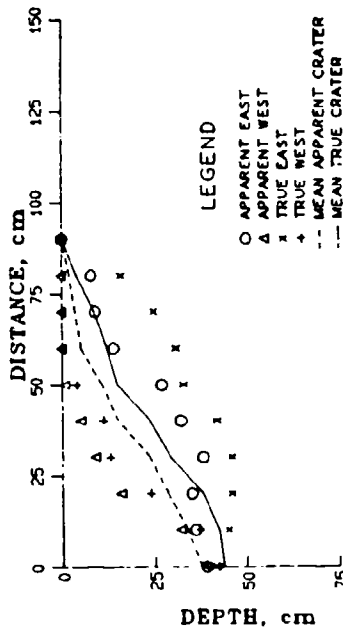
|  | GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|--|----------|----------|----------|----------|
|  | 0.000    | 8.000    | 3.736    | 2.703    |

B2 15 LB 1249HR 20APR83 50,5



LEGEND

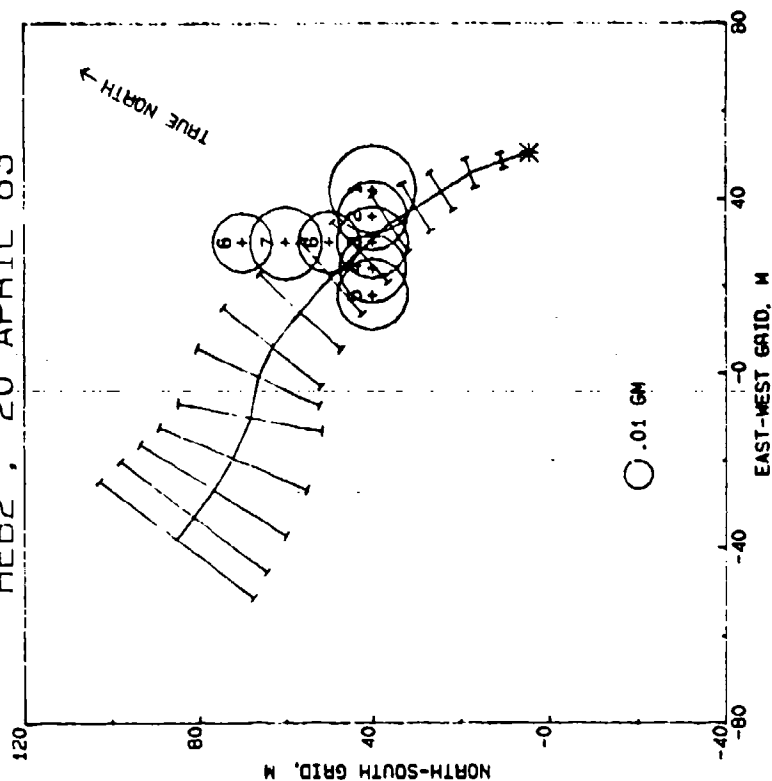
- APPARENT NORTH
- △ APPARENT SOUTH
- × TRUE NORTH
- + TRUE SOUTH
- MEAN APPARENT CRATER
- MEAN TRUE CRATER



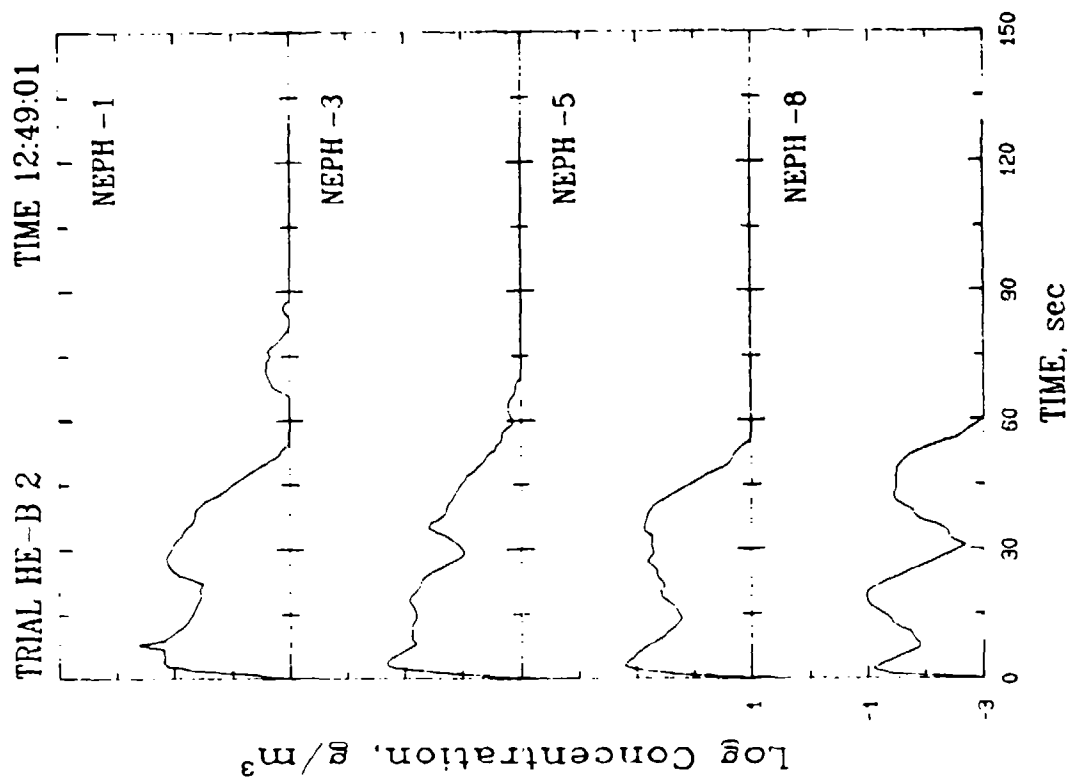
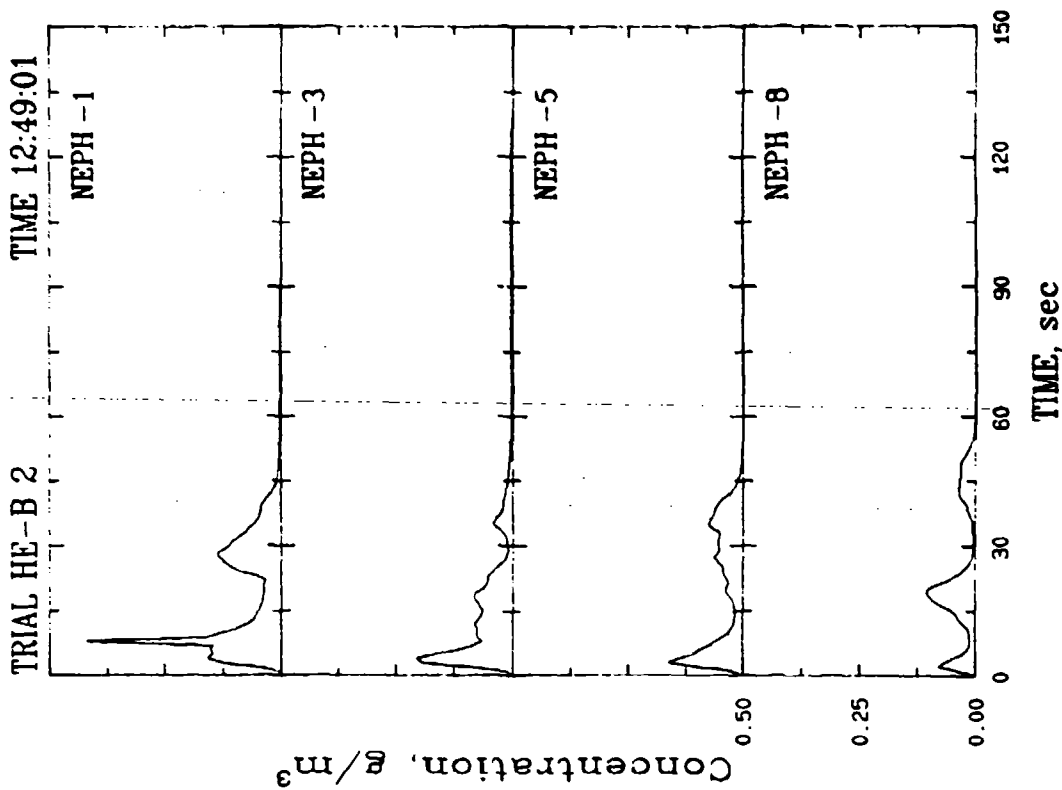
LEGEND

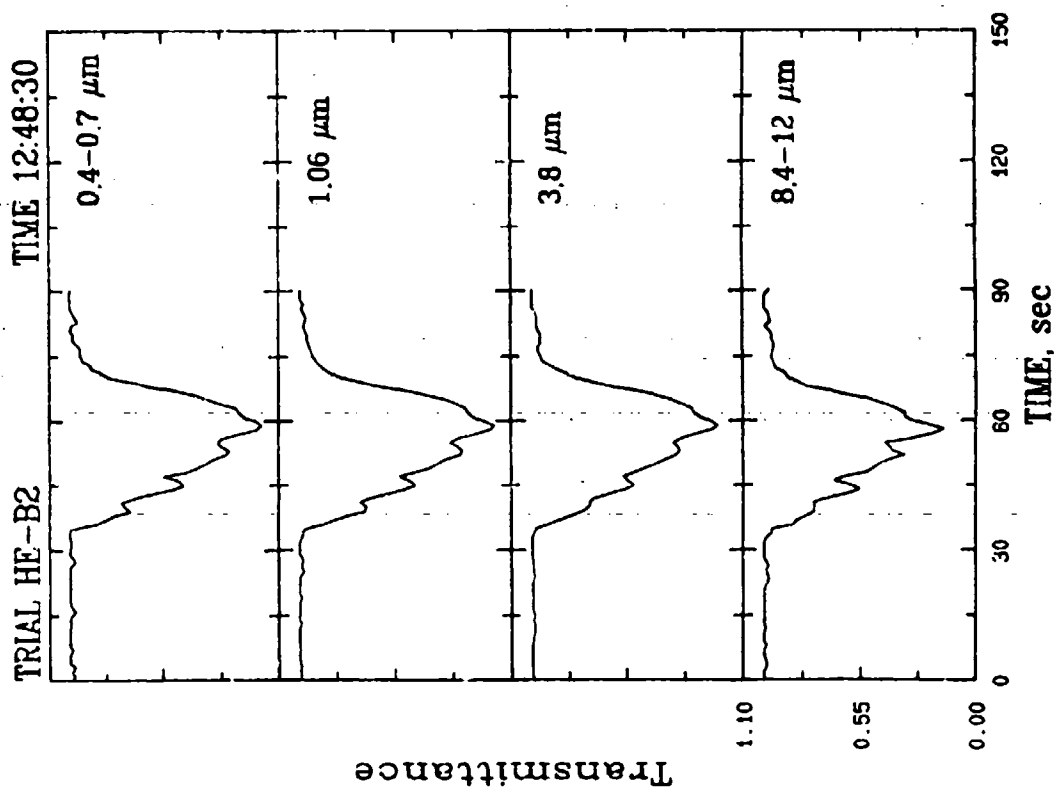
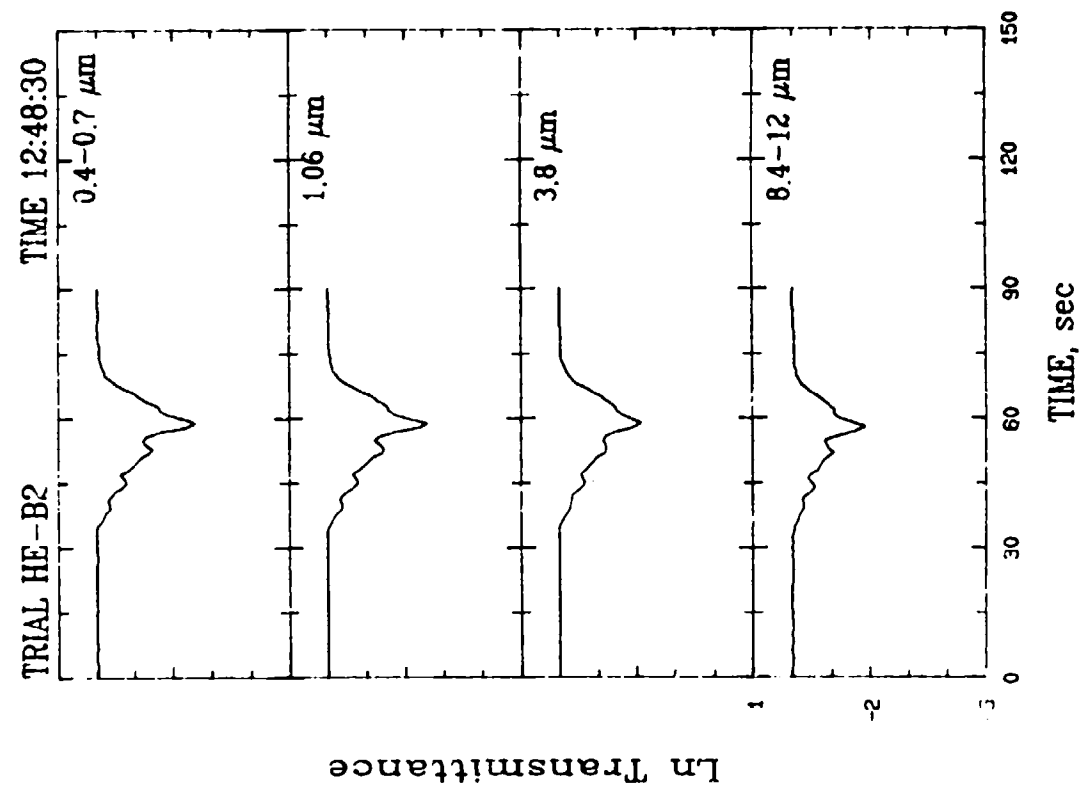
- APPARENT EAST
- △ APPARENT WEST
- × TRUE EAST
- + TRUE WEST
- MEAN APPARENT CRATER
- MEAN TRUE CRATER

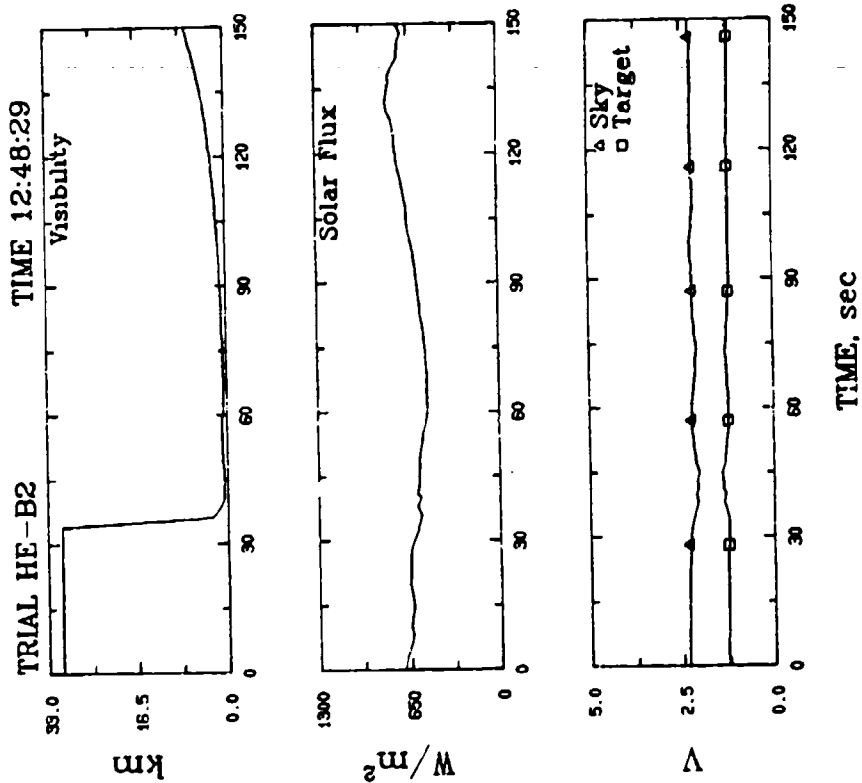
HEB2 , 20 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEB3  
 Date: 21 APRIL 83  
 Detonation Coordinates (M):  
 X: -16.0  
 Y: 78.4  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 15.0 LB  
 Event Time: 11:06:35

## METEOROLOGICAL DATA:

Pasquill Category: C  
 Richardson Number: -0.195  
 16 Meter Tower (Means)  
 Start Time: 10:58: 4 End Time: 11: 8:21

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 6.66  | 7.50  | 7.93  | 8.45  |
| Wind Dir. (DEG)  | 267.0 | 265.4 | 265.3 | 263.0 |
| Sigma WSP        | 1.70  | 1.78  | 1.75  | 1.75  |
| Sigma WDIR       | 17.3  | 17.1  | 16.1  | 16.1  |
| UVN Components   |       |       |       |       |
| U (N-S) (M/S)    | 0.17  | 0.40  | 0.46  | 0.83  |
| V (E-W) (M/S)    | 6.34  | 7.14  | 7.60  | 8.06  |
| W (Vert) (M/S)   | 0.14  | 0.40  | 0.33  | 0     |
| Sigma U          | 2.08  | 2.29  | 2.27  | 2.42  |
| Sigma V          | 1.63  | 1.73  | 1.70  | 1.71  |
| Sigma W          | 0.29  | 0.41  | 0.48  | 0     |
| Temperature (C)  | 19.6  | 18.8  | 18.5  | 17.8  |

Soil Temperature (C): 31.0 Solar Flux (W/M<sup>2</sup>): 972.3  
 Dew Point (C): -4.8 Visual Range (M): 30480.0  
 Temperature (C): 18.3 Vista Ranger Voltages:  
 Rel. Hum. (%): 19.5 Sky: 3.08  
 Target: 1.00  
 Abs. Hum. (G/M<sup>3</sup>): 3.06 Sky-Target Contrast: -0.67  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | -10.0 78.0    | 25  | 92  | 296 | 525 |
| Post-Shot | -10.0 78.0    | 50  | 230 | 208 | 167 |

## CRATER DATA

Moisture Content: 13.3  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.738  
 Apparent Crater: 0.215  
 Flow: 0.523

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.360  
 Flow: 0.934  
 Bottom: 0.984  
 Side: 0.884

## HI VOL DATA (G):

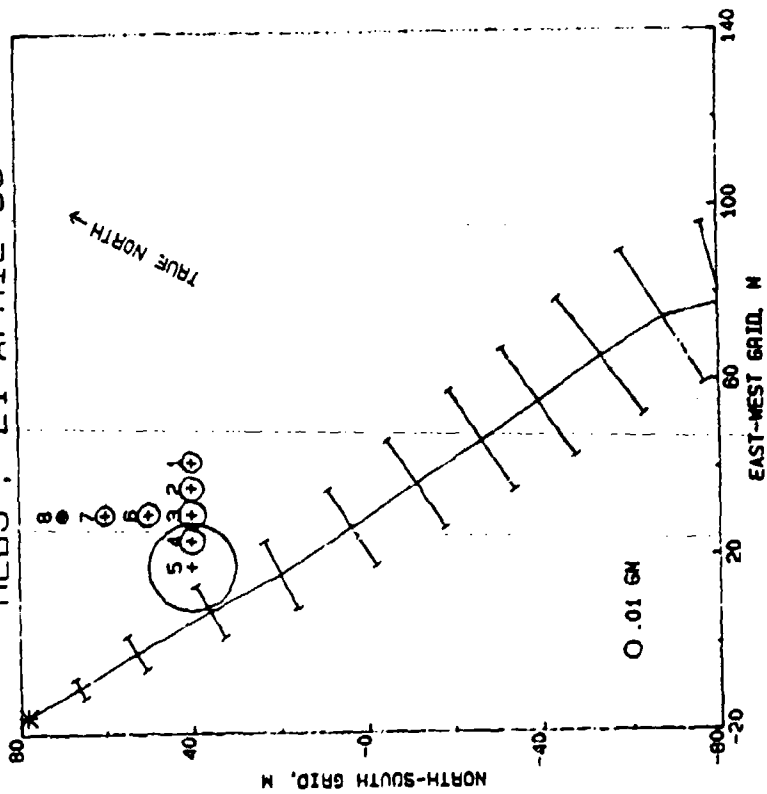
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0165 | 0.0213 | 0.0297 | 0.0246 | 0.2910 | 0.0206 | 0.0148 | 0.0056 |

SUM: 0.4241

## GELMAN DOSAGE (G S/M<sup>3</sup>):

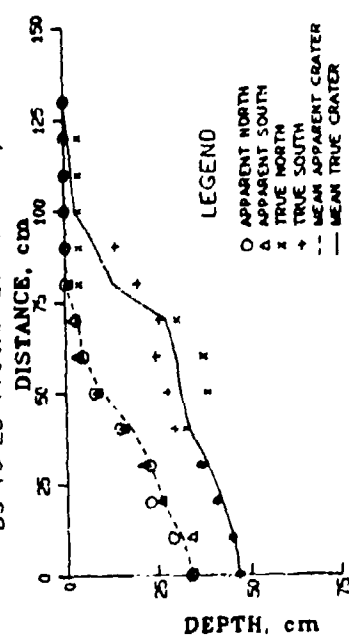
| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 7.583    | 5.600    | 1.494    | 1.622    |

HEB3 . 21 APRIL 83



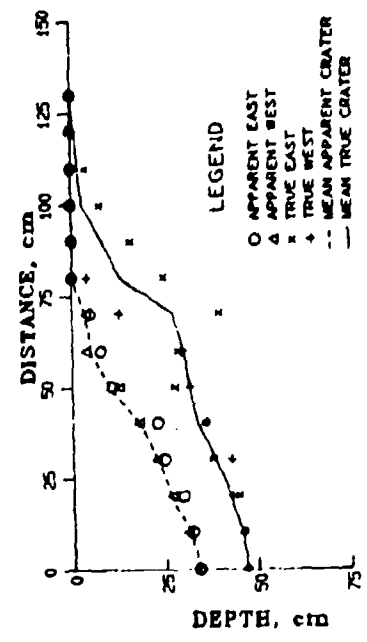
MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS

B3 15 LB 1106HR 21APR83 16,78



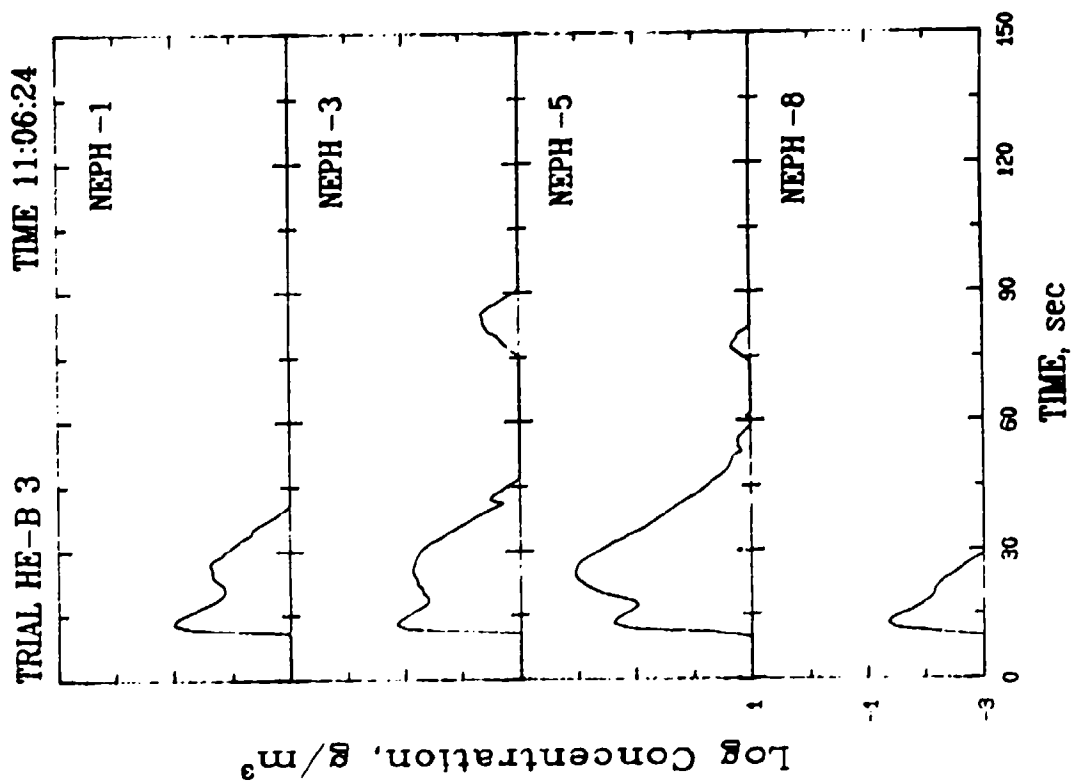
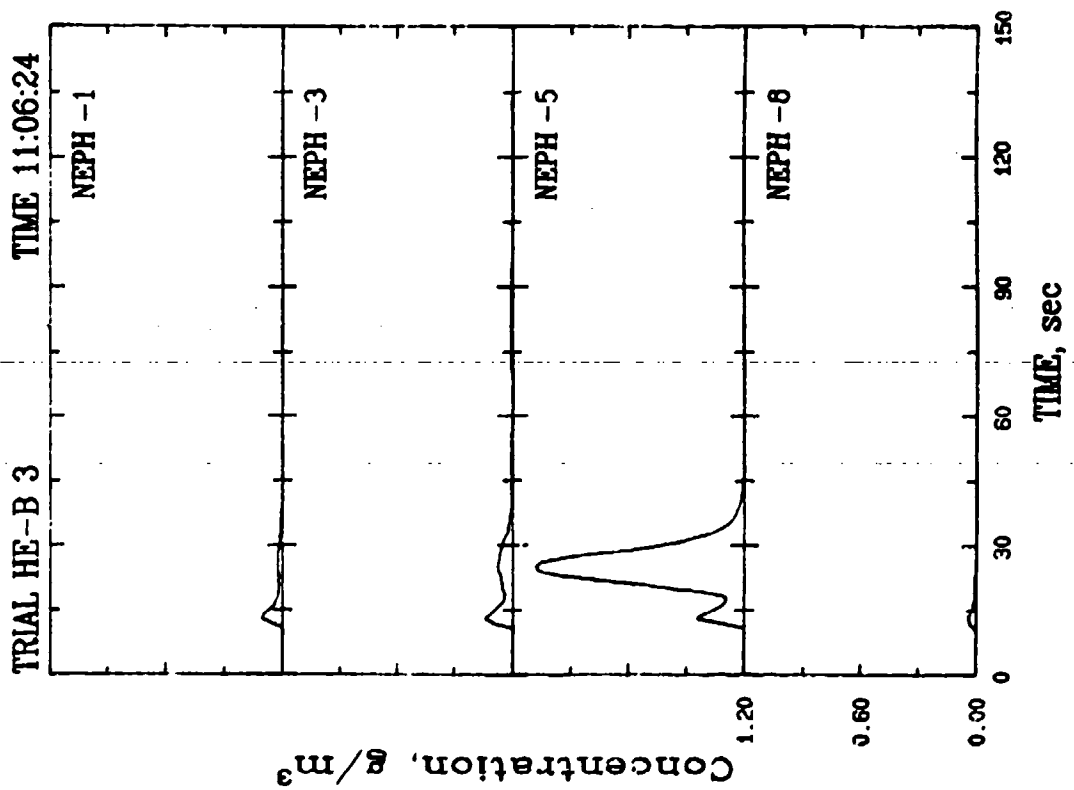
LEGEND

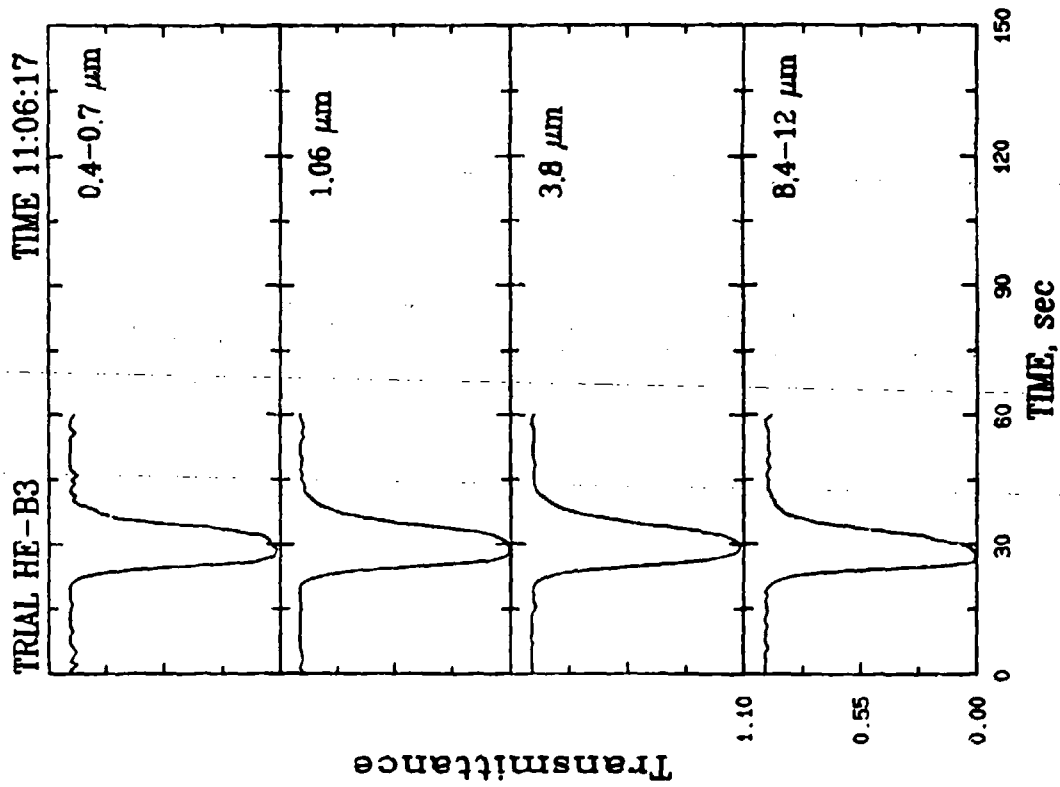
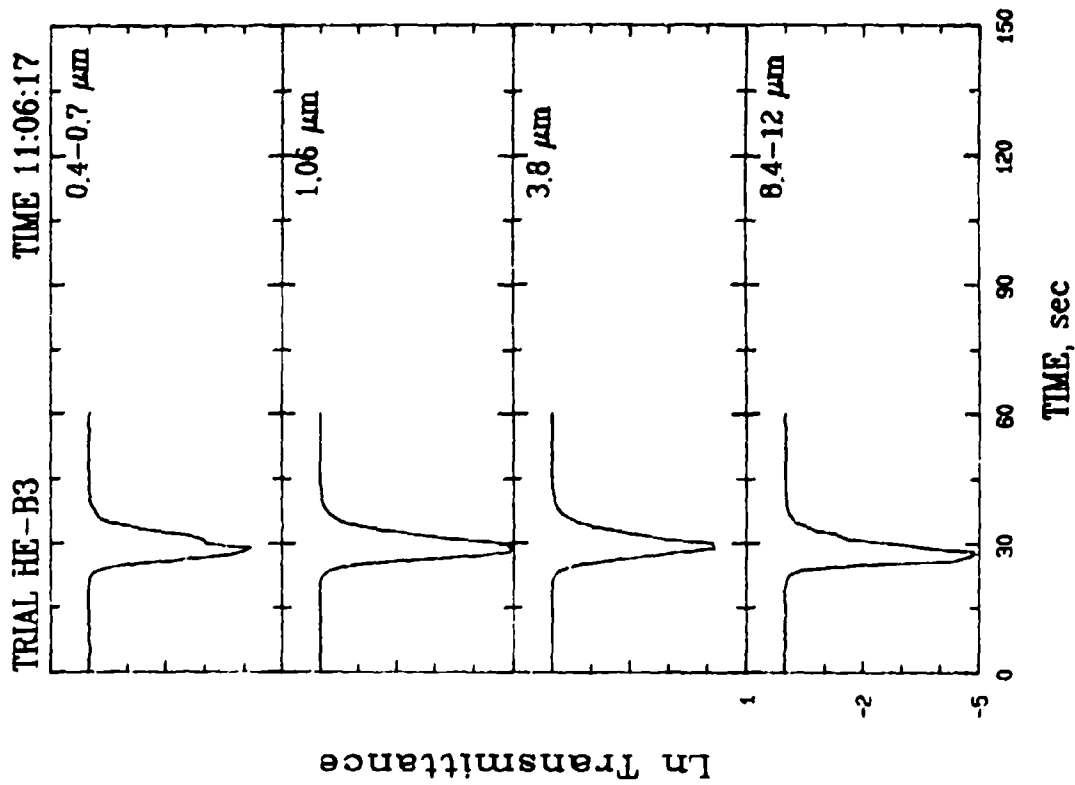
- O APPARENT NORTH
- Δ APPARENT SOUTH
- x TRUE NORTH
- + TRUE SOUTH
- MEAN APPARENT CRATER
- MEAN TRUE CRATER

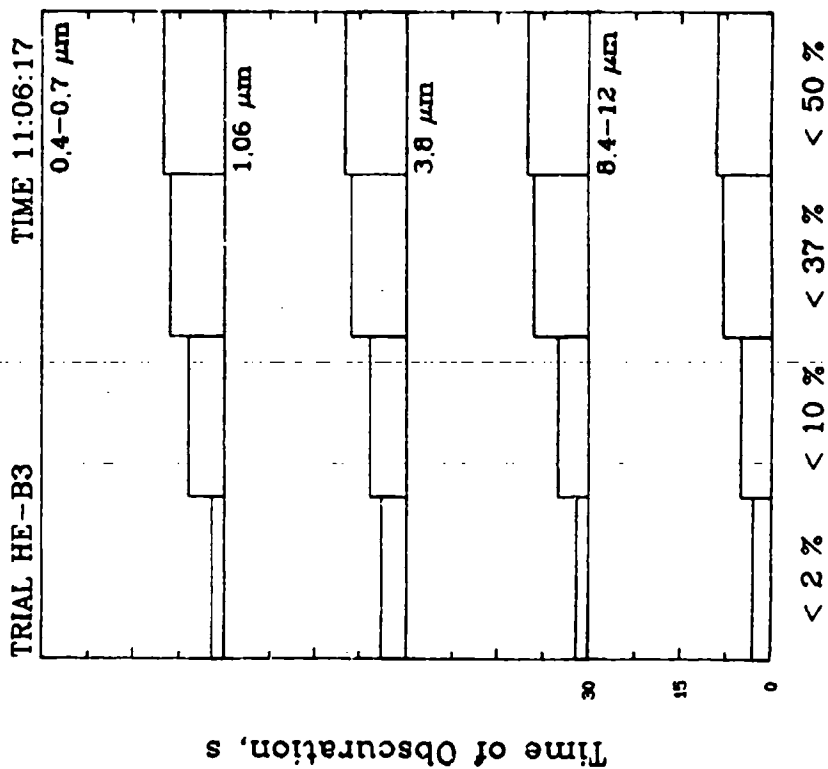
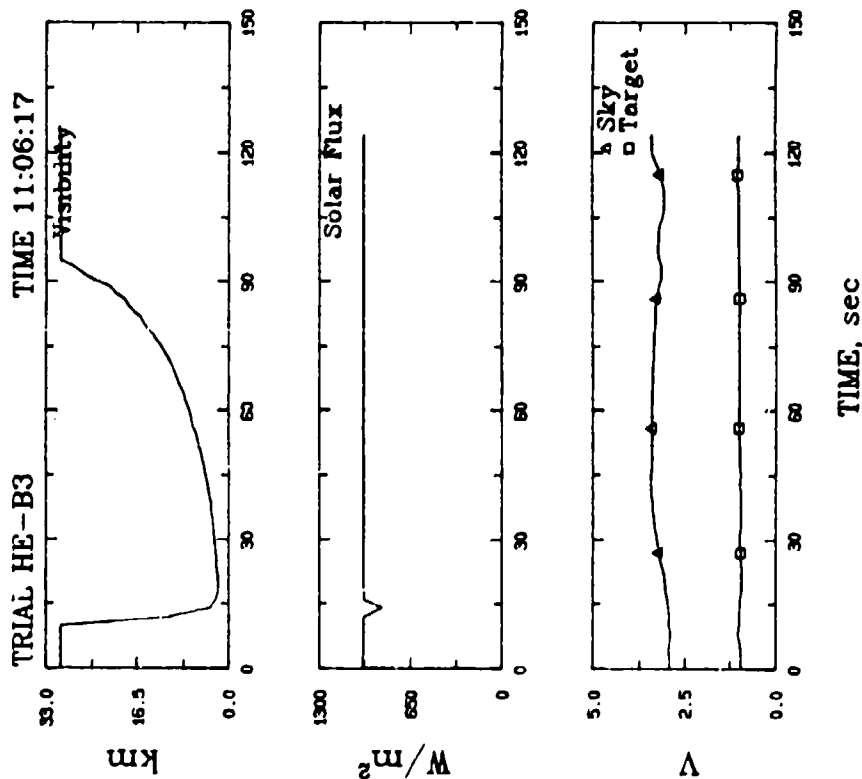


LEGEND

- O APPARENT EAST
- Δ APPARENT WEST
- x TRUE EAST
- + TRUE WEST
- MEAN APPARENT CRATER
- MEAN TRUE CRATER







# EVENT SUMMARY DATA

Test Number: HED4  
 Date: 21 APRIL 83  
 Detonation Coordinates (M):  
 X: -14.9  
 Y: 88.8  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 15.0 LB  
 Event Time: 12:22:44

## METEOROLOGICAL DATA:

Pasquill Category: C  
 Richardson Number: -0.164

16 Meter Tower (Means)  
 Start Time: 12:19:46 End Time: 12:24:44

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 5.76  | 7.47  | 7.86  | 8.42  |
| Wind Dir. (DEG)  | 282.7 | 282.0 | 281.3 | 281.1 |
| Sigma WSP        | 1.93  | 2.16  | 2.14  | 2.24  |
| Sigma WDIR       | 11.4  | 12.2  | 11.9  | 15.5  |
| UVN Components   |       |       |       |       |
| U (N-S)          | -1.47 | -1.52 | -1.51 | -1.53 |
| V (E-W)          | 6.47  | 7.17  | 7.57  | 8.04  |
| W (Vert)         | 0.12  | 0.18  | 0.26  | 0     |
| Sigma U          | 1.27  | 1.38  | 1.42  | 1.81  |
| Sigma V          | 1.93  | 2.20  | 2.18  | 2.39  |
| Sigma W          | 0.29  | 0.41  | 0.46  | 0     |
| Temperature (C)  | 20.7  | 20.2  | 19.8  | 18.9  |

Soil Temperature (C): 35.9 Solar Flux (W/M<sup>2</sup>): 1013.5  
 Dew Point (C): -7.1 Visual Range (M): 30480.0  
 Temperature (C): 19.1 Vista Ranger Voltages:  
 Sky: 3.81  
 Rel. Hum. (%): 25.2 Target: 0.93  
 Abs. Hum. (G/M<sup>3</sup>): 2.50 Sky-Target Contrast: -0.76  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X, Y Coord (M) | SFC | 15 | 30 | 45 |
|-----------|----------------|-----|----|----|----|
| Pre-Shot  | -15.0 89.0     | •   | •  | •  | •  |
| Post-Shot | -15.0 89.0     | •   | •  | •  | •  |

## CRATER DATA

Moisture Content: •  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: •  
 Apparent Crater: •  
 Flow: •

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: •  
 Flow: •  
 Bottom: •  
 Side: •

## HI VOL DATA (G):

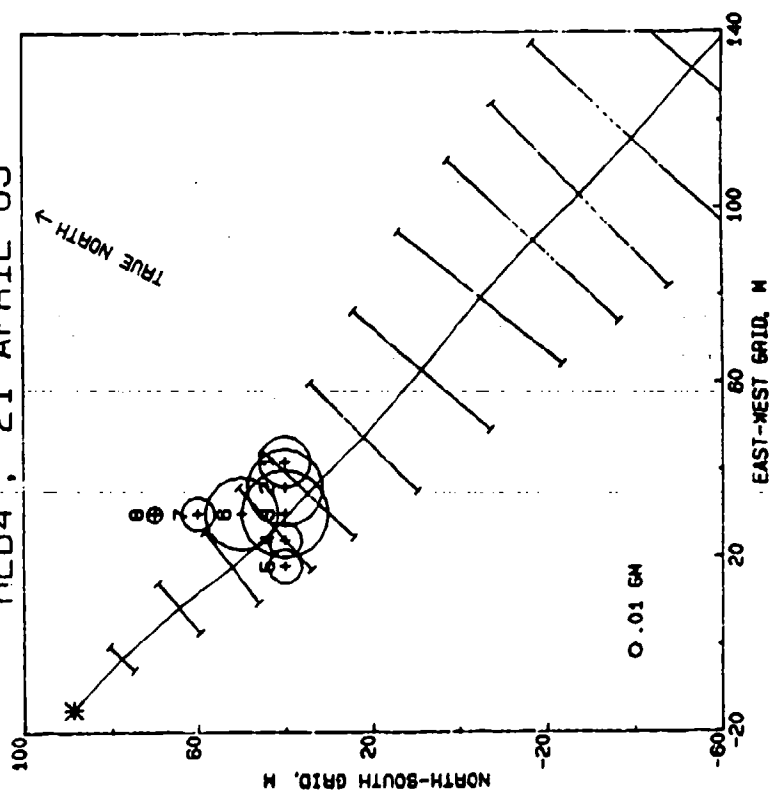
|        | HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8 |
|--------|--------|--------|--------|--------|--------|--------|--------|-----|
| 0.1405 | 0.3135 | 0.4069 | 0.0627 | 0.0624 | 0.2859 | 0.0594 | 0.0121 |     |

SUM: 1.3434

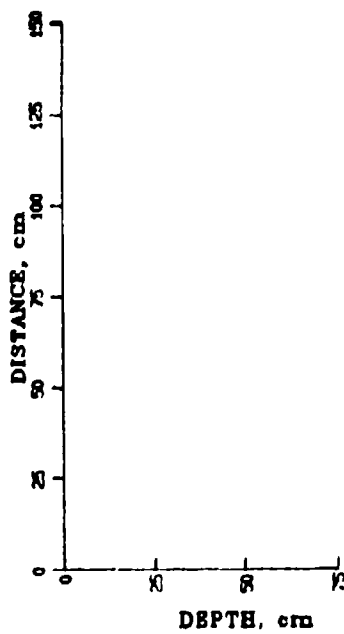
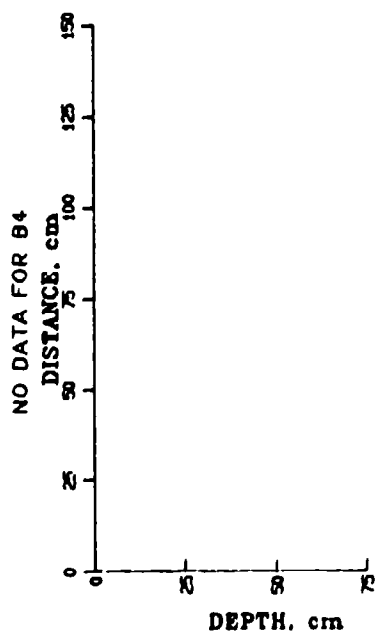
## GELMAN DOSAGE (G S/M<sup>3</sup>):

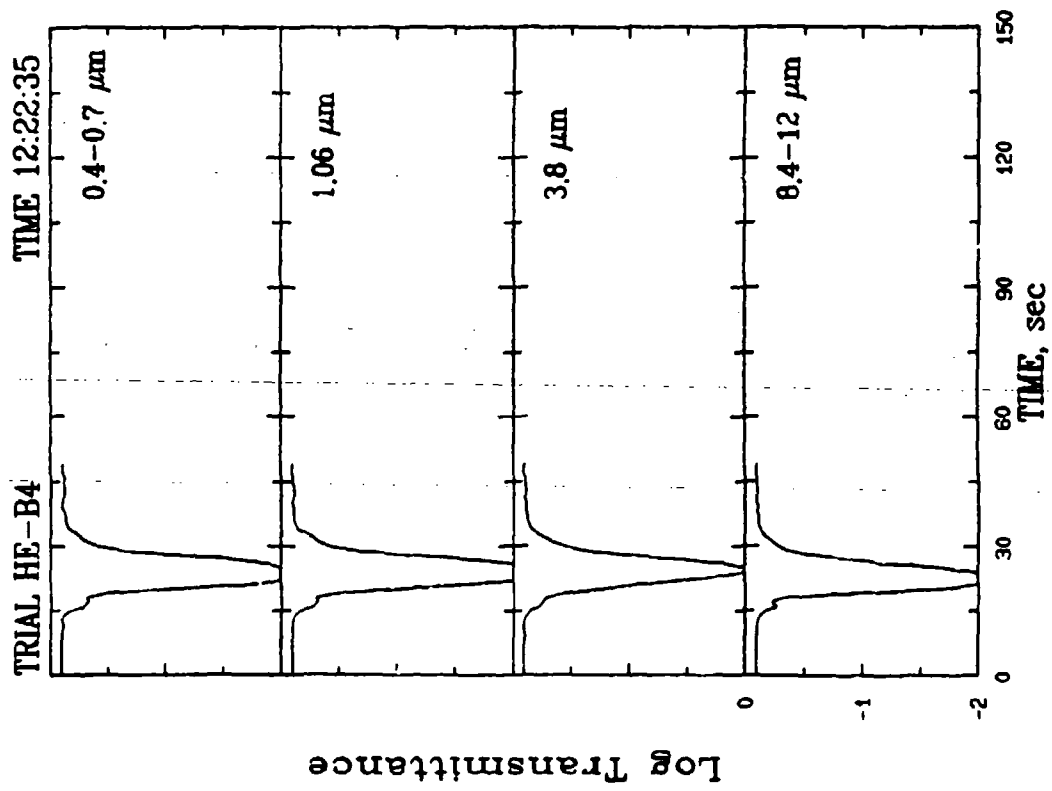
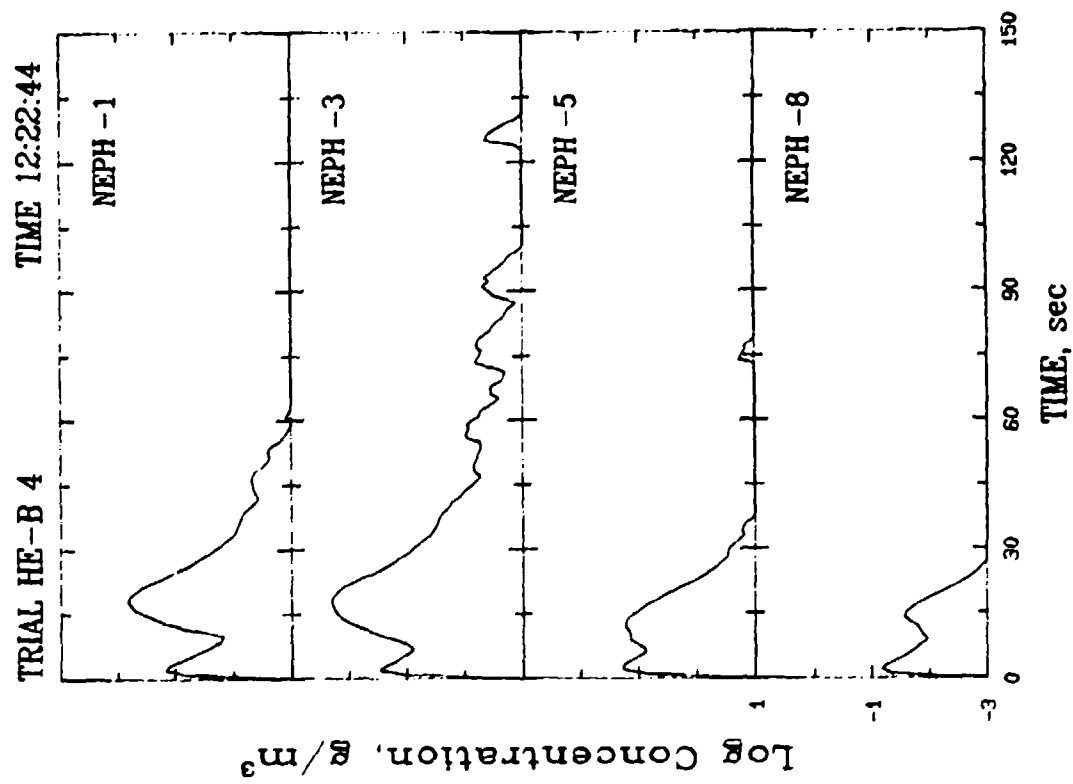
| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 4.483    | 4.865    |

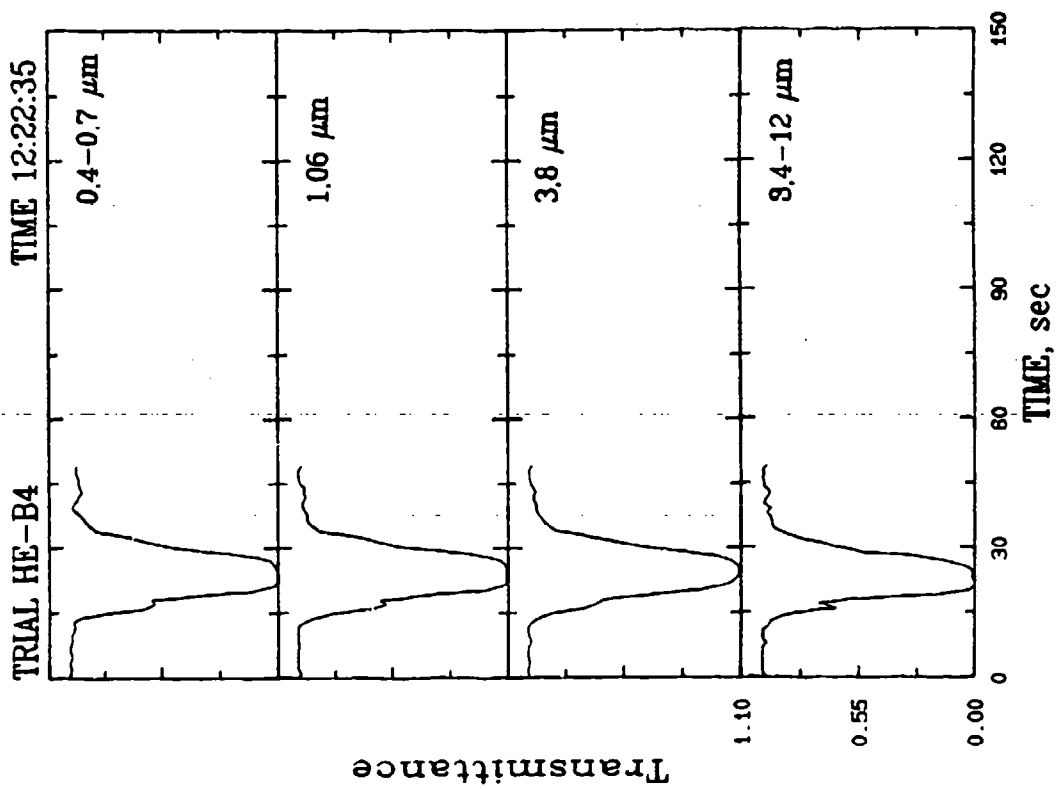
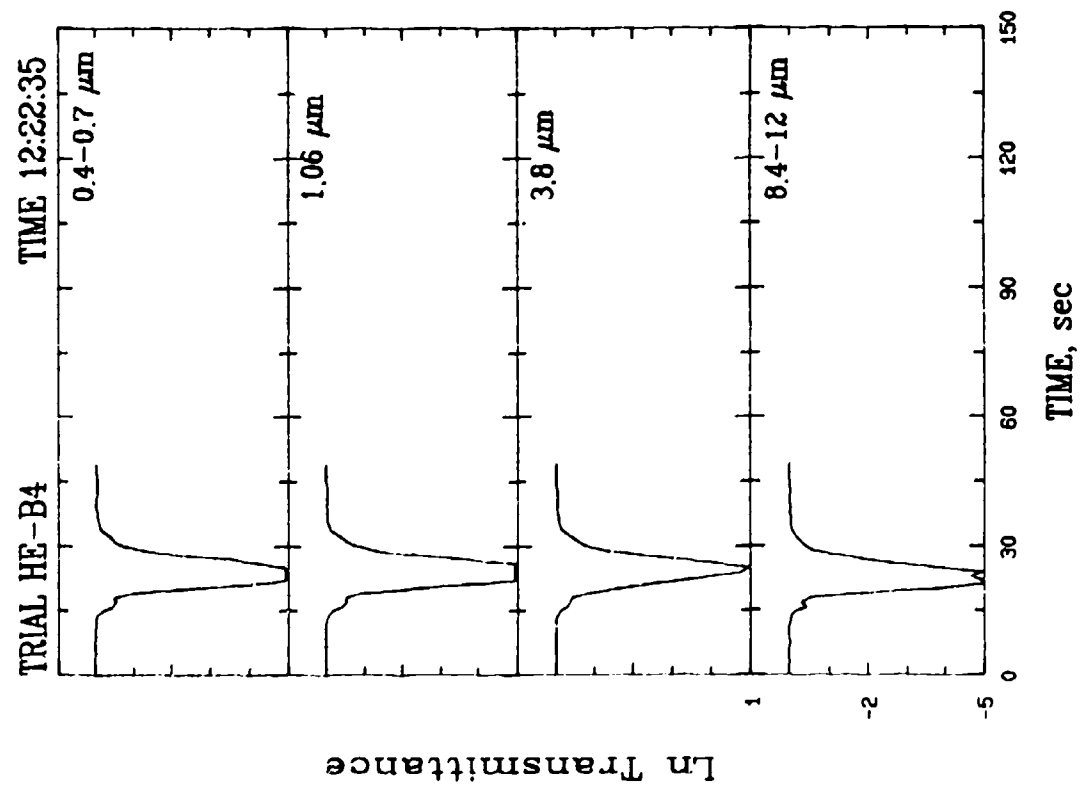
HEB4 . 21 APRIL 83

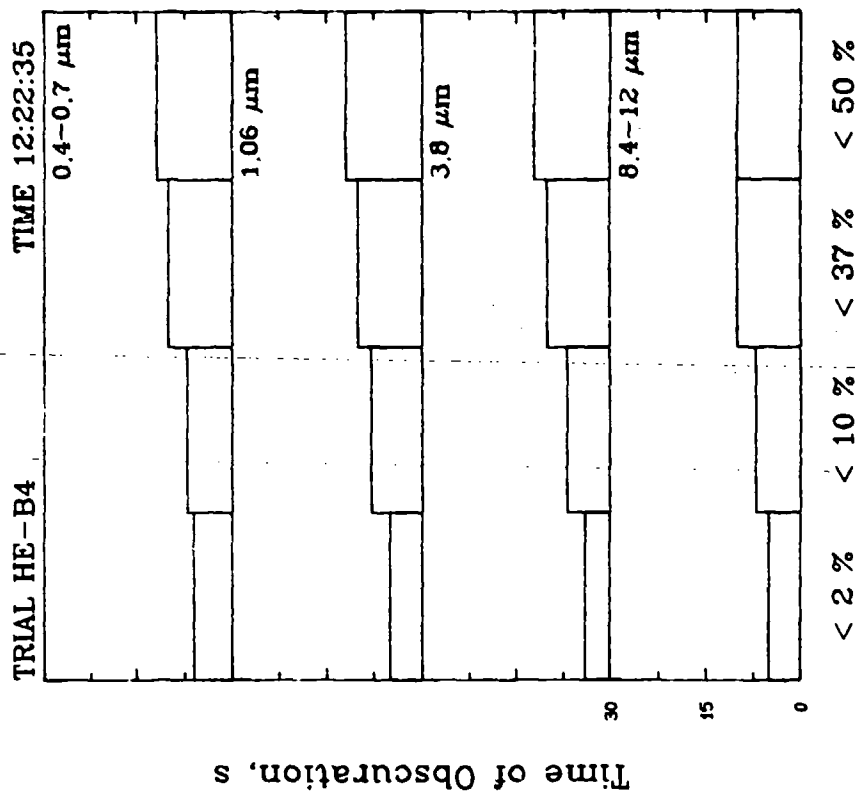
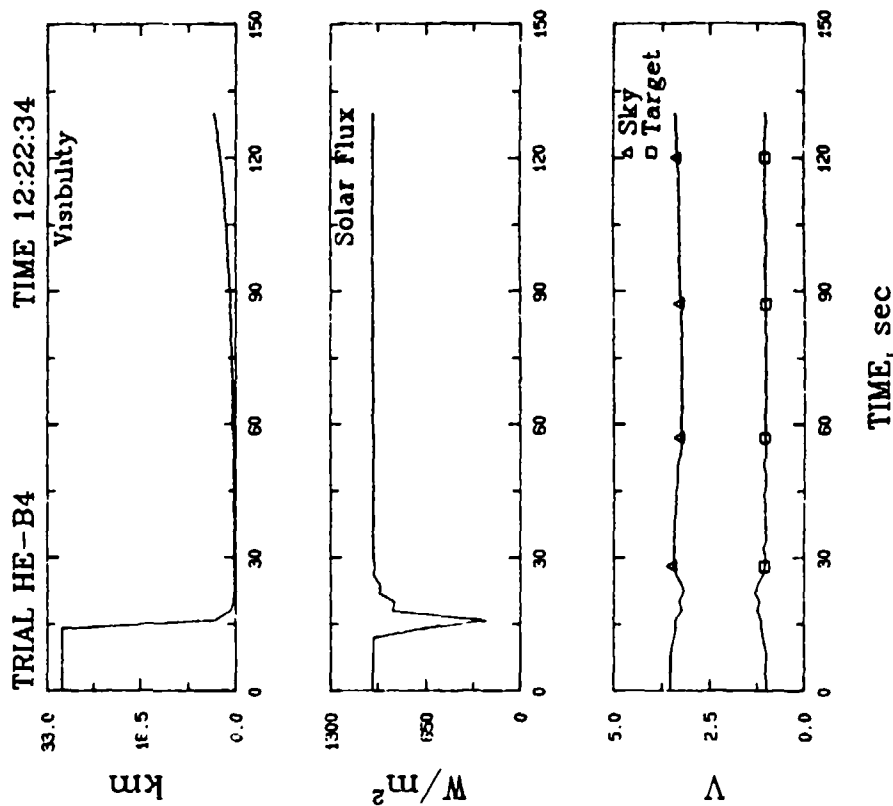


MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS









# EVENT SUMMARY DATA

Test Number: HEB5  
 Date: 21 APRIL 83  
 Detonation Coordinates (M):  
 X: 37.9  
 Y: 18.5  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 15.0 LB  
 Event Time: 16:58:01

## METEOROLOGICAL DATA:

Pasquill Category: D  
 Richardson Number: 0.000

16 Meter Tower (Means)  
 Start Time: 16:57:11 End Time: 17: 1:46

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 0.90  | 0.87  | 1.02  | 1.19  |
| Wind Dir. (DEG)  | 99.6  | 104.1 | 103.6 | 90.1  |
| Sigma WSP        | 0.20  | 0.21  | 0.23  | 0.36  |
| Sigma WDIR       | 11.4  | 11.7  | 15.5  | 19.0  |
| UVW Components   |       |       |       |       |
| U (N-S) (M/S)    | 0.15  | 0.21  | 0.23  | -0.05 |
| V (E-W) (M/S)    | -0.87 | -0.83 | -0.96 | -1.13 |
| W (Vert) (M/S)   | 0.00  | 0.01  | 0.01  | *     |
| Sigma U          | 0.18  | 0.17  | 0.25  | 0.36  |
| Sigma V          | 0.21  | 0.21  | 0.24  | 0.37  |
| Sigma W          | 0.01  | 0.04  | 0.04  | *     |
| Temperature (C)  | 17.4  | 17.3  | 17.3  | 17.3  |

Soil Temperature (C): 20.2 Solar Flux (W/M<sup>2</sup>): 82.9  
 Dew Point (C): -3.3 Visual Range (M): 30480.0  
 Temperature (C): 16.4 Vista Ranger Voltages:  
 Sky: 0.91  
 Rel. Hum. (%): 24.7 Target: 0.40  
 Abs. Hum. (G/M<sup>3</sup>): 3.47 Sky-Target Contrast: -0.56  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X, Y Coord (M) | SPC | 15  | 30  | 45  |
|-----------|----------------|-----|-----|-----|-----|
| Pre-Shot  | 64.0 29.0      | 35  | 129 | 260 | 588 |
| Post-Shot | 64.0 29.0      | 25  | 192 | 325 | 485 |

## CRATER DATA

Moisture Content: 11.5

## CRATER VOLUMES (M<sup>3</sup>):

True Crater: \*  
 Apparent Crater: \*  
 Flow: \*

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: \*  
 Flow: 0.925  
 Bottom: 0.925  
 Side: 0.926

## HI VOL DATA (G):

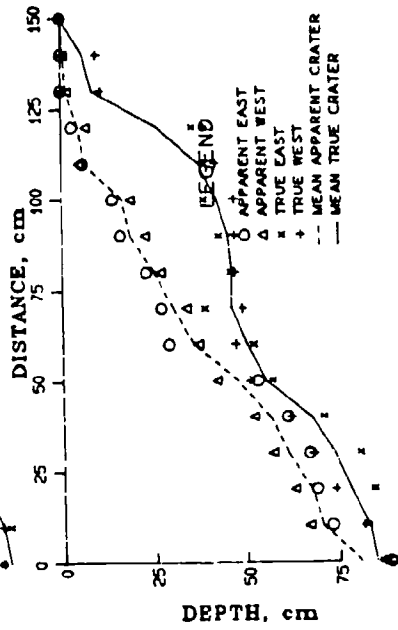
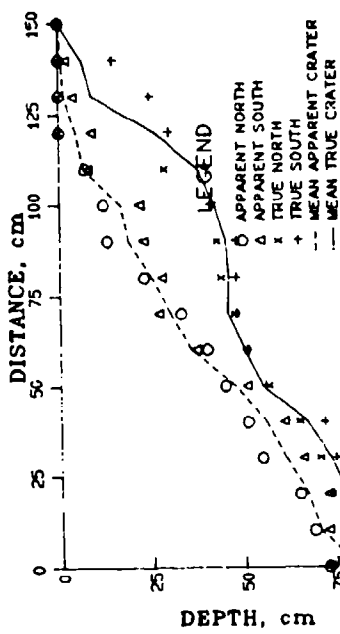
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.5196 | 1.0856 | 1.0502 | 2.8643 | 1.1068 | 0.6853 | 0.1133 | 0.0482 |

SUM: 7.4733

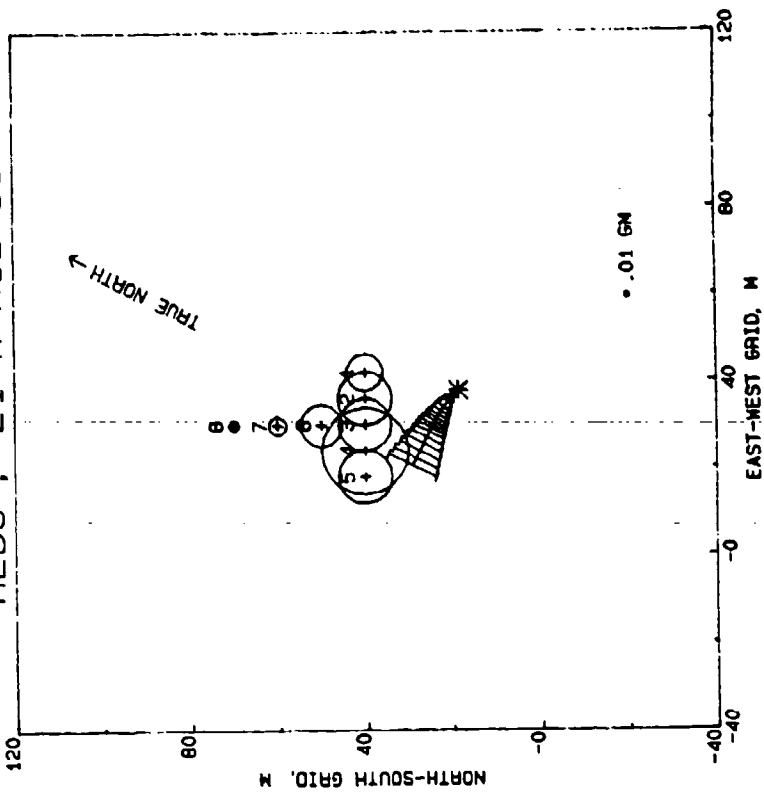
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 0.000    | 0.000    |

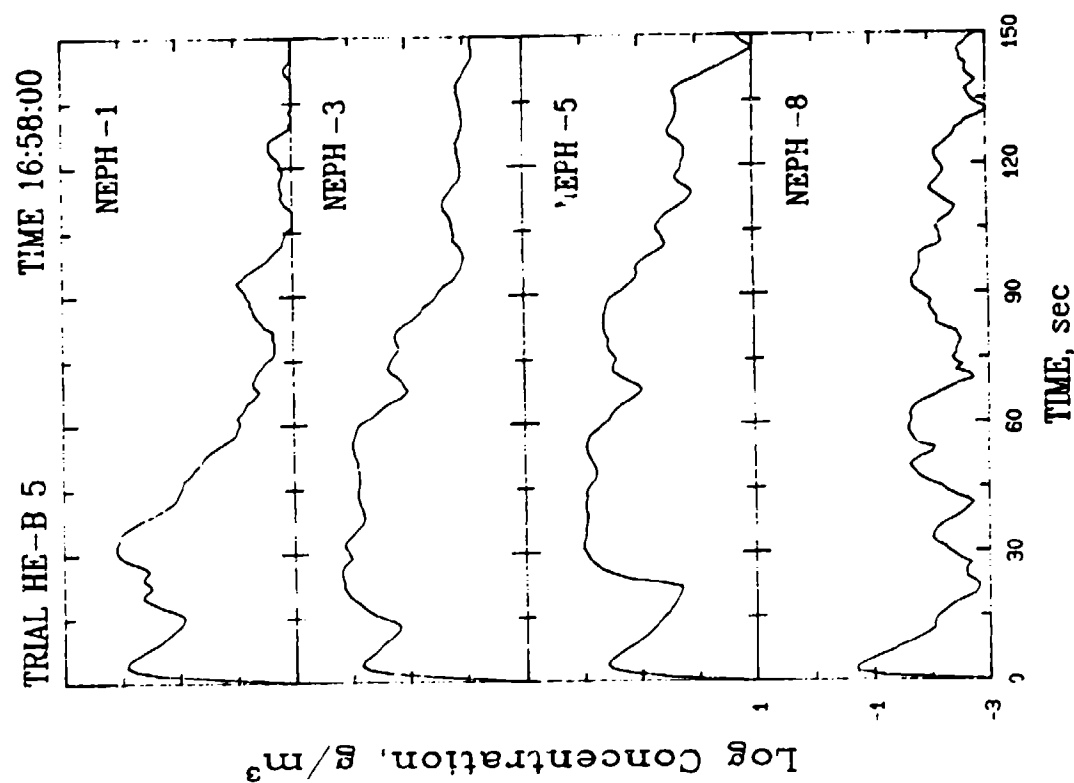
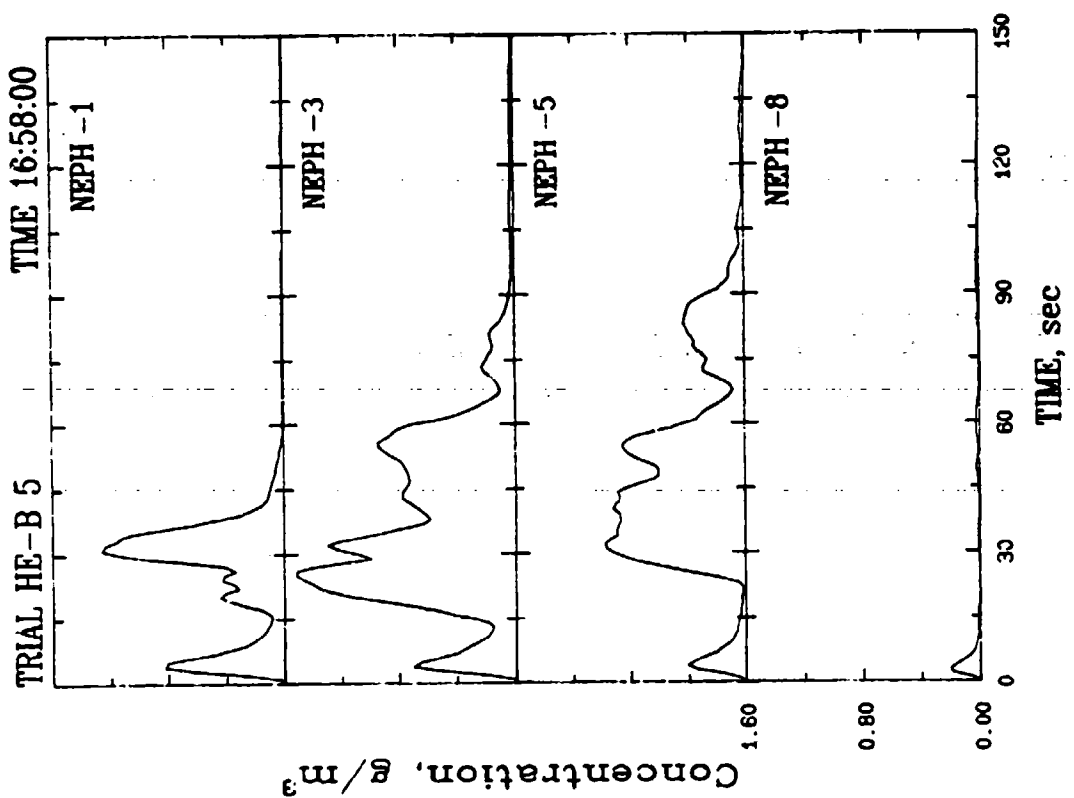
B5 15 LB 1658HR 21APR83 37,19

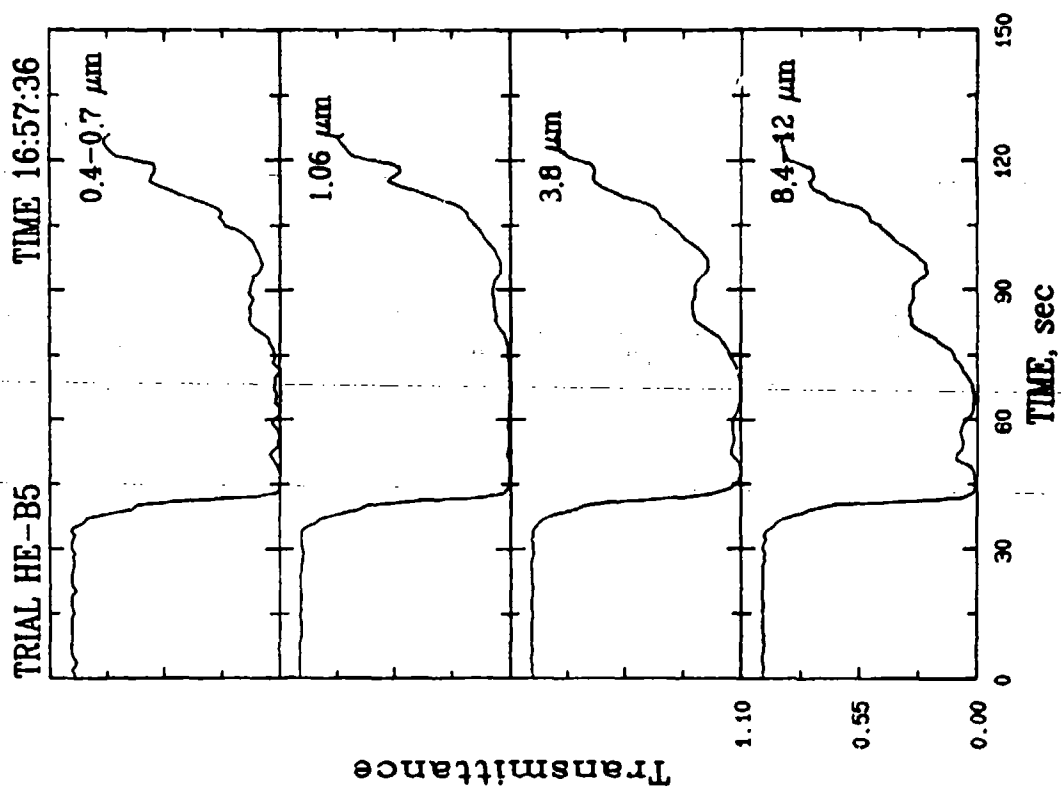
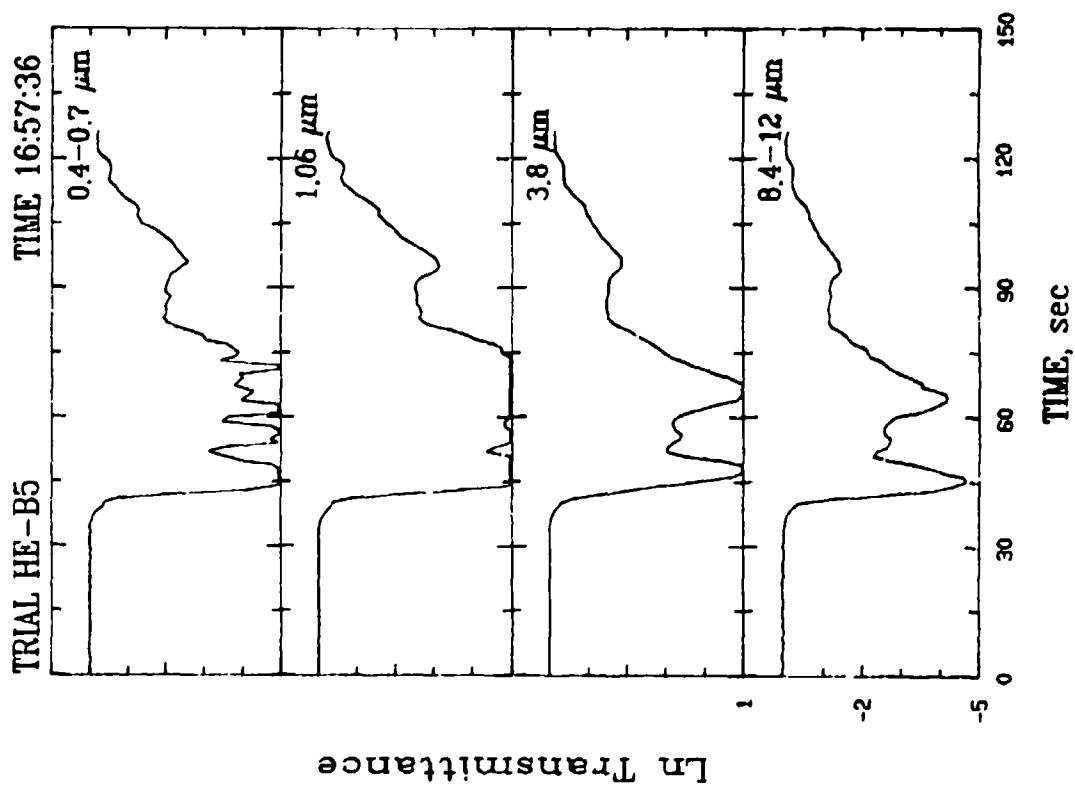


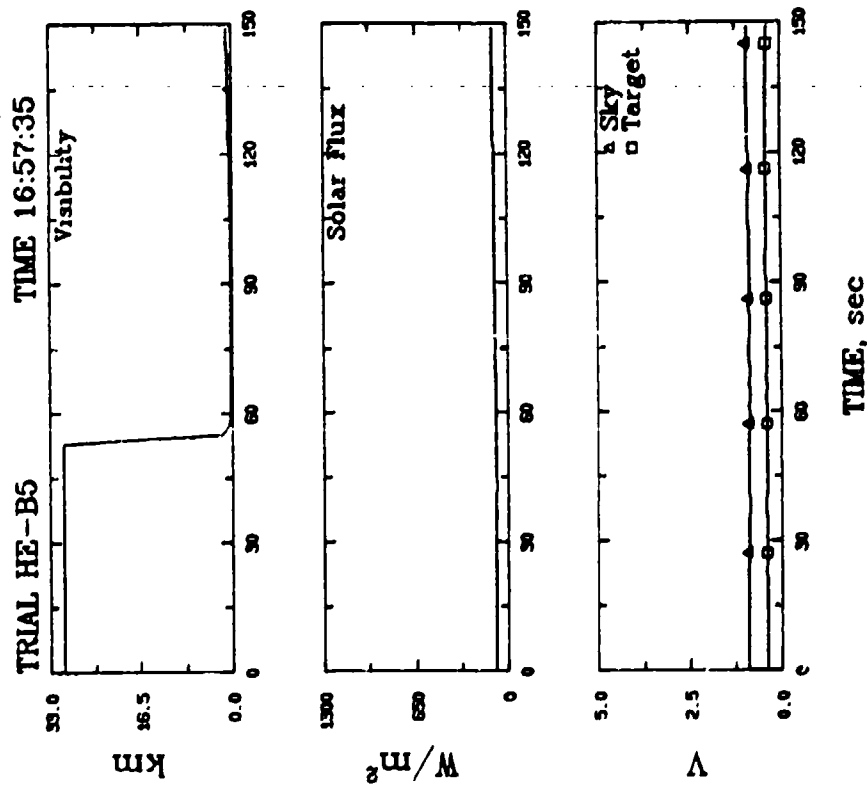
HEB5, 21 APRIL 83



MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEDC  
 Date: 22 APRIL 83  
 Destination: Coordinates (M):  
 X: 61.7  
 Y: 72.7  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 15.0 LB  
 Event Time: 11:22:01

## METEOROLOGICAL DATA:

Pasquill Category: D  
 Richardson Number: -0.020

16 Meter Tower (Means)  
 Start Time: 11:20:49 End Time: 11:24: 1

|                  | ZN    | 4N    | 6N    | 16N   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 6.20  | 7.07  | 7.17  | 8.65  |
| Wind Dir. (DEG)  | 32.7  | 29.8  | 32.3  | 27.4  |
| Sigma MSP        | 1.00  | 1.15  | 1.08  | 0.94  |
| Sigma MDIR       | 10.5  | 9.4   | 8.6   | 7.0   |
| UTW Components   |       |       |       |       |
| U (M-S)          | -5.15 | -6.08 | -6.01 | -7.64 |
| V (E-W)          | -3.25 | -3.42 | -3.75 | -3.92 |
| W (Vert)         | 0.46  | -0.04 | 0.65  | •     |
| Sigma U          | 1.16  | 1.30  | 1.18  | 1.03  |
| Sigma V          | 0.96  | 0.97  | 0.96  | 0.95  |
| Sigma W          | 0.22  | 0.32  | 0.34  | •     |
| Temperature (C)  | 11.0  | 10.9  | 10.8  | 10.6  |

Soil Temperature (C): 11.7 Solar Flux (W/m<sup>2</sup>): 131.5  
 Dew Point (C): 2.7 Visual Range (M): 30400.0  
 Temperature (C): 10.2 Vista Ranger Voltages:  
 Sky: •  
 Rel. Hum. (%): 59.4 Target: •  
 Abs. Hum. (G/m<sup>3</sup>): 5.69 SKY-Target Contrast: •  
 Rain Accumulation (mm): 0.00

## CONE INDEX:

|           | X,Y Coord (M) | SPC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 62.0 73.0     | 26  | 192 | 308 | 667 |
| Post-Shot | 62.0 73.0     | 25  | 70  | 130 | 195 |

## CRATER DATA

Moisture Content: 13.1

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 1.260  
 Apparent Crater: 0.231  
 Flow: 1.029

DENSITIES (G/cm<sup>3</sup>):  
 Pre-Shot: 1.380  
 Flow: 1.040  
 Bottom: 0.975  
 Side: 1.104

## HI VOL DATA (G):

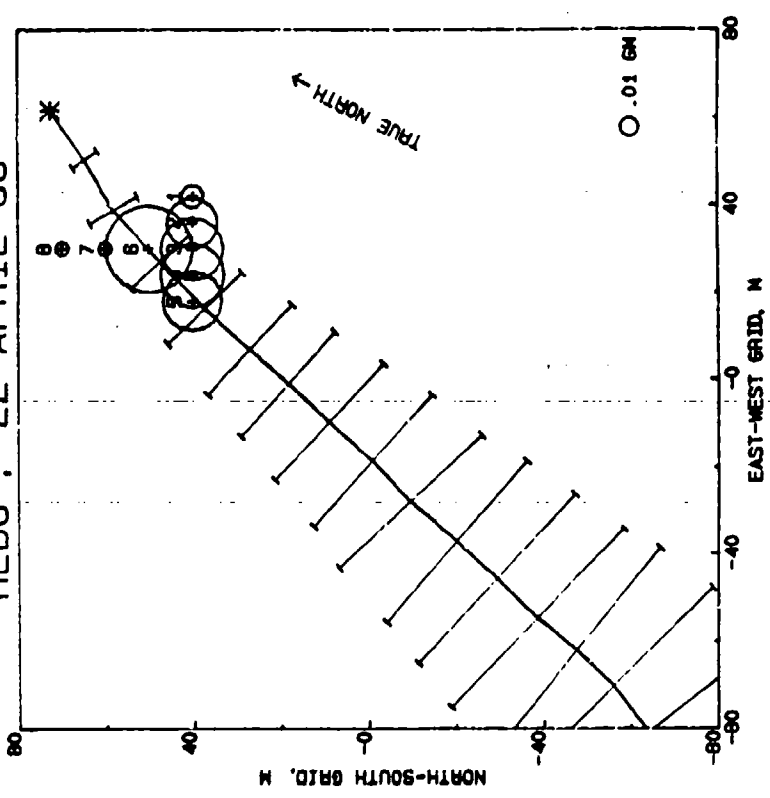
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0147 | 0.0693 | 0.1081 | 0.1129 | 6.0968 | 0.2123 | 0.0049 | 0.0059 |

SUM: 0.6249

## GELMAN DOSAGE (G S/M<sup>2</sup>):

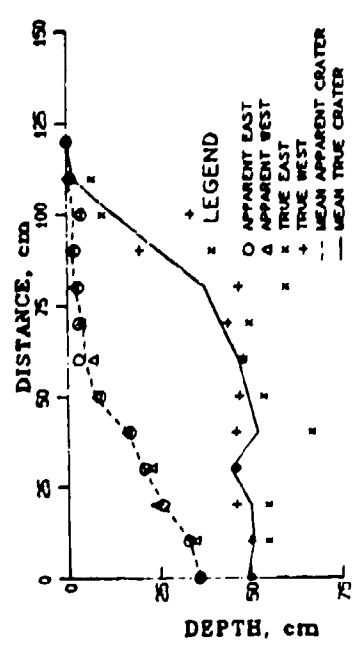
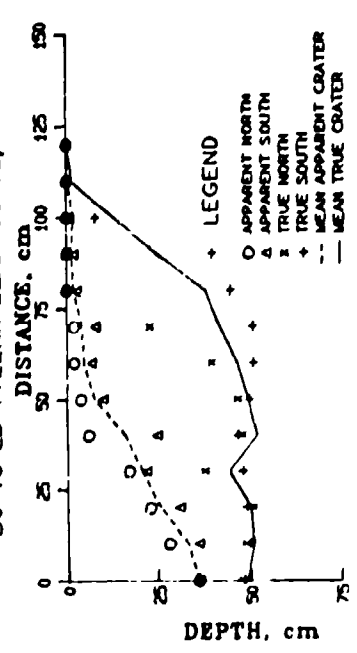
| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 16.114   | 55.200   | 76.961   | 67.568   |

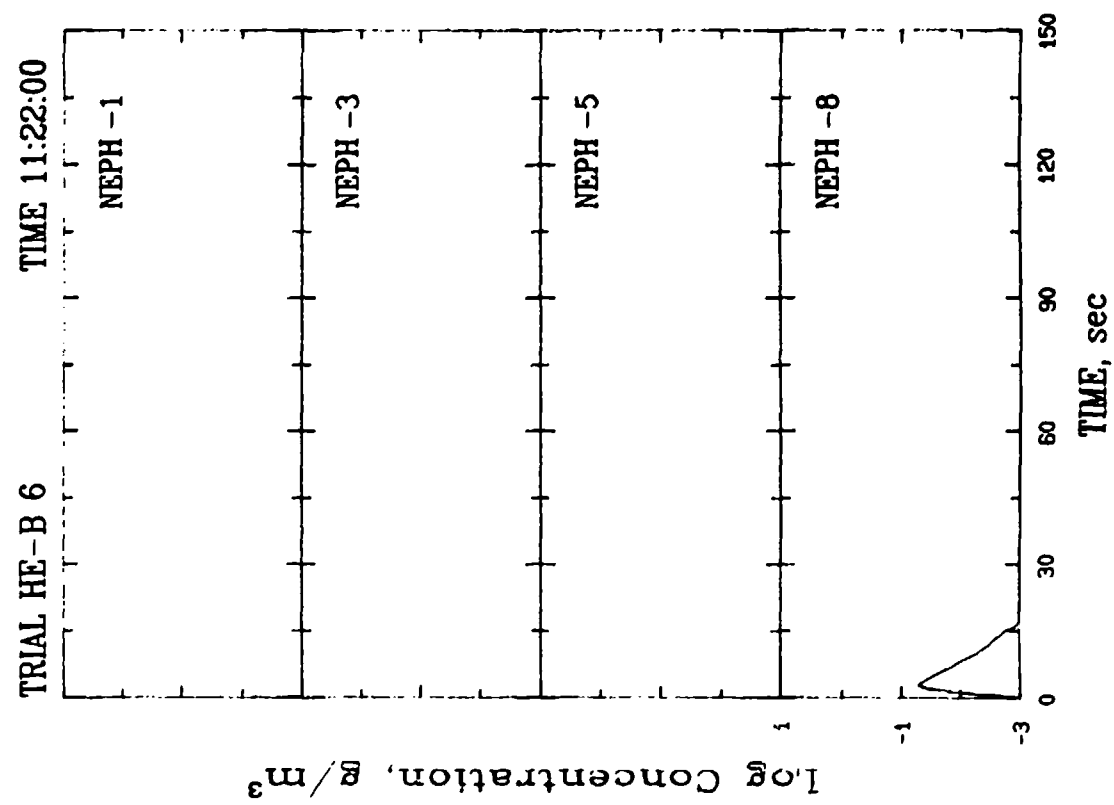
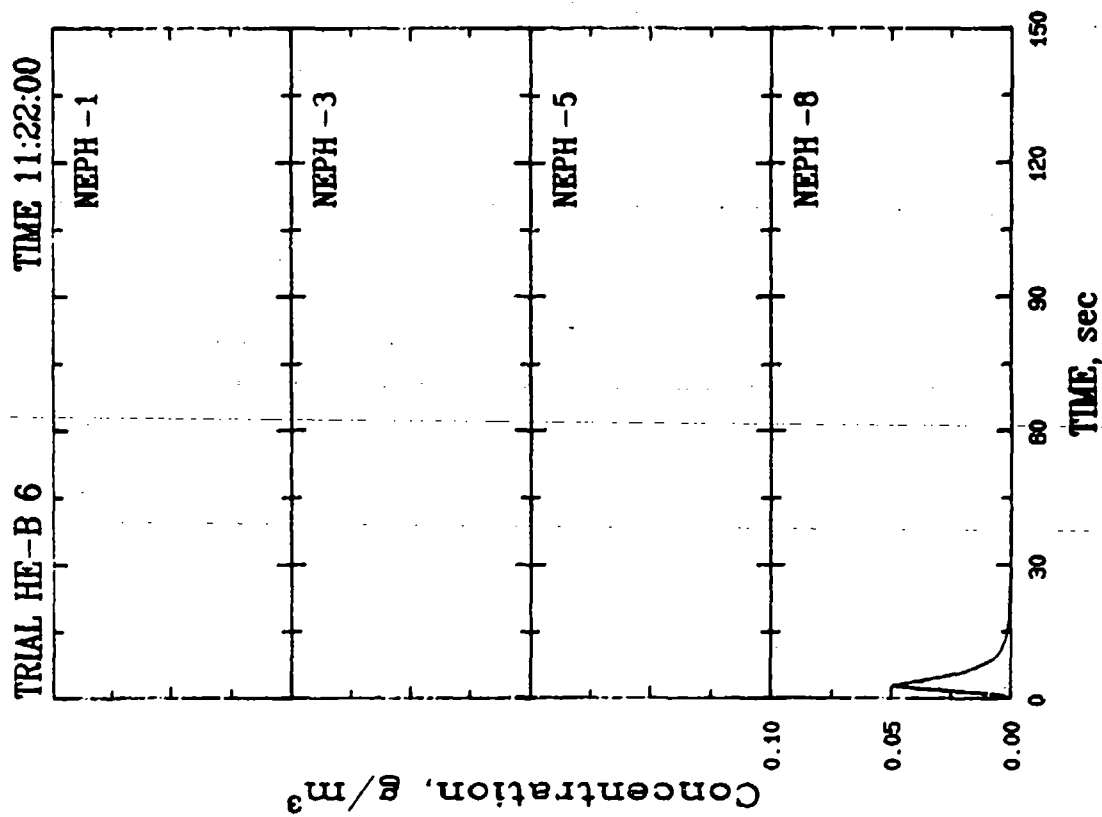
HEB6 . 22 APRIL 83

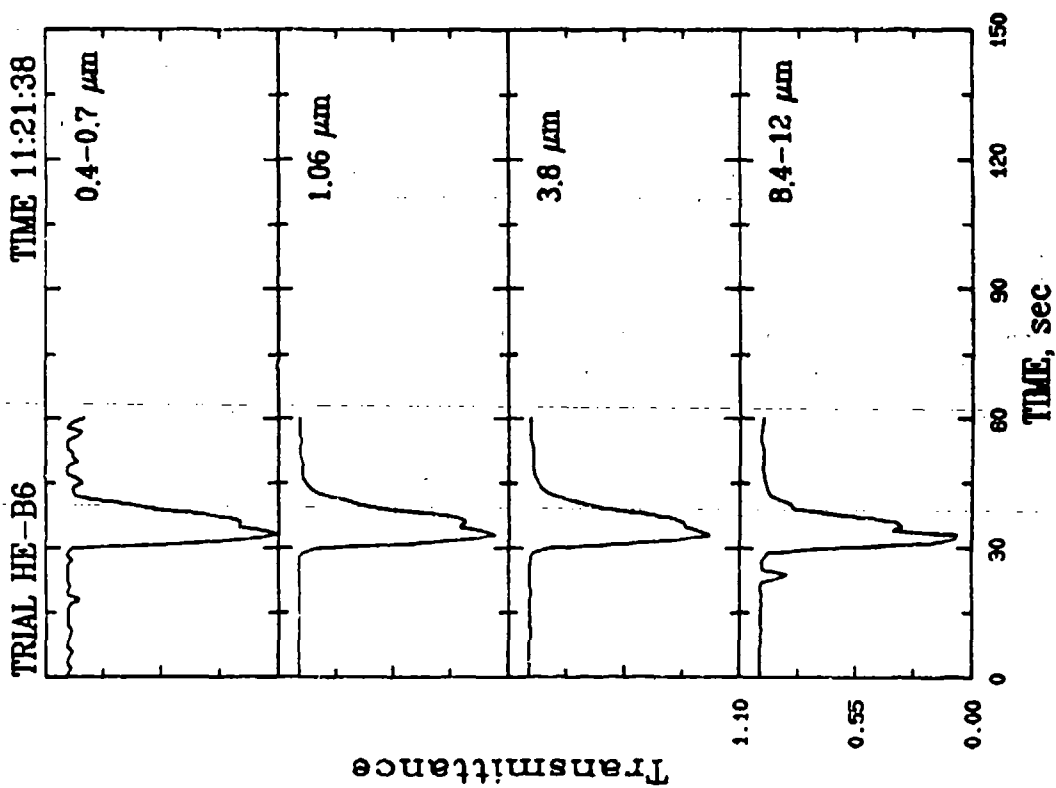
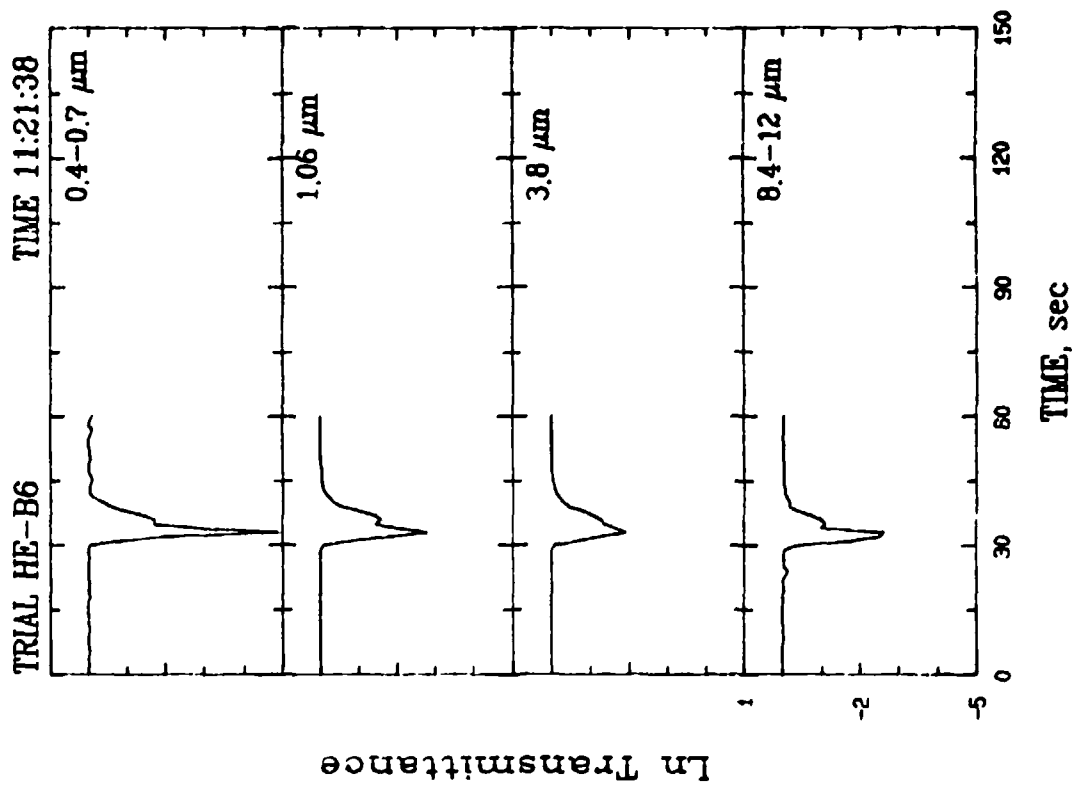


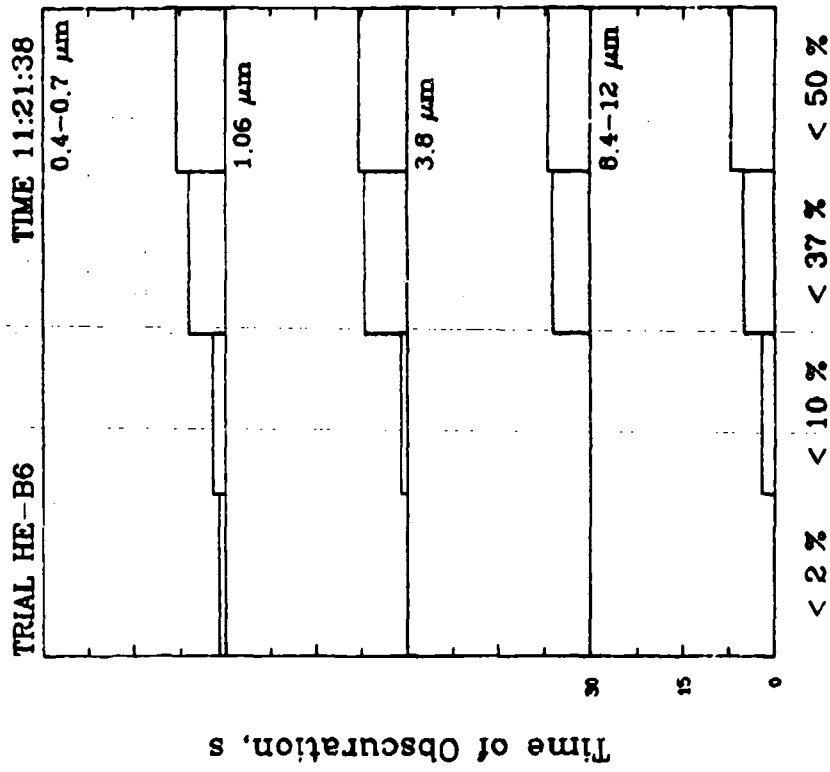
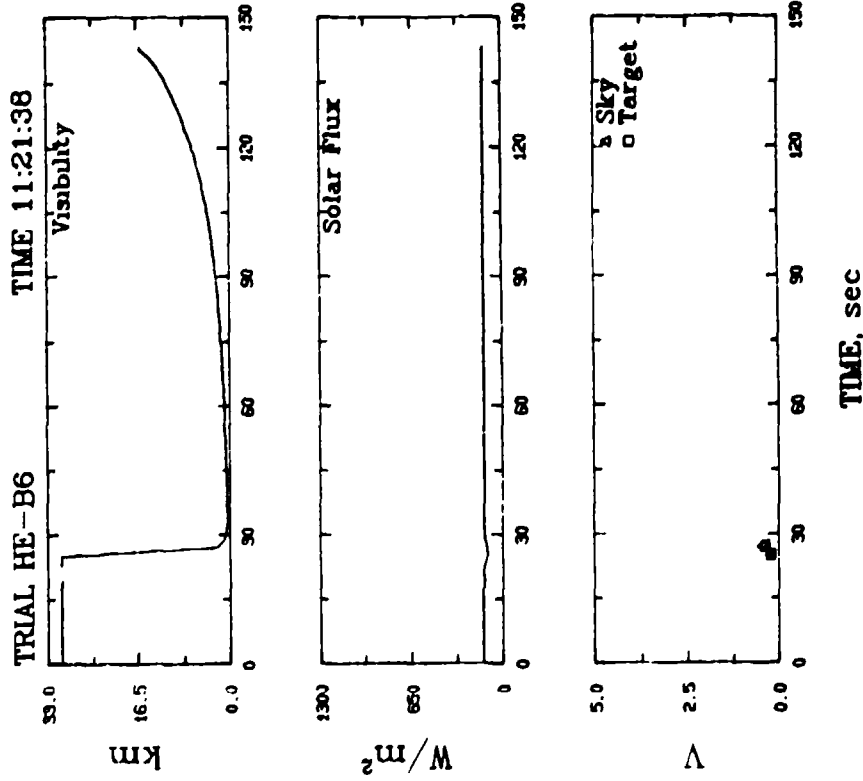
MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS

B6 15 LB 1122HR 22APR83 62,73









# EVENT SUMMARY DATA

Test Number: HEB7  
 Date: 22 APRIL 83  
 Detonation Coordinates (M):  
 X: 80.9  
 Y: 69.1  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 15.0 LB  
 Event Time: 15:41:00

## METEOROLOGICAL DATA:

Pasquill Category: D  
 Richardson Number: -0.026  
 16 Meter Tower (Means)  
 Start Time: 15:31:17 End Time: 15:43: 2

|                  | 2M    | 4M    | 6M    | 10M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 8.79  | 10.27 | 10.28 | 12.10 |
| Wind Dir. (DB)   | 29.7  | 27.0  | 31.0  | 27.1  |
| Sigma WSP        | 1.47  | 1.65  | 1.62  | 1.65  |
| Sigma WDIR       | 7.5   | 6.6   | 6.8   | 5.4   |
| UVV Components   |       |       |       |       |
| U (N-S)          | -7.61 | -9.12 | -8.79 | -10.7 |
| V (E-W)          | -4.26 | -4.57 | -5.20 | -5.43 |
| W (Vert)         | 0.69  | 0.20  | 1.08  | 0     |
| Sigma U          | 1.57  | 1.74  | 1.72  | 1.73  |
| Sigma V          | 1.01  | 1.04  | 1.07  | 1.03  |
| Sigma W          | 0.29  | 0.39  | 0.33  | 0     |
| Temperature (C)  | 11.1  | 10.9  | 10.8  | 10.4  |

Soil Temperature (C): 14.5 Solar Flux (W/M<sup>2</sup>): 190.1  
 Dew Point (C): 2.6 Visual Range (M): 30480.0  
 Temperature (C): 10.7 Vista Ranger Voltages:  
 Rel. Hum. (%): 57.5 Sky: 0.49  
 Abs. Hum. (G/M<sup>3</sup>): 5.66 Target: 0.39  
 Rain Accumulation (MM): 0.00 Sky-Target Contrast: -0.22

## CRATER INDEX:

|           | X,Y Coord (M) | SPC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 81.0 69.0     | 38  | 280 | 258 | 375 |
| Post-Shot | 81.0 69.0     | 50  | 88  | 138 | 446 |

## CRATER DATA

Moisture Content: 11.8  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.840  
 Apparent Crater: 0.230  
 Flow: 0.610  
 DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.280  
 Flow: 1.138  
 Bottom: 1.095  
 Side: 1.181

## HI VOL DATA (G):

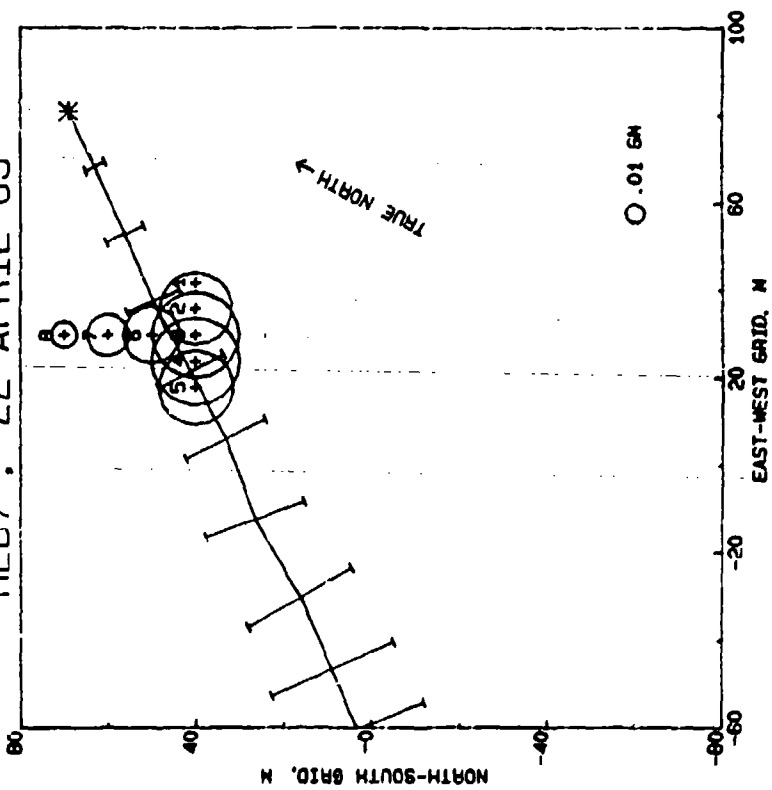
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0000 | 0.1486 | 0.2105 | 0.2168 | 0.1558 | 0.0945 | 0.0502 | 0.0200 |

SUM: 0.8964

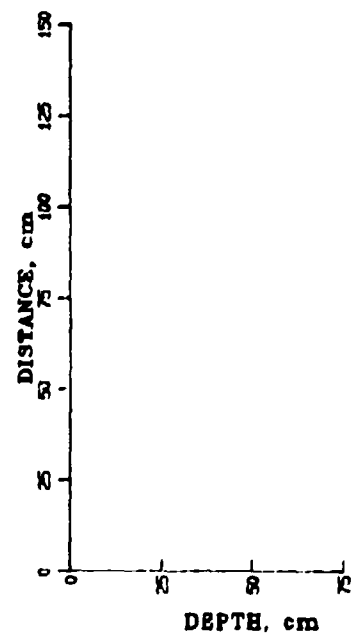
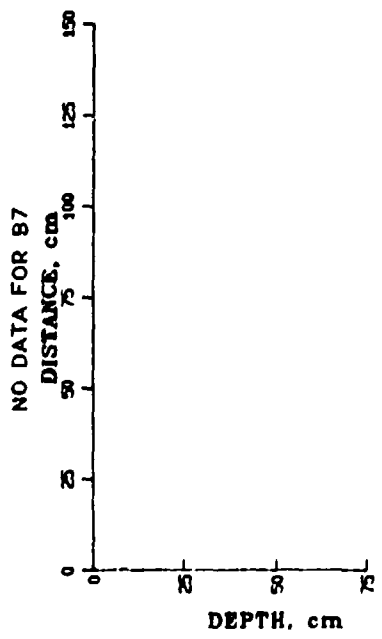
## GELMAN DOSAGE (G S/M<sup>3</sup>):

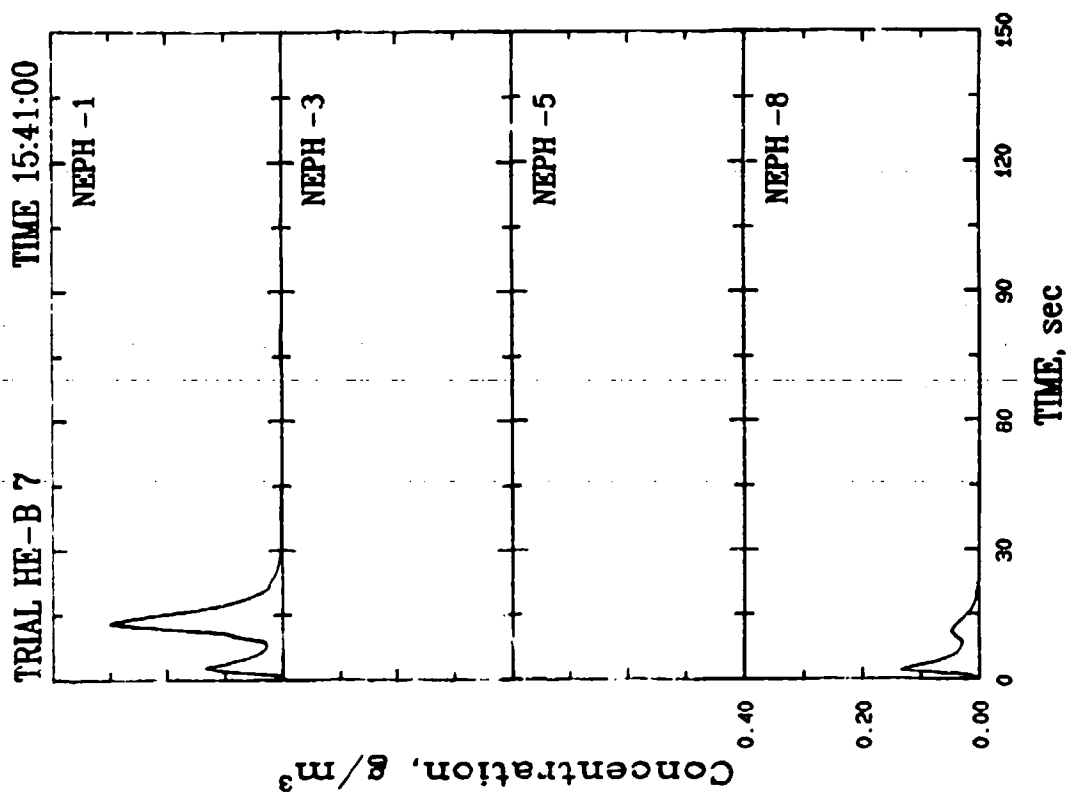
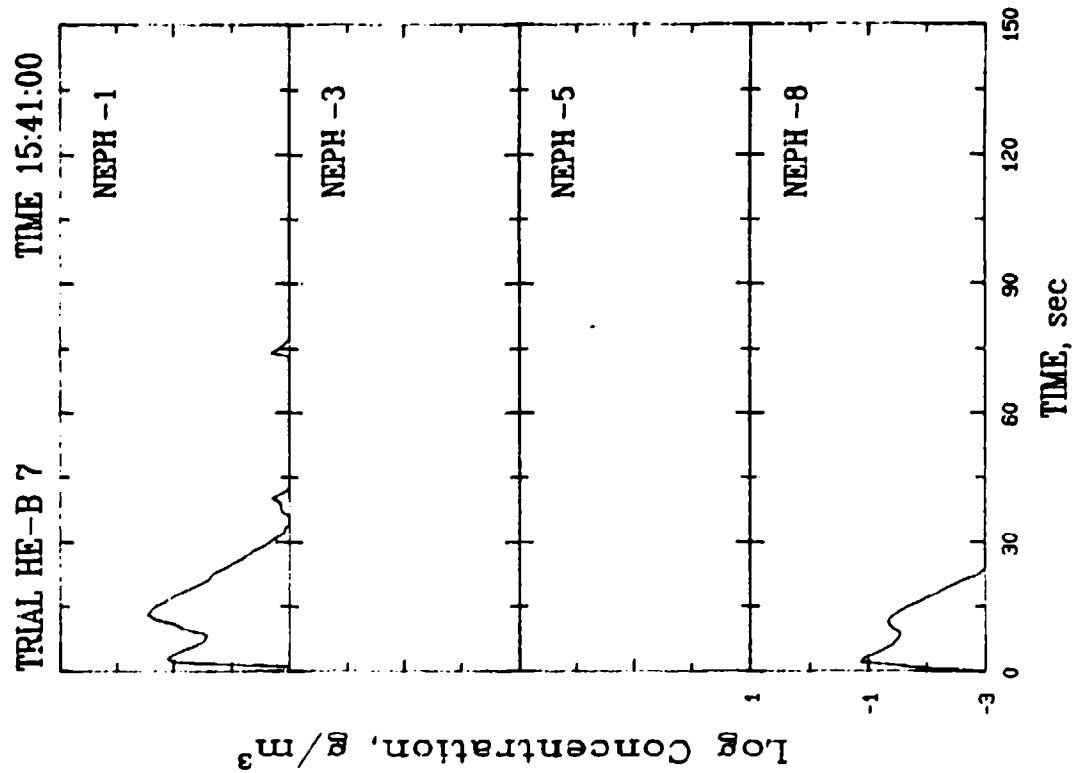
| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 49.600   | 91.905   | 103.243  |

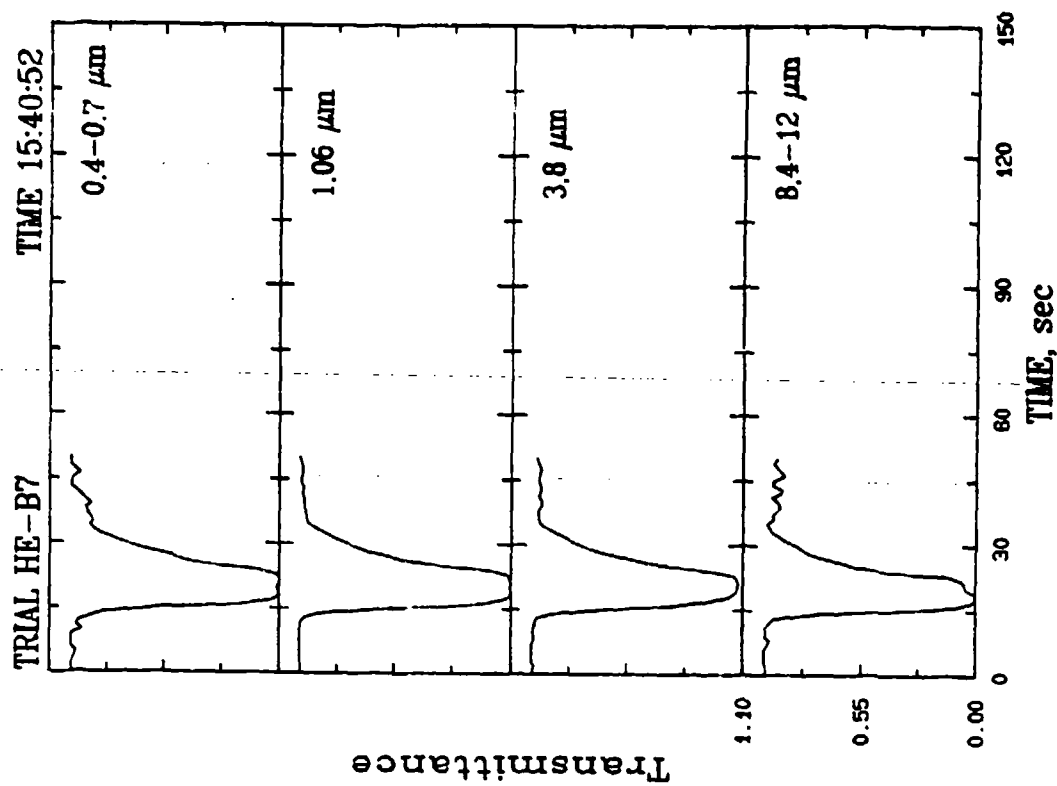
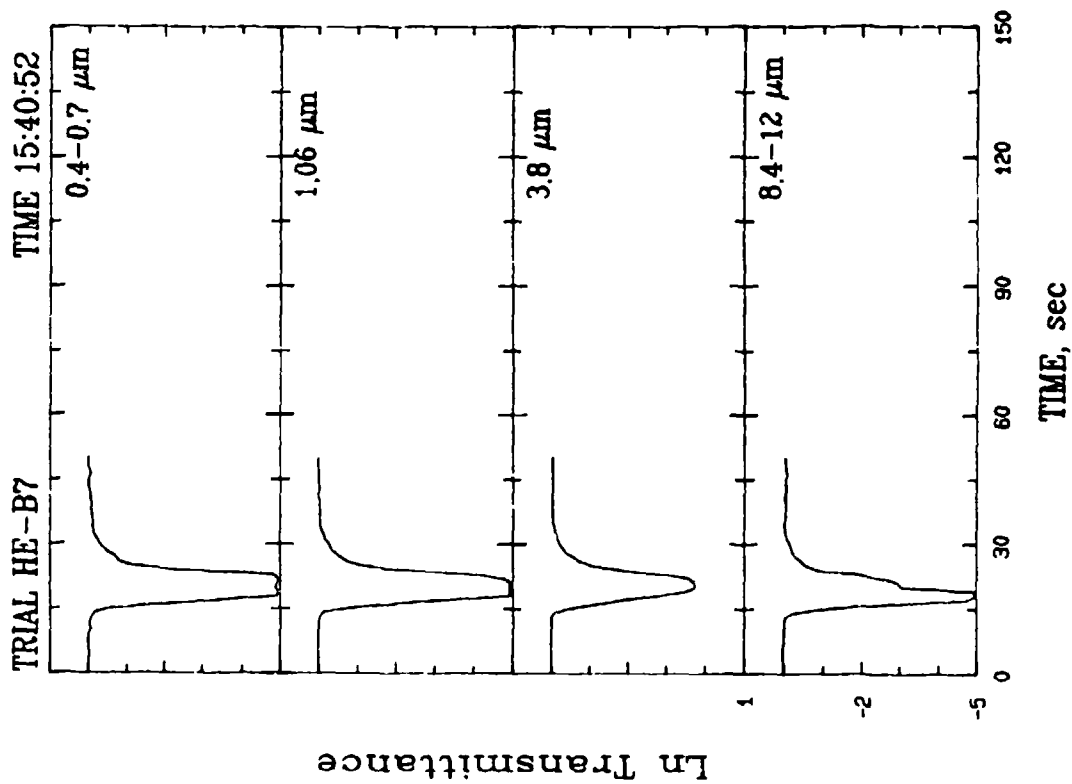
HEB7 . 22 APRIL 83

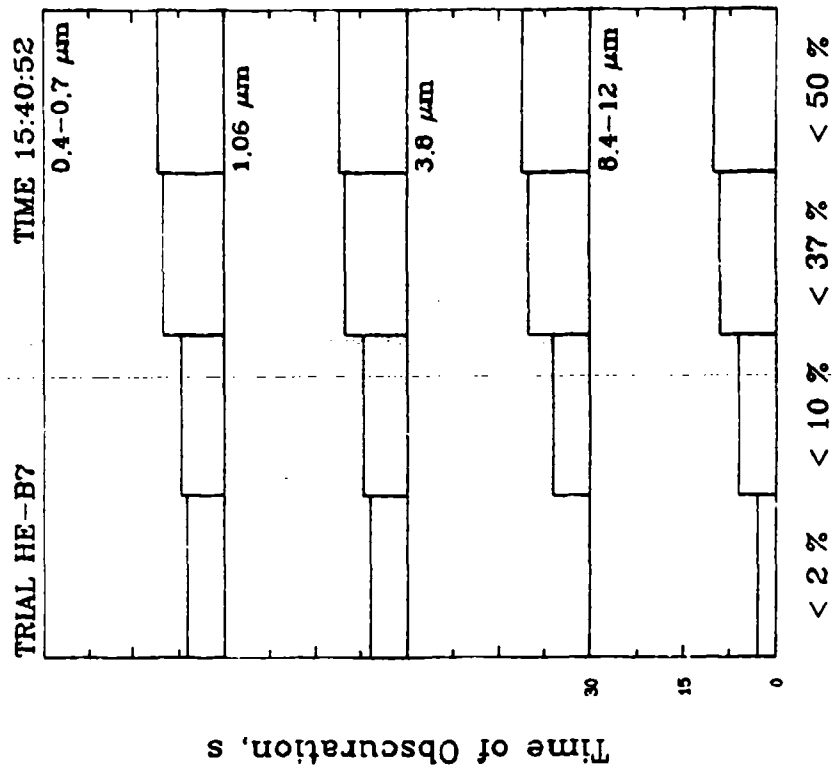
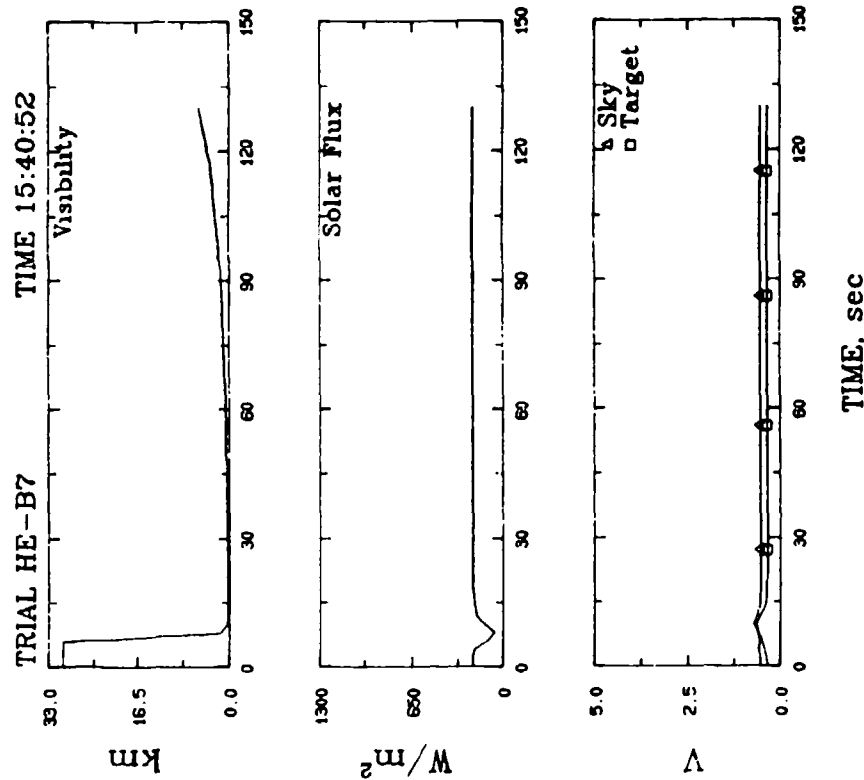


MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS









# EVENT SUMMARY DATA

Test Number: HEB8  
 Date: 23 APRIL 83  
 Detonation Coordinates (M):  
 X: 53.5  
 Y: 18.3  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 15.0 LB  
 Event Time: 11:38:00

## METEOROLOGICAL DATA:

Pasquill Category: B  
 Richardson Number: -5.758

16 Meter Tower (Means)  
 Start Time: 11:34:44  
 End Time: 11:40: 7

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 3.99  | 4.16  | 4.40  | 4.97  |
| Wind Dir. (DEG)  | 114.4 | 113.9 | 114.2 | 110.6 |
| Sigma WSP        | 1.05  | 1.08  | 1.24  | 1.53  |
| Sigma WDIR       | 22.3  | 22.0  | 20.9  | 23.0  |
| UVW Components   |       |       |       |       |
| U (N-S) (M/S)    | 1.40  | 1.45  | 1.53  | 1.51  |
| V (E-W) (M/S)    | -3.44 | -3.60 | -3.85 | -4.34 |
| W (Vert) (M/S)   | 0.27  | 0.32  | 0.40  | •     |
| Sigma U          | 1.15  | 1.29  | 1.22  | 1.71  |
| Sigma V          | 1.37  | 1.35  | 1.50  | 1.73  |
| Sigma W          | 0.20  | 0.28  | 0.39  | •     |
| Temperature (C)  | 14.9  | 14.0  | 13.8  | 13.3  |

Solil Temperature (C): 26.6  
 Dew Point (C): 2.8  
 Temperature (C): 13.9  
 Rel. Hum. (%): 47.2  
 Abs. Hum. (G/M<sup>3</sup>): 5.67  
 Rain Accumulation (MM): 0.00  
 Solar Flux (W/M<sup>2</sup>): 782.4  
 Visual Range (M): 30480.0  
 Vista Ranger Voltages:  
 Sky: 1.54  
 Target: 1.39  
 Sky-Target Contrast: -0.10

# CONE INDEX:

|           | X,Y Coord (M) | SPC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 54.0 18.0     | 100 | 258 | 225 | 433 |
| Post-Shot | 54.0 18.0     | 50  | 90  | 145 | 240 |

## CRATER DATA

Moisture Content: 12.4

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.930  
 Apparent Crater: 0.335  
 Flow: 0.594

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.430  
 Flow: 1.127  
 Bottom: 1.136  
 Side: 1.118

## HI VOL DATA (G):

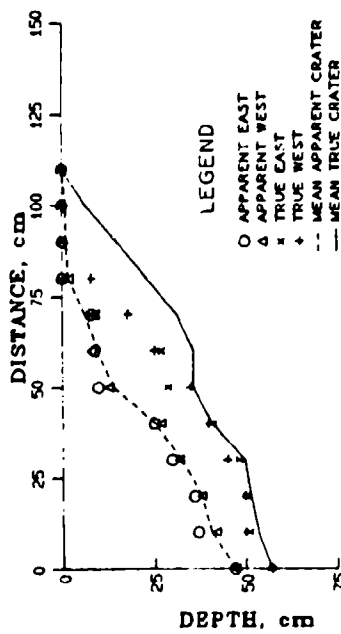
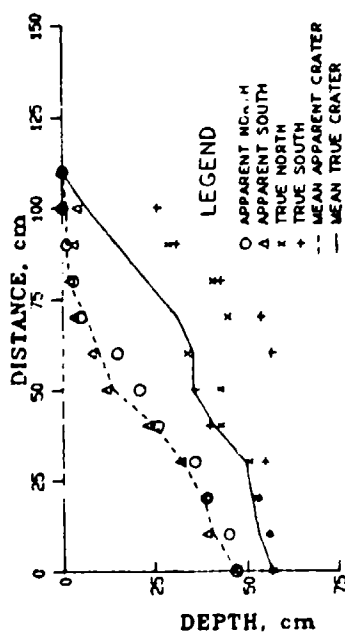
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 1.0707 | 0.2778 | 0.2178 | 0.0881 | 0.0578 | 0.3186 | 0.2340 | 0.0455 |

SUM: 2.3103

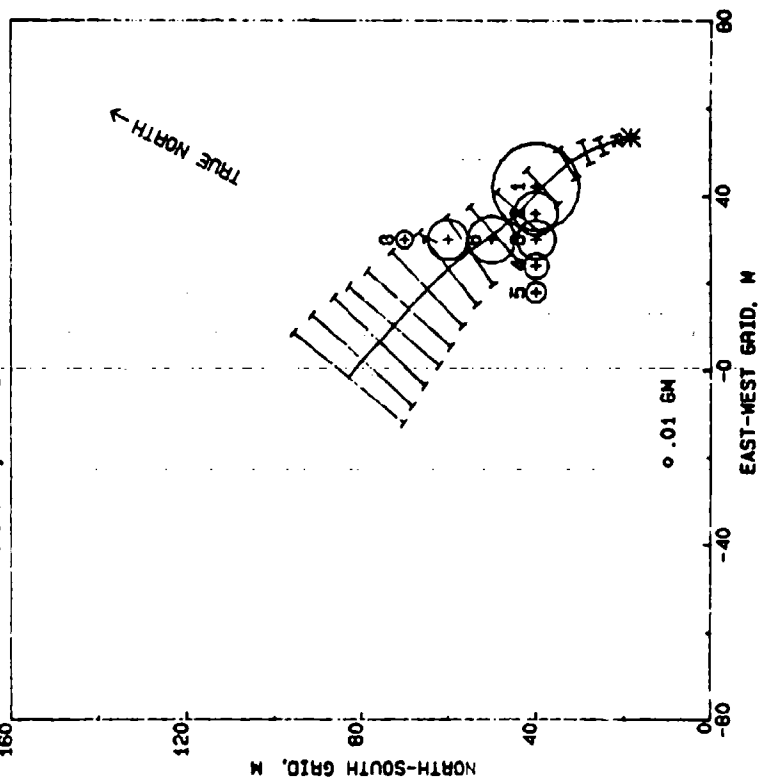
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 0.000    | 0.000    |

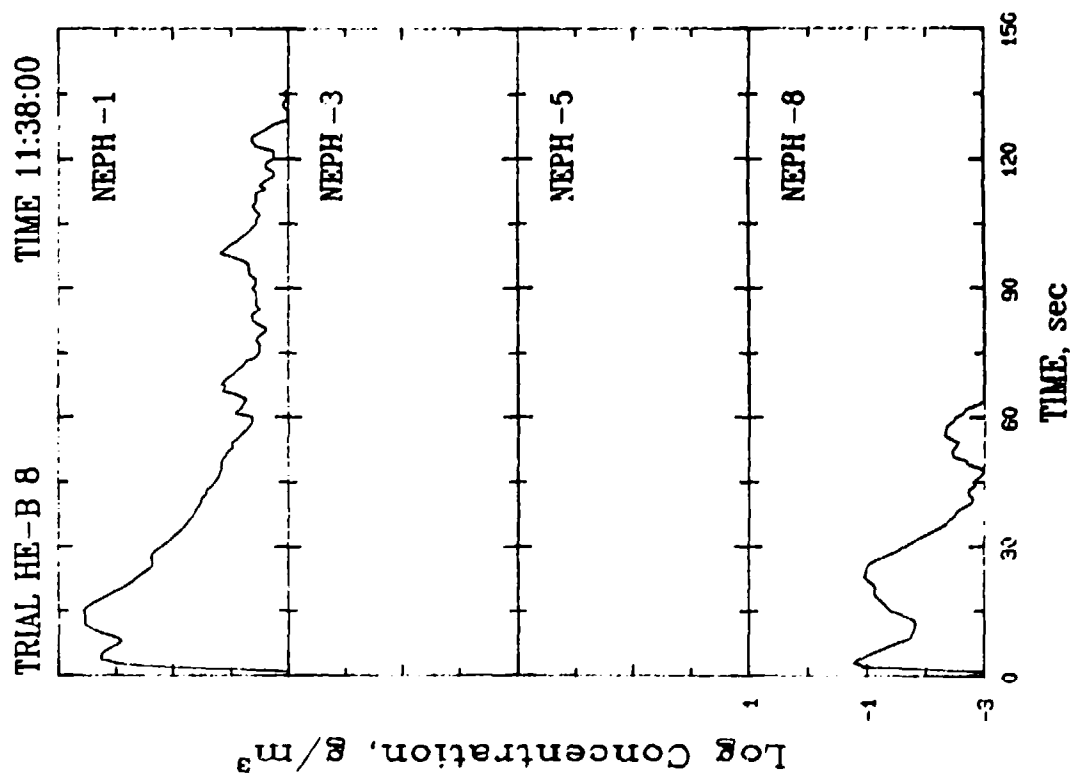
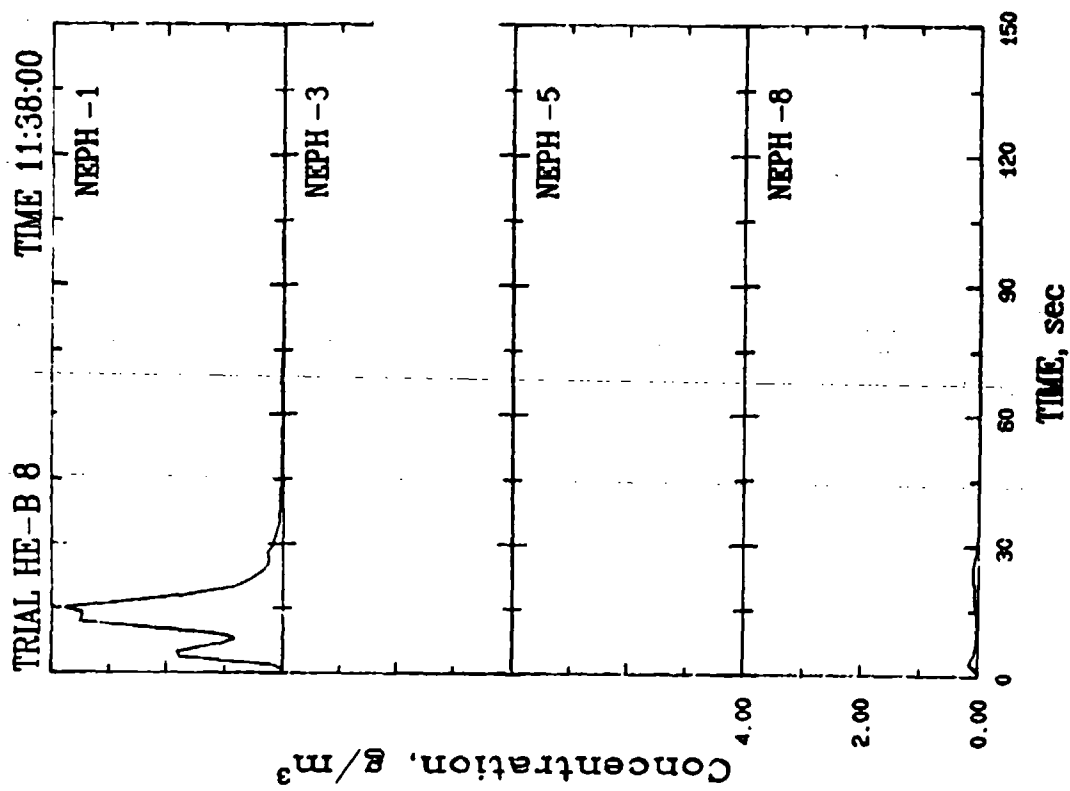
BB 15 LB 1138HR 23APR83 54,18

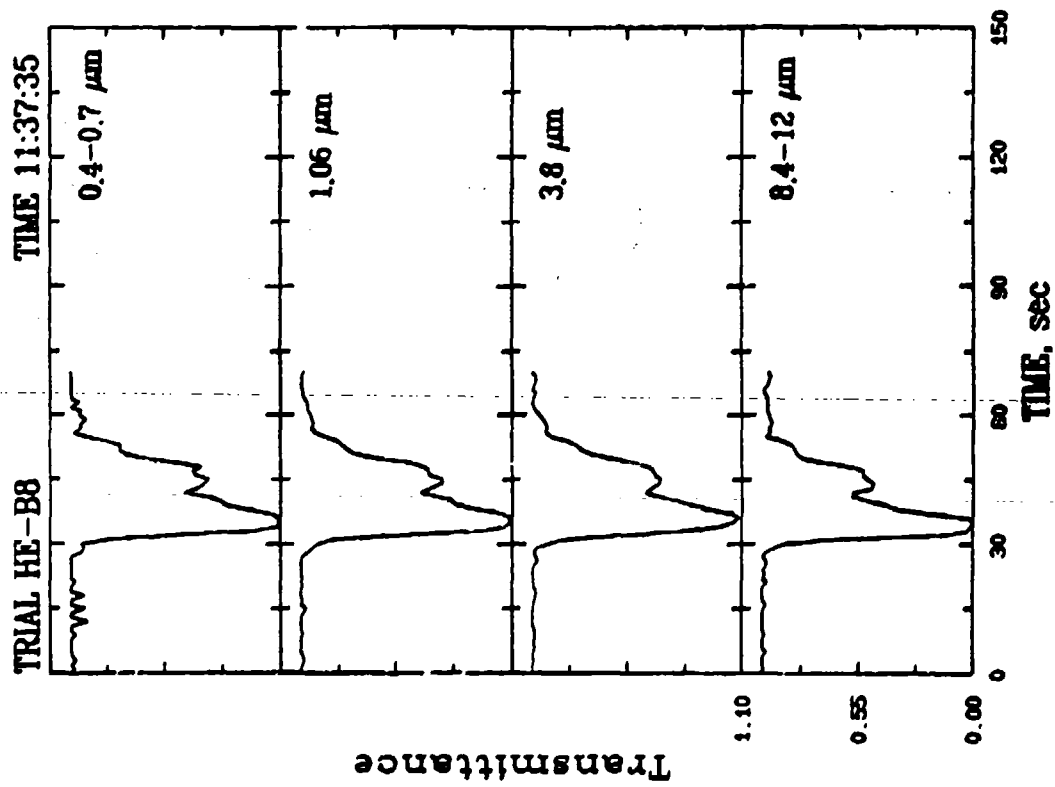
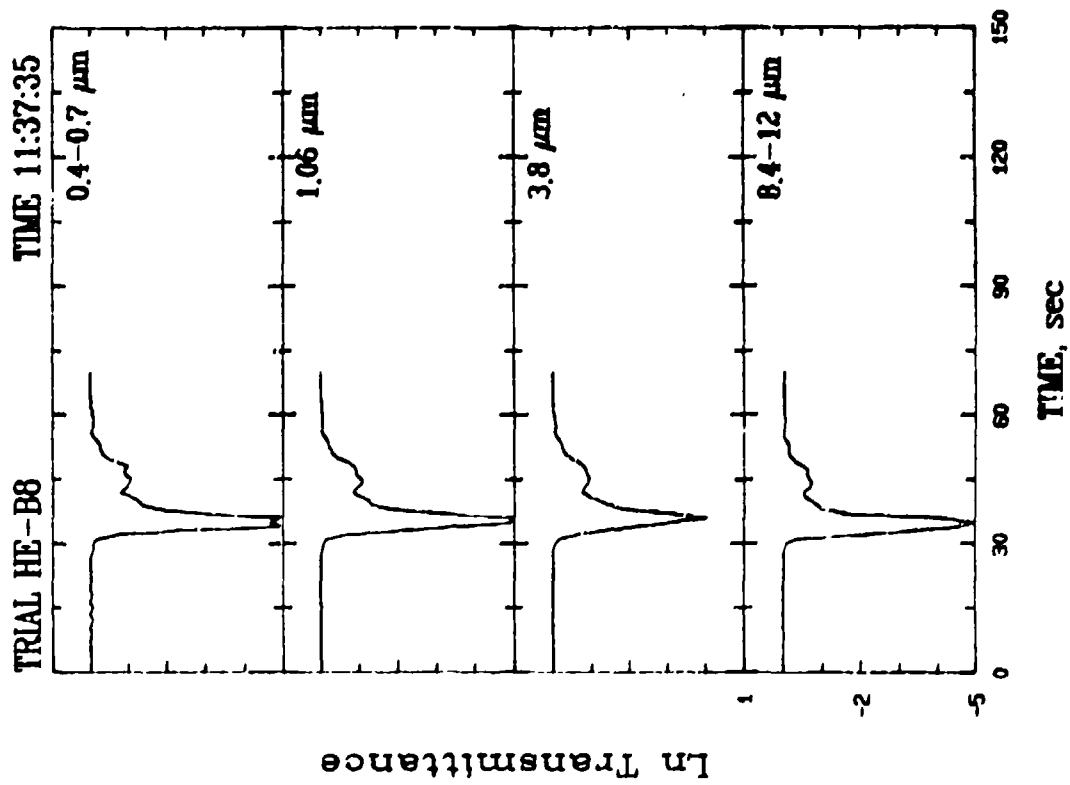


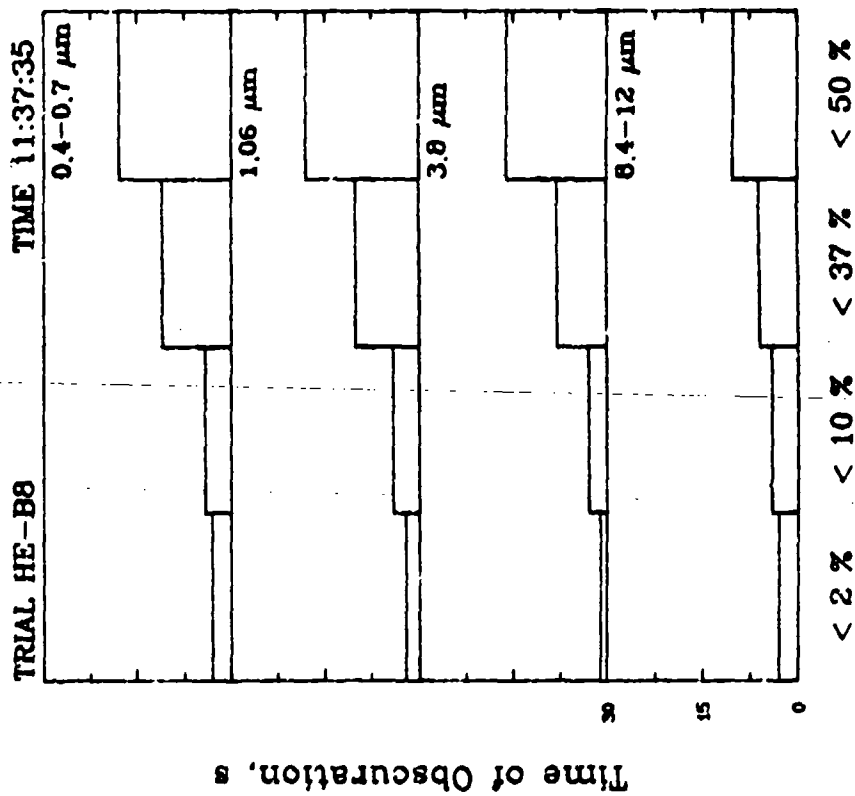
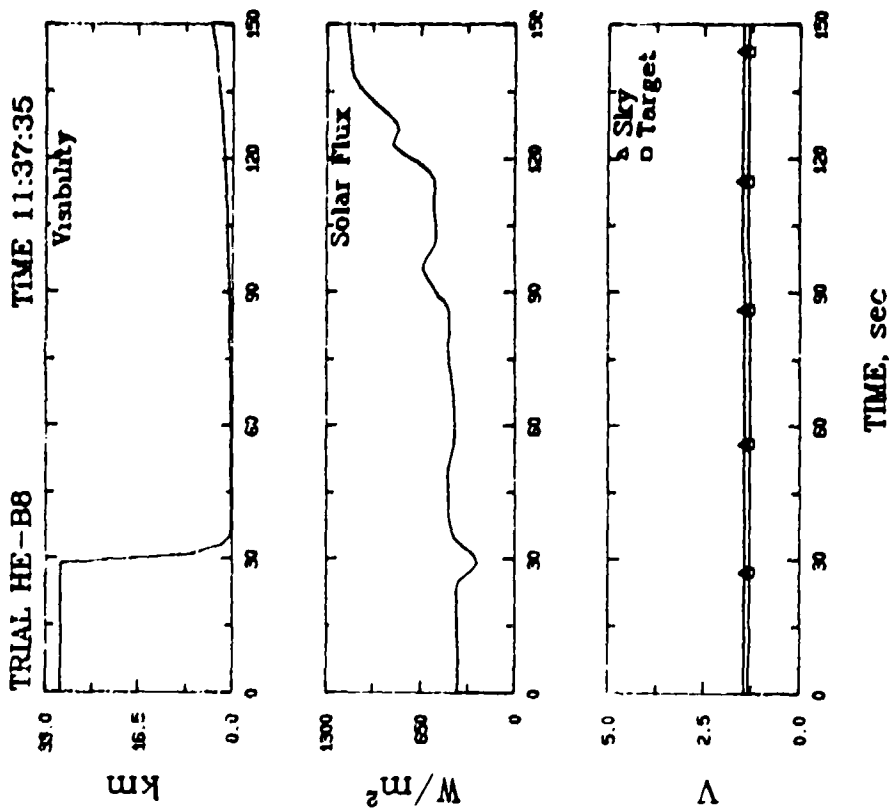
HEB8, 23 APRIL 83



MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEB9  
 Date: 23 APRIL 83  
 Detonation Coordinates (M):  
 X: 88.9  
 Y: -0.6  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 15.0 LB  
 Event Time: 14:51:57

## METEOROLOGICAL DATA:

Pasquill Category: C  
 Richardson Number: -0.602

16 Meter Tower (Means)  
 Start Time: 14:48:35 End Time: 14:54: 0

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 3.61  | 3.77  | 4.12  | 4.64  |
| Wind Dir. (DEG)  | 95.2  | 94.9  | 96.9  | 97.5  |
| Sigma WSP        | 1.36  | 1.32  | 1.45  | 1.36  |
| Sigma WDIA       | 21.6  | 22.8  | 21.5  | 20.1  |
| UVM Components   |       |       |       |       |
| U (N-S) (M/S)    | 0.60  | 0.64  | 0.81  | 0.90  |
| V (E-W) (M/S)    | -3.35 | -3.48 | -3.81 | -4.31 |
| W (Vert) (M/S)   | 0.22  | 0.18  | 0.20  | 0     |
| Sigma U          | 1.30  | 1.42  | 1.46  | 1.58  |
| Sigma V          | 1.26  | 1.22  | 1.33  | 1.23  |
| Sigma W          | 0.24  | 0.29  | 0.31  | 0     |
| Temperature (C)  | 15.3  | 14.8  | 14.5  | 14.4  |

Soil Temperature (C): 24.2 Solar Flux (W/M<sup>2</sup>): 267.0  
 Dew Point (C): 2.2 Visual Range (M): 30:55.0  
 Temperature (C): 14.3 Vista Ranger Voltages:  
 Rel. Hum. (%): 44.0 Sky: 1.24  
 Target: 1.04  
 Abs. Hum. (G/M<sup>3</sup>): 5.44 Sky-Target Contrast: -0.17  
 Rain Accumulation (MM): 6.00

# CONE INDEX:

|           | I, Y Coord (M) | SFC | 15  | 30  | 45   |
|-----------|----------------|-----|-----|-----|------|
| Pre-Shot  | 89.0 0.0       | 50  | 245 | 615 | 750+ |
| Post-Shot | 89.0 0.0       | 50  | 290 | 635 | 750+ |

## CRATER DATA

Moisture Content: 12.9

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.529  
 Apparent Crater: 0.221  
 Flow: 0.308  
 DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.420  
 Flow: 1.135  
 Bottom: 0  
 Side: 0

## HI VOL DATA (G):

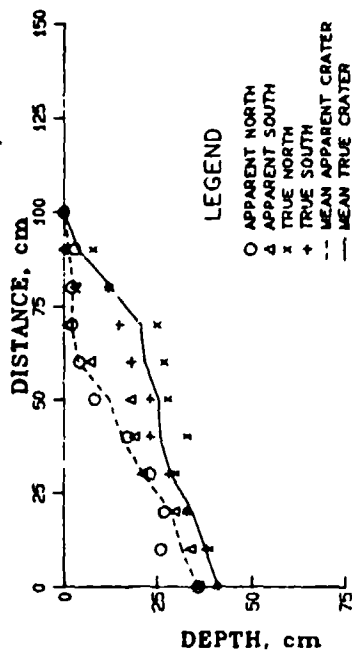
|  | HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--|--------|--------|--------|--------|--------|--------|--------|--------|
|  | 0.0858 | 0.0334 | 0.0281 | 0.0221 | 0.0190 | 0.0453 | 0.1429 | 0.1193 |

SUM: 0.4959

## GELMAN DOSAGE (G S/M<sup>3</sup>):

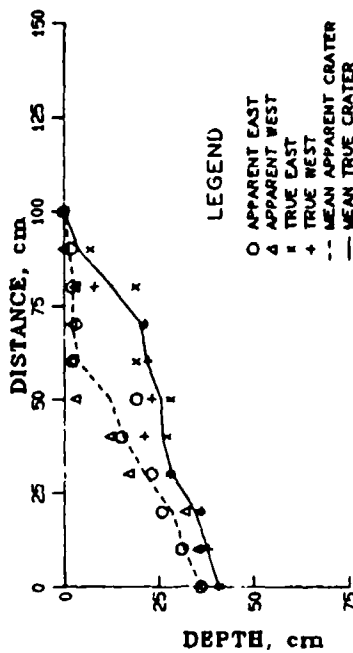
| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 105.213  | 42.400   | 20.174   | 22.703   |

B9 15 LB 1451HR 23APR83 89,0



LEGEND

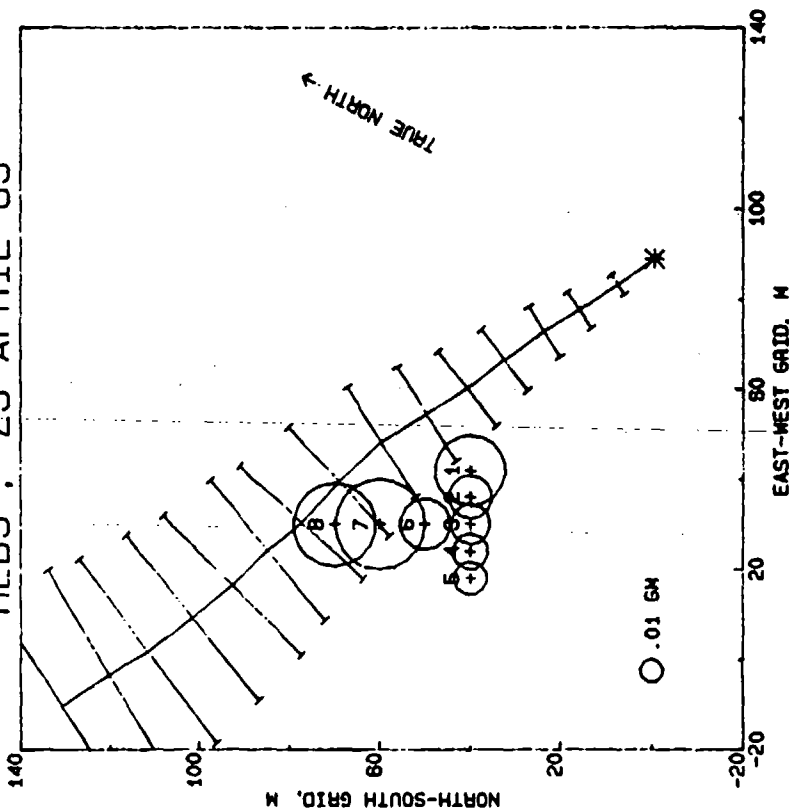
- APPARENT NORTH
- △ APPARENT SOUTH
- × TRUE NORTH
- + TRUE SOUTH
- MEAN APPARENT CRATER
- MEAN TRUE CRATER



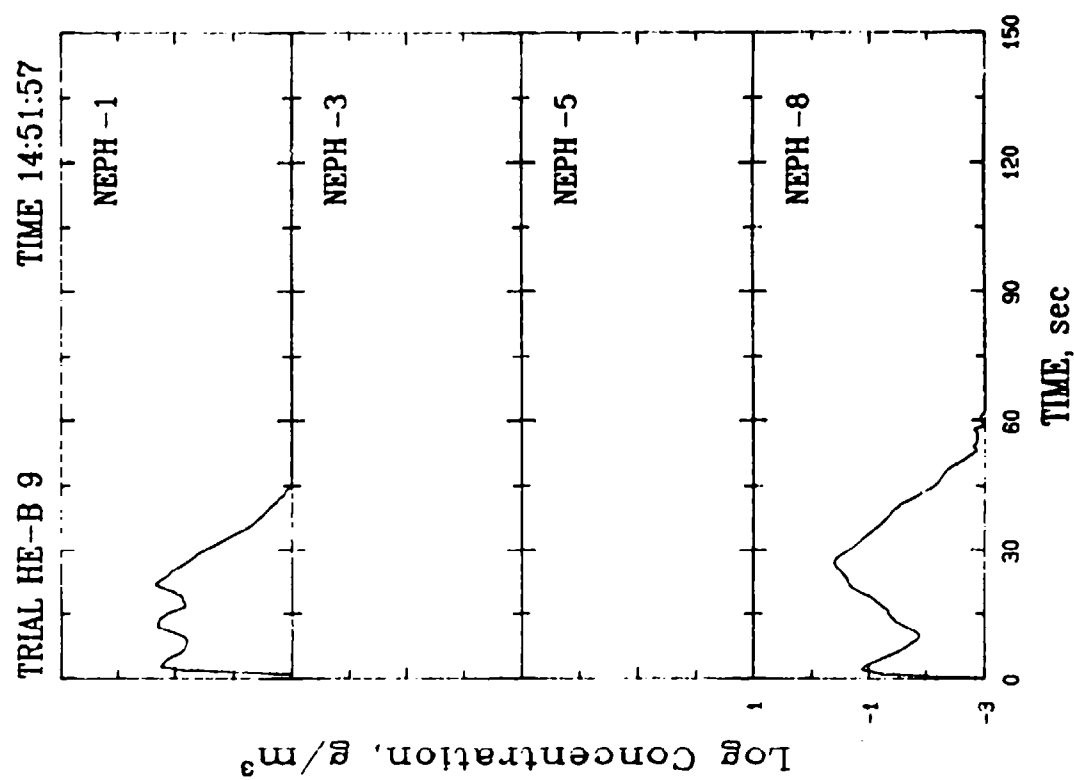
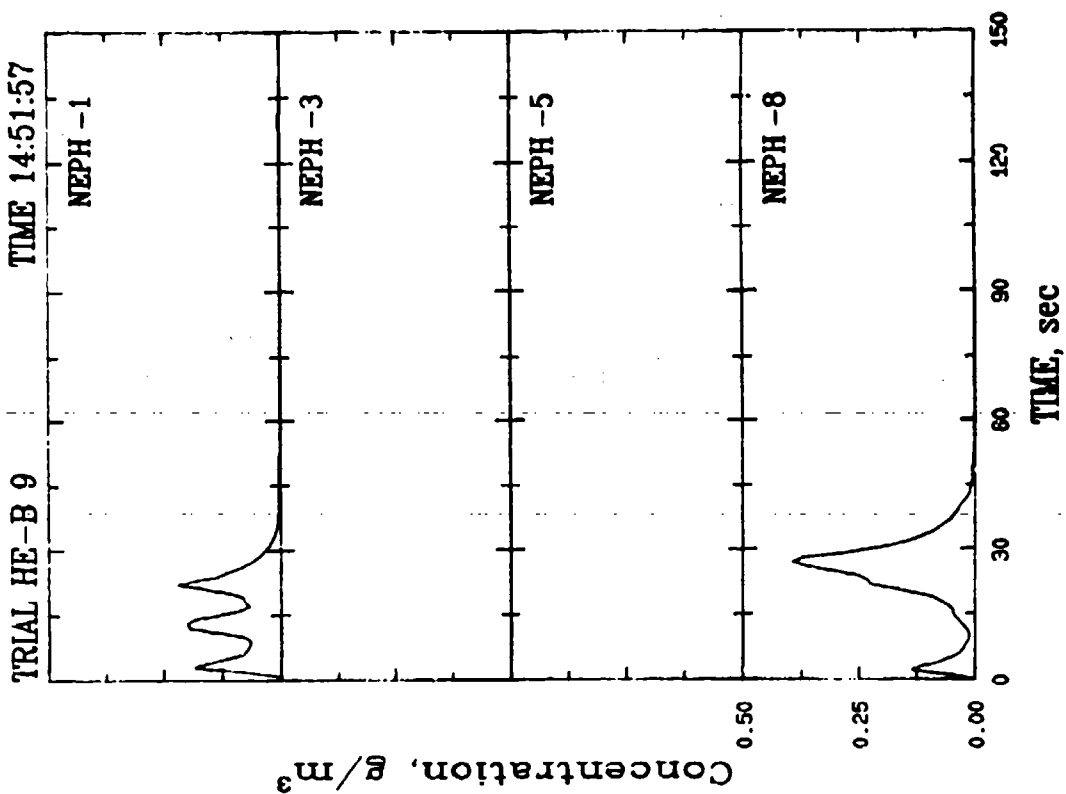
LEGEND

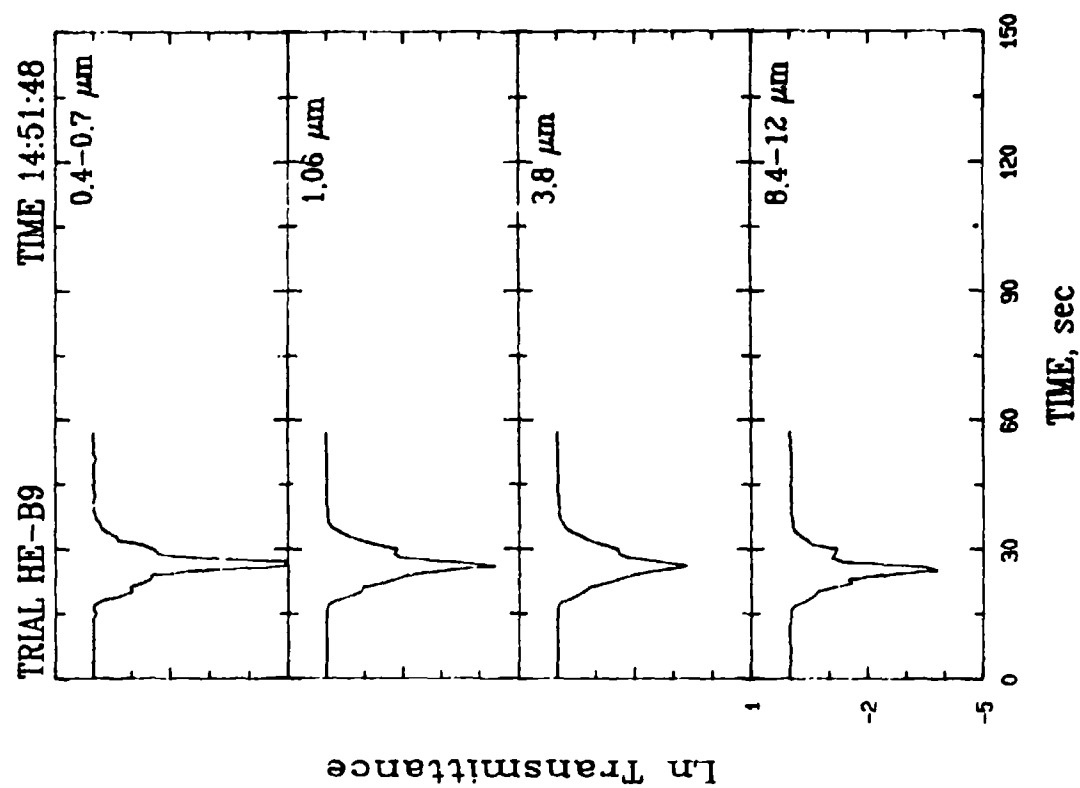
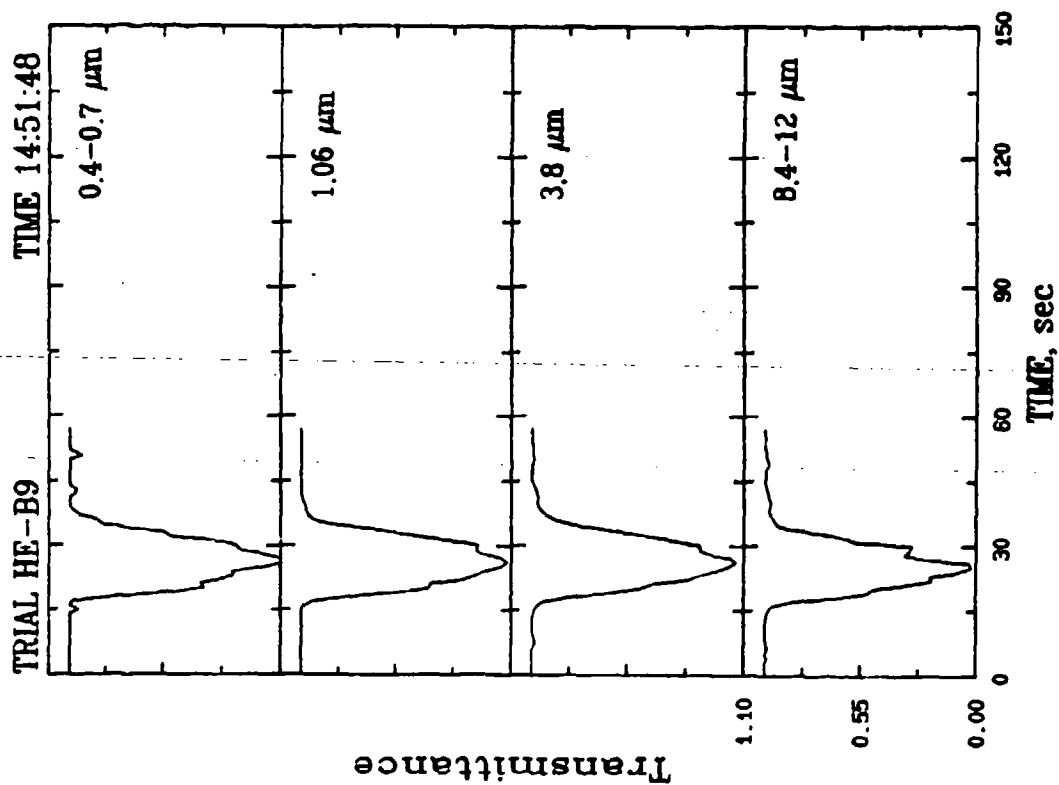
- APPARENT EAST
- △ APPARENT WEST
- × TRUE EAST
- + TRUE WEST
- MEAN APPARENT CRATER
- MEAN TRUE CRATER

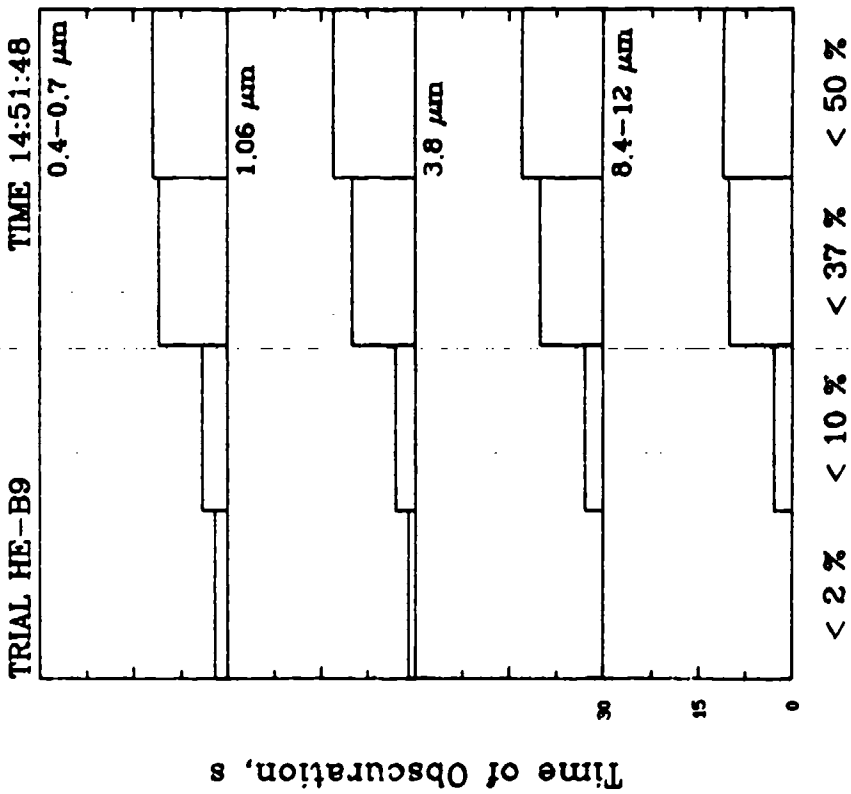
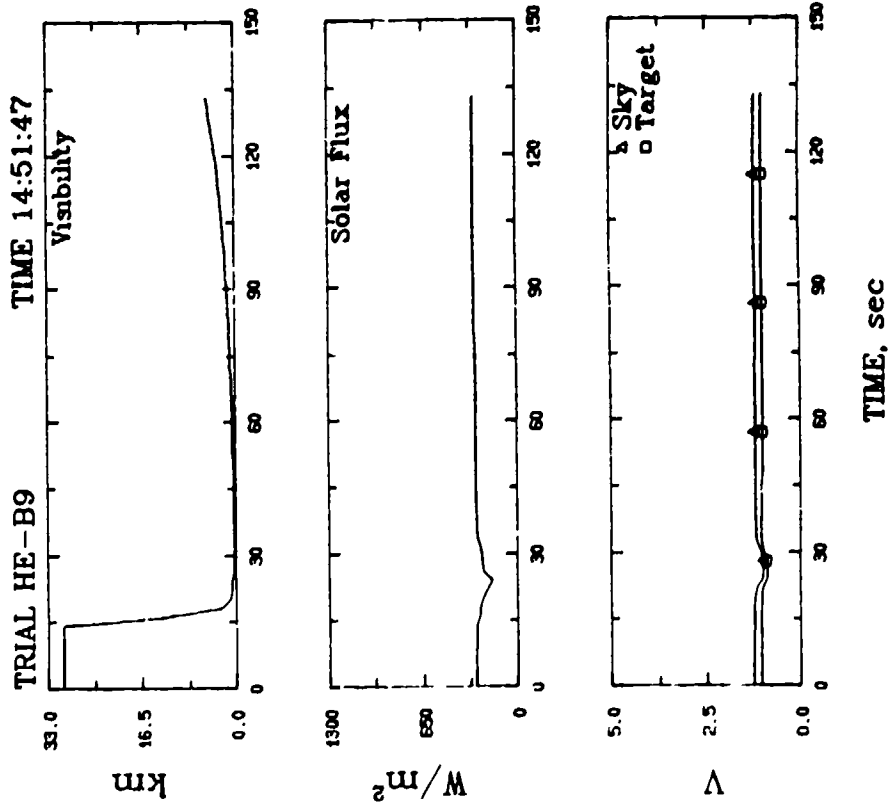
HEB9 . 23 APRIL 83



MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEB10  
 Date: 26 APRIL 83  
 Detonation Coordinates (N):  
 X: 43.5  
 Y: 17.5  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 15.0 LB  
 Event Time: 09:22:04

## METEOROLOGICAL DATA:

Pasquill Category: B  
 Richardson Number: -1.020

16 Meter Tower (Means)  
 Start Time: 9:20:37 End Time: 9:24: 5

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 5.61  | 5.87  | 6.25  | 6.74  |
| Wind Dir. (DEG)  | 116.6 | 117.2 | 118.4 | 118.8 |
| Sigma WSP        | 1.36  | 1.44  | 1.63  | 1.67  |
| Sigma WDIR       | 11.9  | 12.5  | 12.0  | 8.7   |
| UVW Components   |       |       |       |       |
| U (M-S)          | 2.35  | 2.52  | 2.78  | 3.12  |
| V (E-W)          | -4.98 | -5.16 | -5.46 | -5.89 |
| W (Vert)         | 0.36  | 0.41  | 0.38  | 0     |
| Sigma U          | 0.80  | 0.97  | 0.91  | 0.83  |
| Sigma V          | 1.55  | 1.63  | 1.84  | 1.74  |
| Sigma W          | 0.17  | 0.24  | 0.29  | 0     |
| Temperature (C)  | 11.5  | 10.6  | 10.3  | 10.0  |

Soil Temperature (C): 17.6 Solar Flux (W/M<sup>2</sup>): 586.7  
 Dew Point (C): -0.3 Visual Range (M): 30480.0  
 Temperature (C): 10.4 Vista Ranger Voltages:  
 Rel. Hum. (%): 47.1 Sky: 1.10  
 Target: 0.89  
 Abs. Hum. (G/M<sup>3</sup>): 4.56 Sky-Target Contrast: -0.19  
 Rain Accumulation (MM): 0.00

## COME INDEX:

|           | X,Y Coord (M) | SPC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 43.0 18.0     | 75  | 290 | 325 | 515 |
| Post-Shot | 43.0 18.0     | 50  | 185 | 190 | 130 |

## CRATER DATA

Moisture Content: 12.4

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.875  
 Apparent Crater: 0.191  
 Flow: 0.683

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.370  
 Flow: 1.160  
 Bottom: 1.122  
 Side: 1.148

## HI VOL DATA (G):

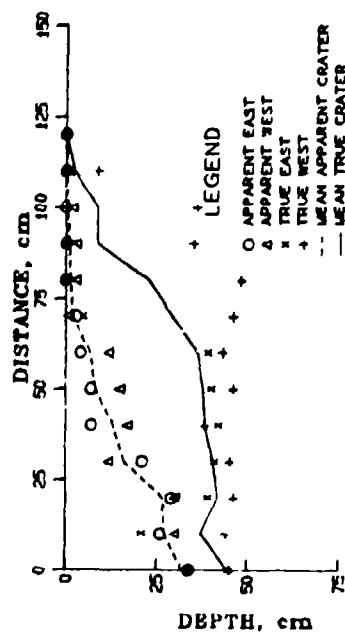
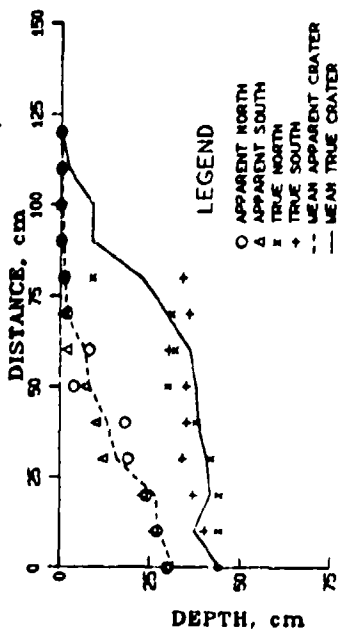
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.1007 | 0.4363 | 0.3390 | 0.1051 | 0.0582 | 0.3429 | 0.1682 | 0.0593 |

SUM: 1.6097

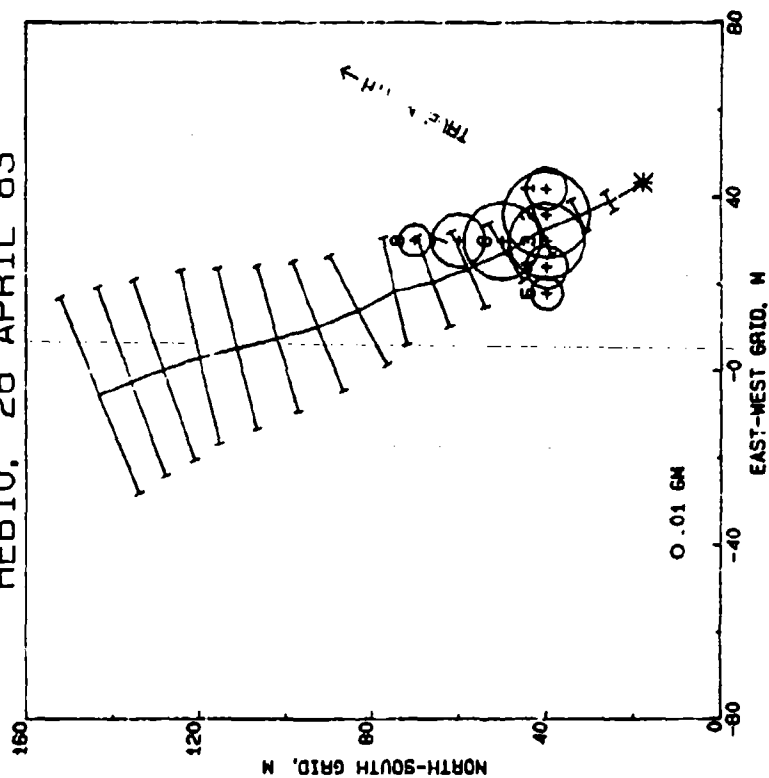
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 0.000    | 0.000    |

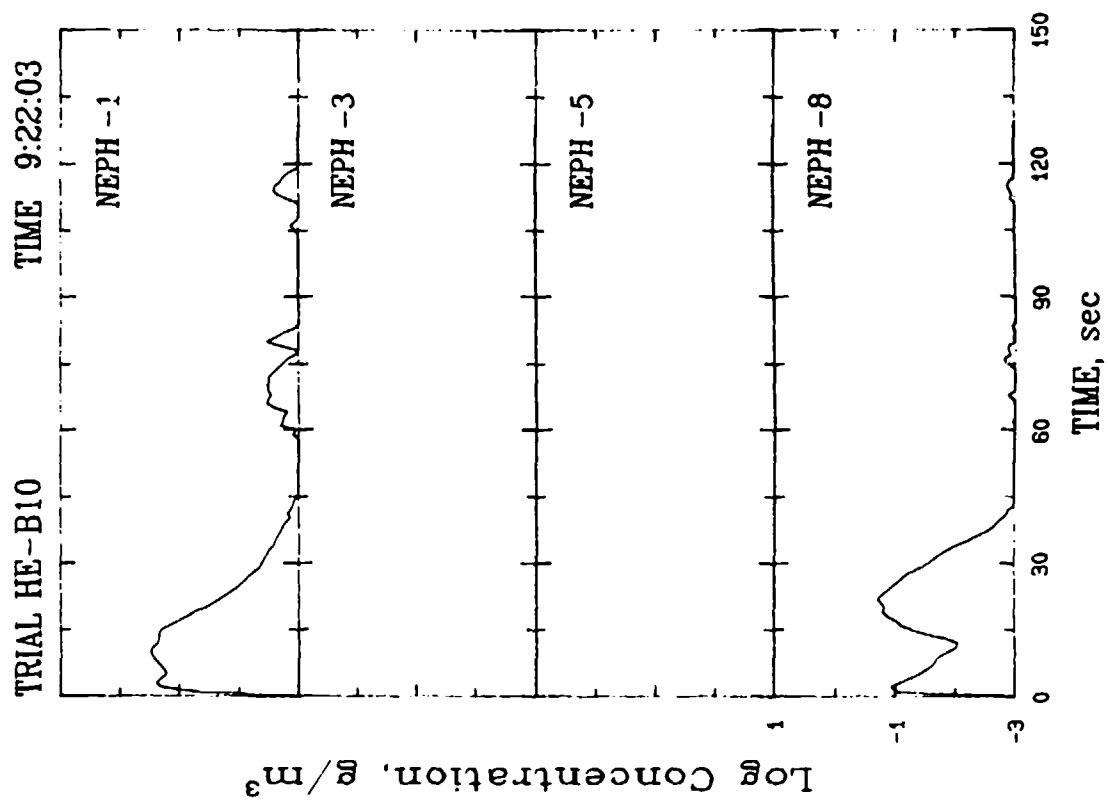
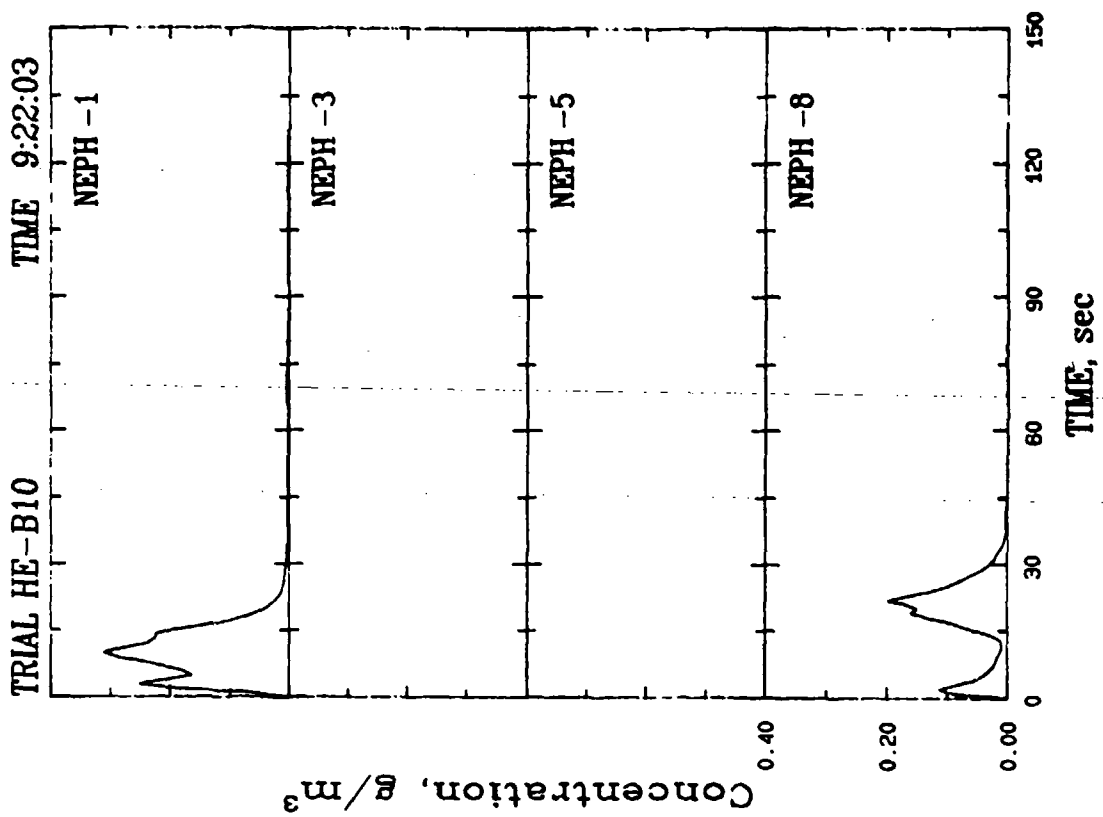
B10 15 LB 0922HR 26APR83 43.18

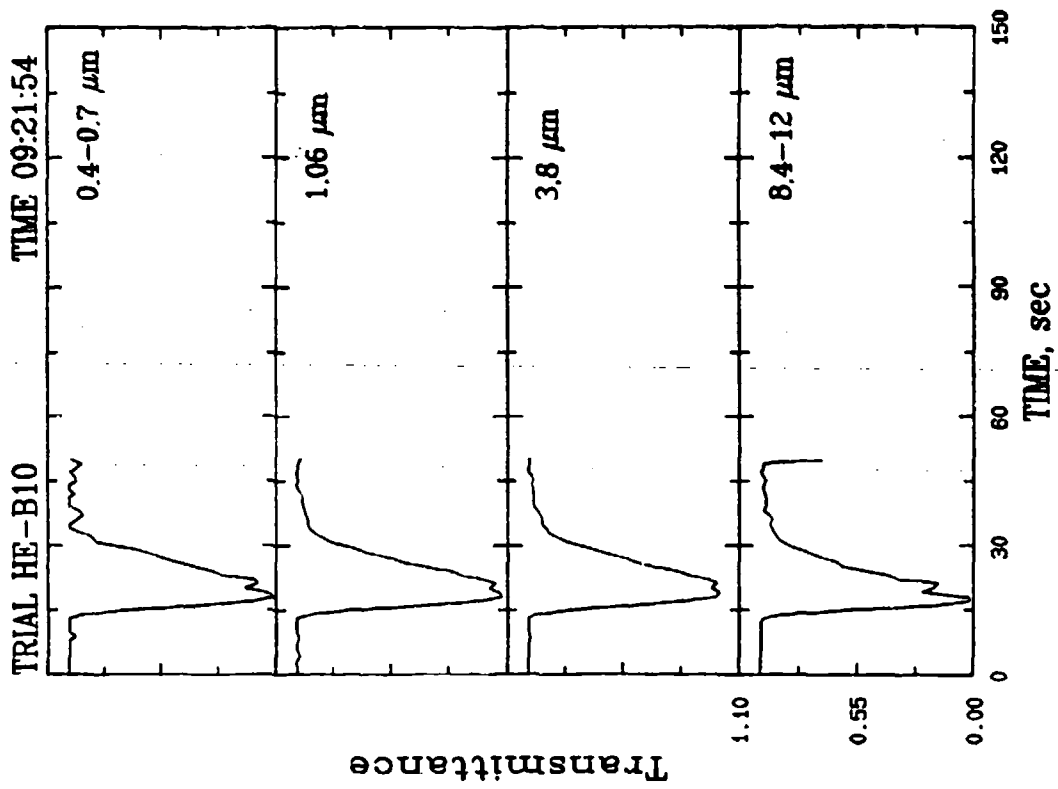
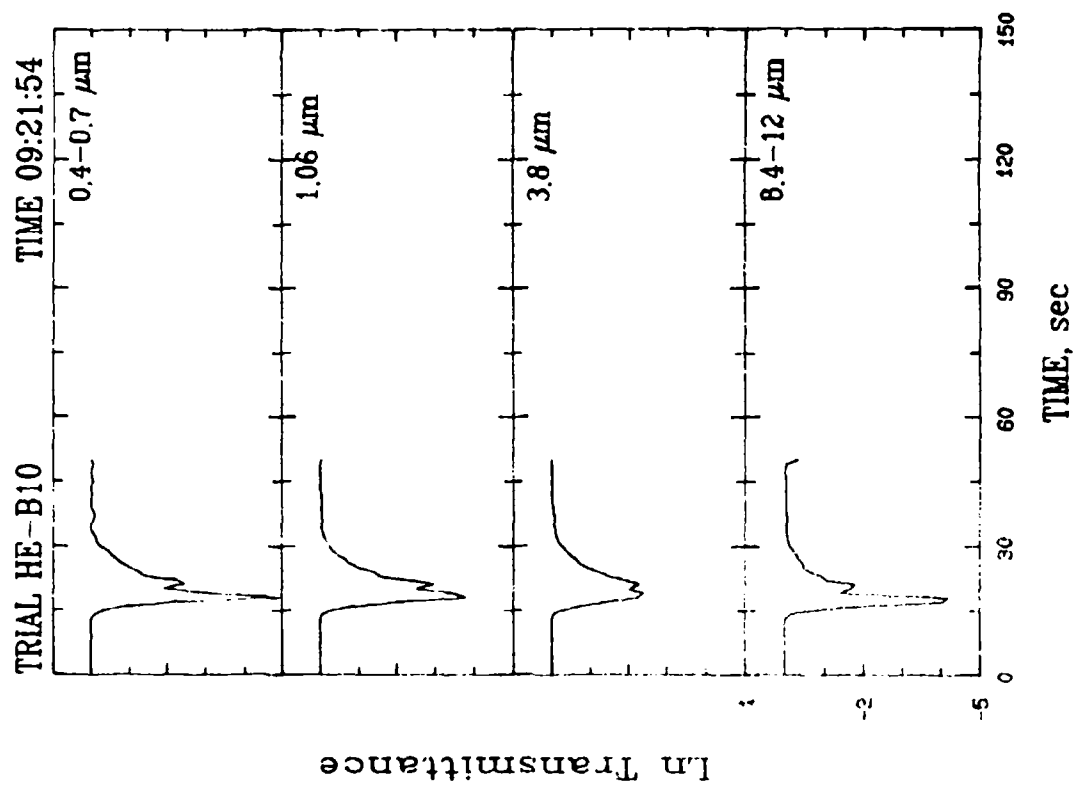


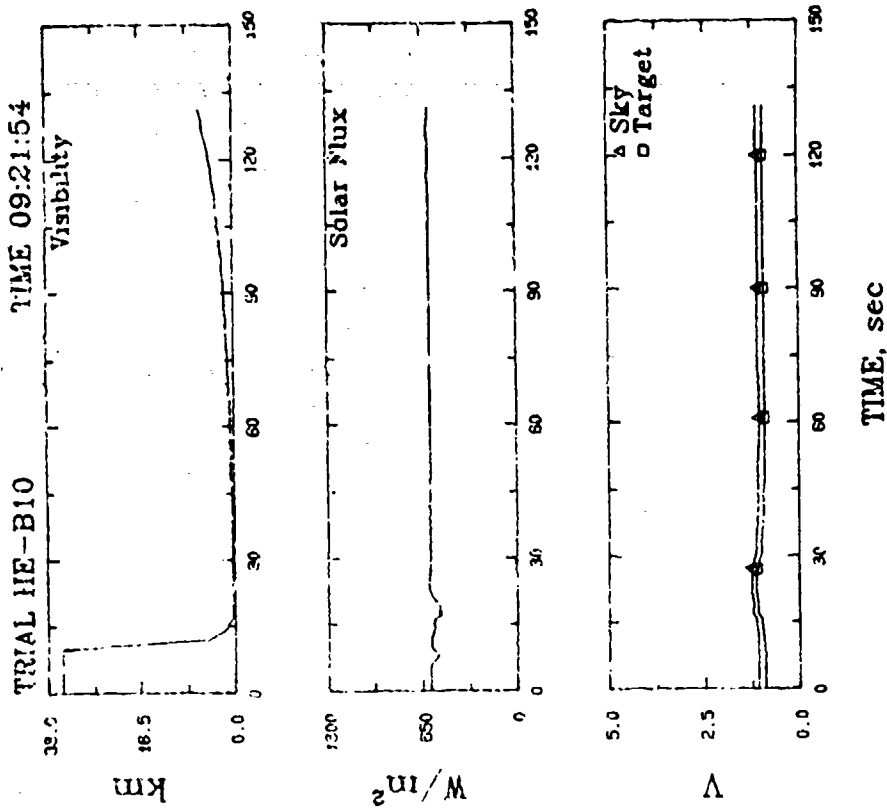
HEB10. 26 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
 CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEB11  
 Date: 26 APRIL 83  
 Detonation Coordinates (M):  
 X: 39.1  
 Y: 9.4  
 Surface Tangent  
 Charge Shape: BLOCK  
 Charge Wt: 15.0 LB  
 Event Time: 10:07:56

## METEOROLOGICAL DATA:

Pasquill Category: C  
 Richardson Number: -0.200

16 Meter Tower (Means)  
 Start Time: 10: 3:41 End Time: 10: 9:55

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 5.11  | 5.47  | 5.71  | 6.46  |
| Wind Dir. (DEG)  | 135.6 | 135.2 | 135.6 | 136.1 |
| Sigma WSP        | 1.13  | 1.29  | 1.33  | 1.32  |
| Sigma WDIR       | 15.1  | 14.9  | 14.0  | 13.2  |
| UVW Components   |       |       |       |       |
| U (N-S) (M/S)    | 3.53  | 3.80  | 4.00  | 4.64  |
| V (E-W) (M/S)    | -3.43 | -3.67 | -3.83 | -4.24 |
| W (Vert) (M/S)   | 0.3*  | 0.44  | 0.28  | *     |
| Sigma U          | 1.31  | 1.48  | 1.50  | 1.77  |
| Sigma V          | 1.26  | 1.23  | 1.24  | 0.94  |
| Sigma W          | 0.27  | 0.30  | 0.33  | *     |
| Temperature (C)  | 12.5  | 11.5  | 11.1  | 10.5  |

Soil Temperature (C): 21.4 Solar Flux (W/M<sup>2</sup>): 726.1  
 Dew Point (C): 6.3 Visual Range (M): 30480.0  
 Temperature (C): 11.5 Vista Ranger Voltages:  
 Rel. H<sub>2</sub>O (%): 46.0 Sky: 1.23  
 Target: 0.98  
 Abs. H<sub>2</sub>O (G/M<sup>3</sup>): 4.76 Sky-Target Contrast: -0.20  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X, Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|----------------|-----|-----|-----|-----|
| Pre-Shot  | 59.0 9.0       | 40  | 155 | 175 | 285 |
| Post-Shot | 39.0 9.0       | 40  | 120 | 310 | 700 |

## CRATER DATA

Moisture Content: 11.8

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.547  
 Apparent Crater: 0.143  
 Flow: 0.404

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.34  
 Flow: 1.005  
 Bottom: 1.165  
 Side: 0.845

## HI VOL DATA (G):

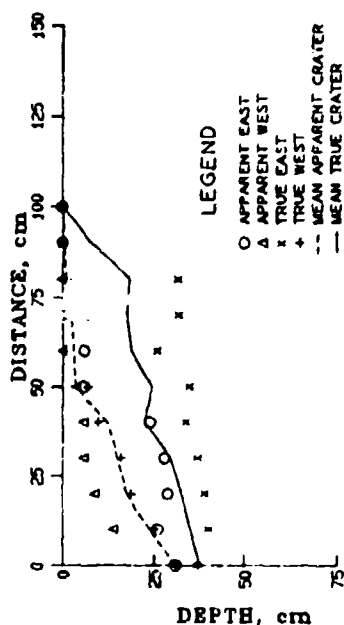
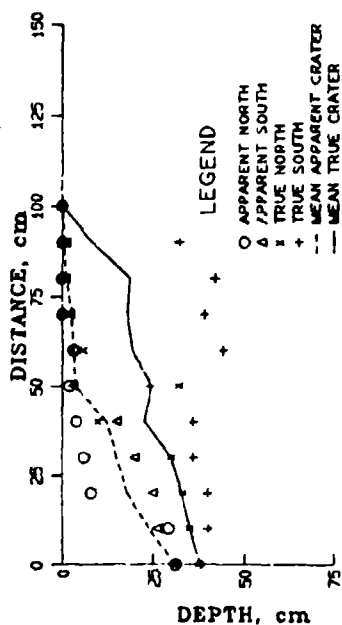
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.3915 | 0.6033 | 0.2360 | 0.0761 | 0.0306 | 0.5330 | 0.1969 | 0.1908 |

SUN: 2.2582

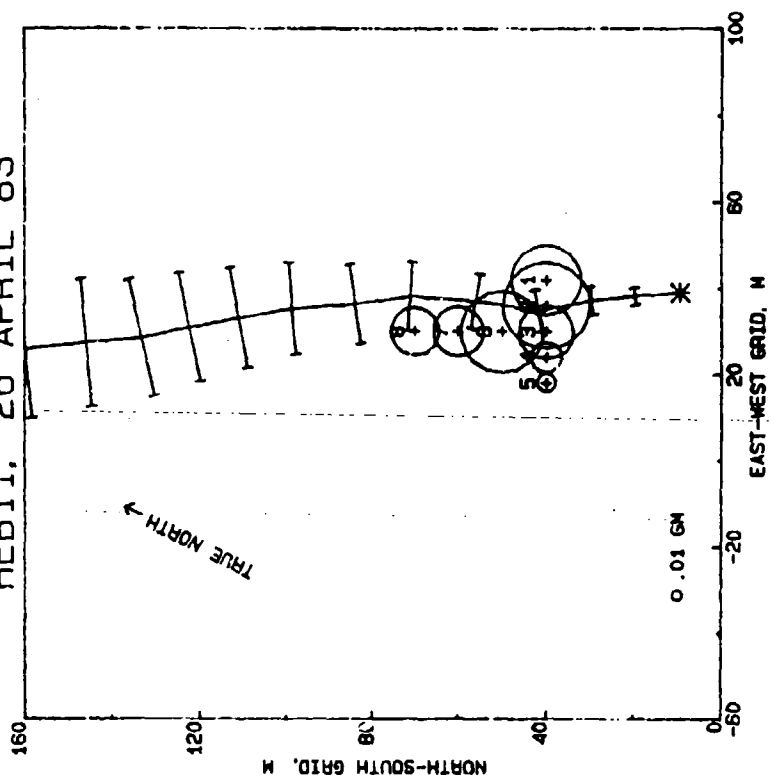
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 2.844    | 48.800   | 53.051   | 62.703   |

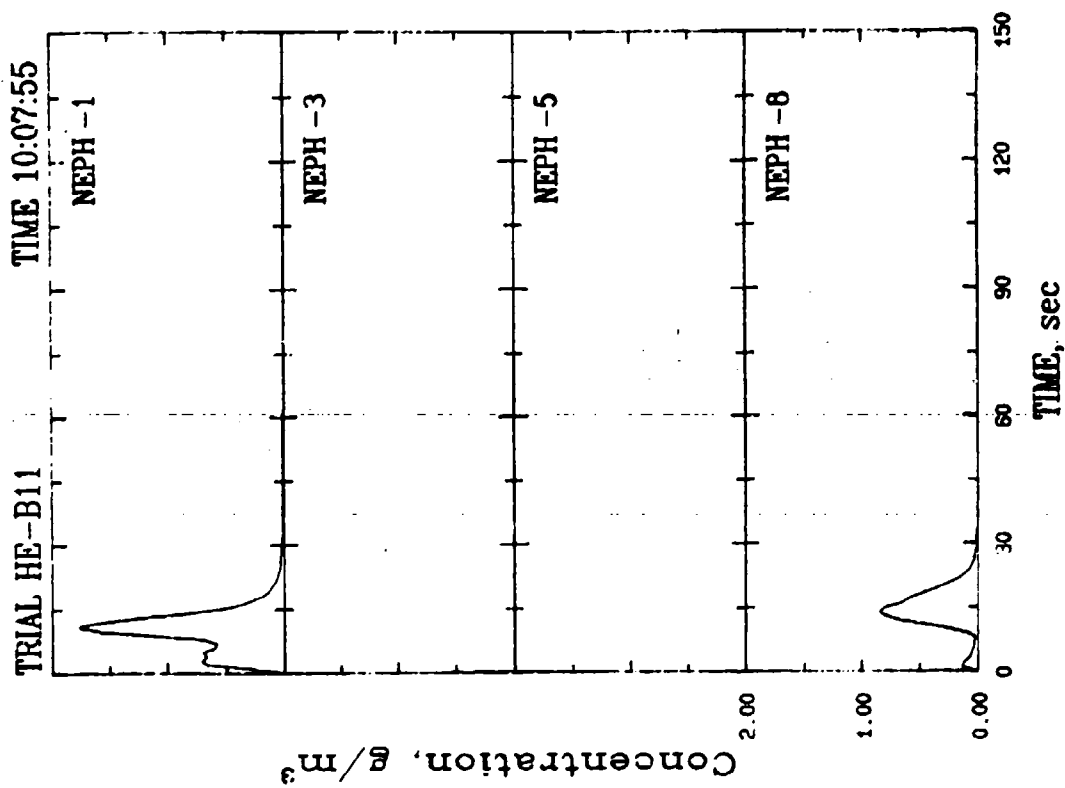
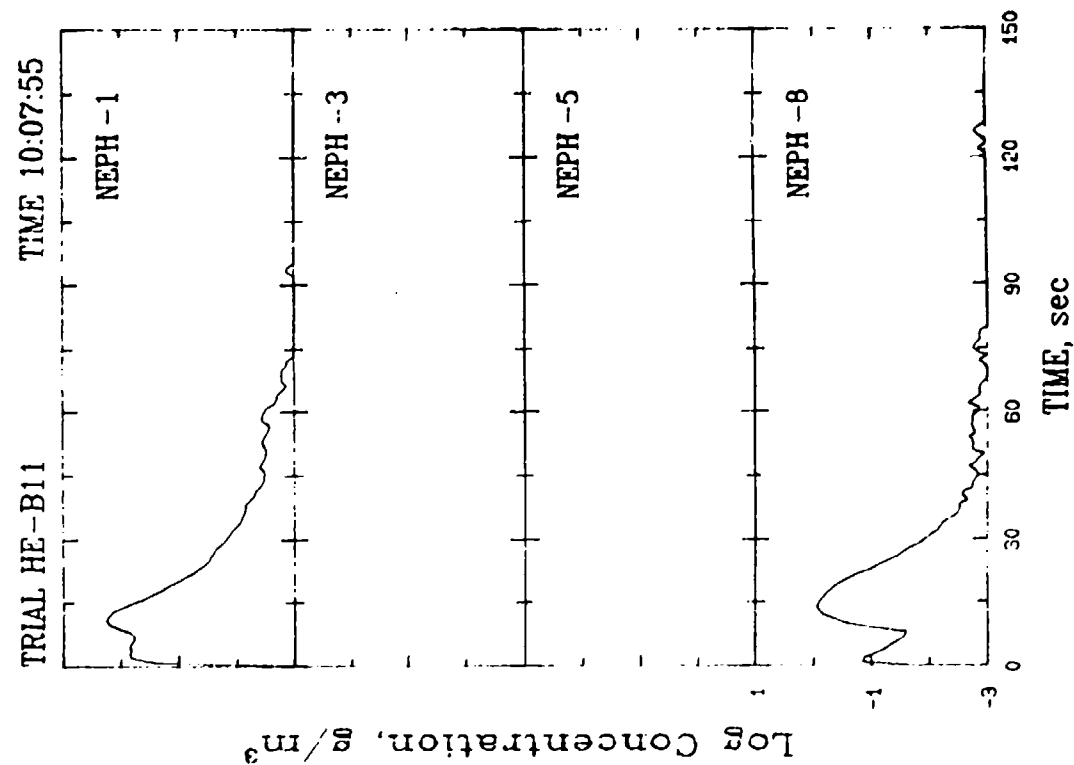
811 15 LB 1007HR 26APR83 39,9

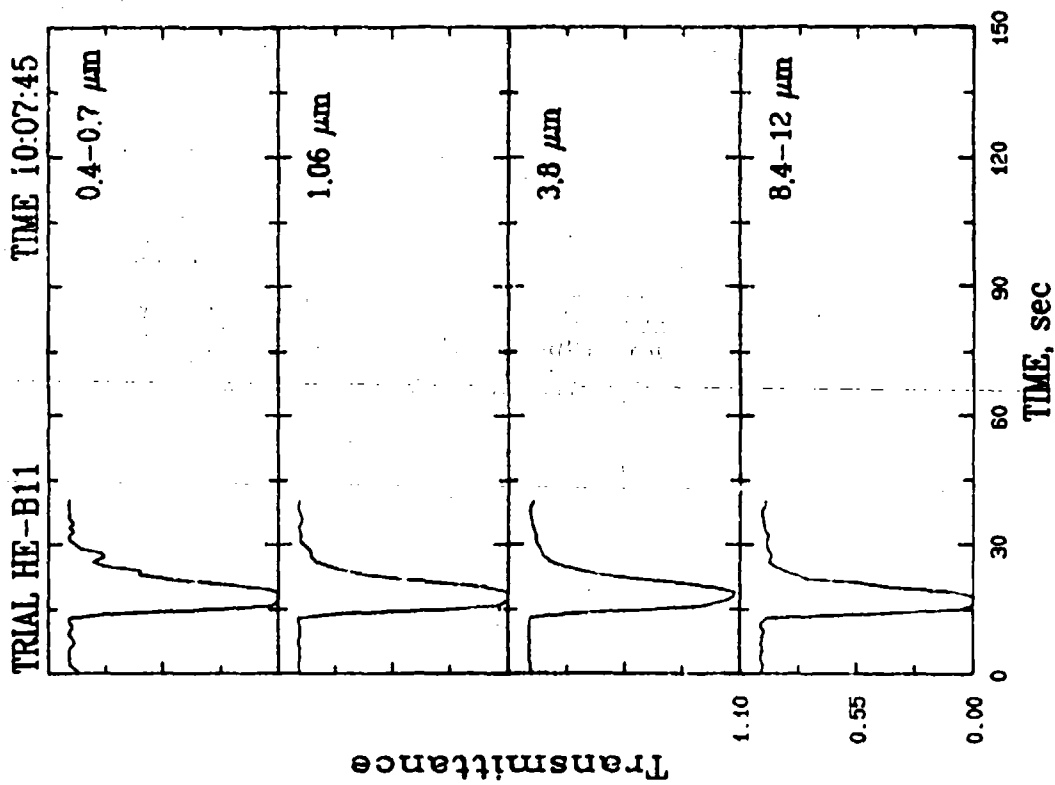
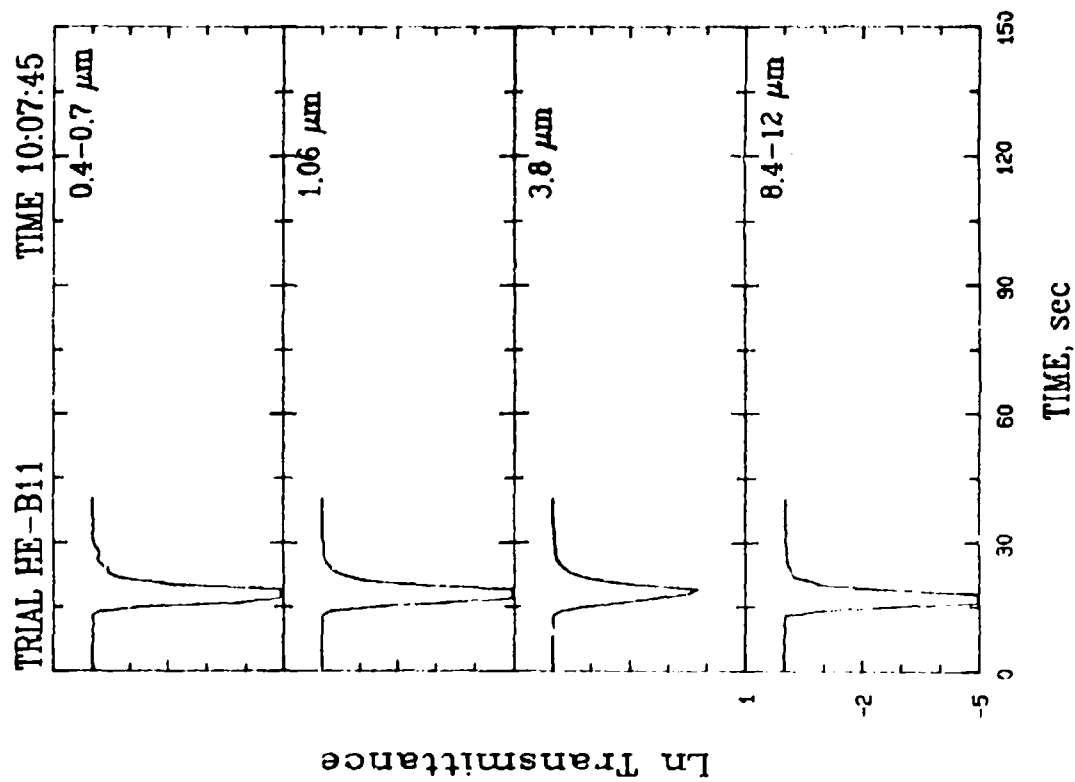


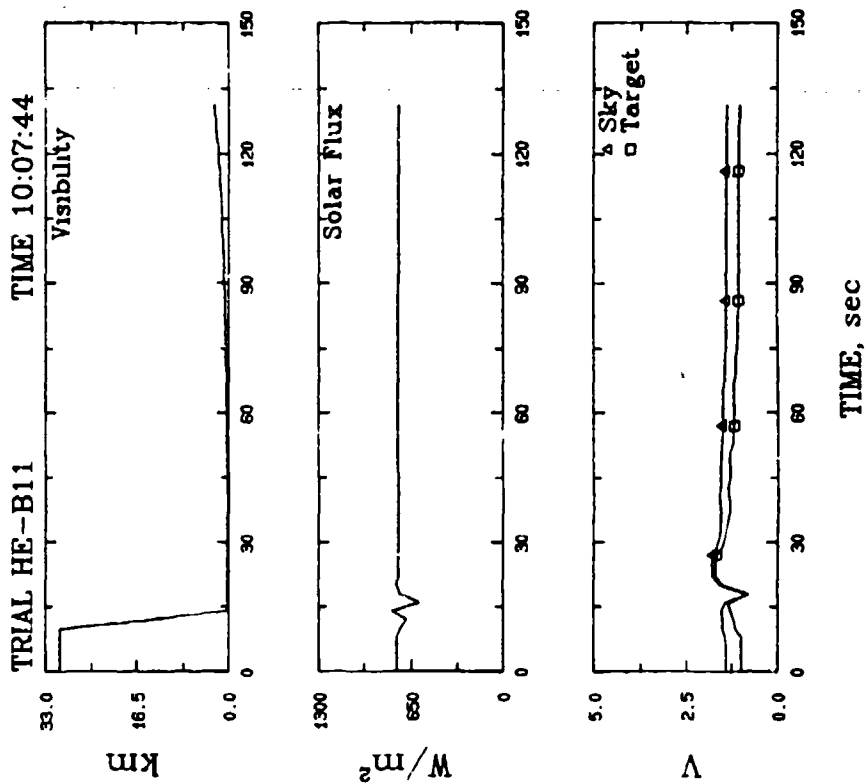
HEB11, 26 APRIL 83



MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEB12  
 Date: 26 APRIL 83  
 Detonation Coordinates (M):  
 X: 65.0  
 Y: -11.4  
 Surface Tangent Buried  
 Charge Shape: BLOCK  
 Charge Wt: 15.0 LB  
 Event Time: 11:22:38

## METEOROLOGICAL DATA:

Pasquill Category: B  
 Richardson Number: -0.468

16 Meter Tower (Means)  
 Start Time: 11:20: 3  
 End Time: 11:24:37

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 4.37  | 4.57  | 4.92  | 5.52  |
| Wind Dir. (DEG)  | 131.1 | 131.7 | 132.5 | 136.2 |
| Sigma WSP        | 1.38  | 1.40  | 1.48  | 1.66  |
| Sigma WDIR       | 18.8  | 17.4  | 16.8  | 17.7  |
| UVW Components   |       |       |       |       |
| U (N-S) (M/S)    | 2.73  | 2.94  | 3.19  | 3.79  |
| V (E-W) (M/S)    | -3.09 | -3.21 | -3.44 | -3.63 |
| W (Vert) (M/S)   | 0.25  | 0.29  | 0.17  | •     |
| Sigma U          | 1.42  | 1.49  | 1.51  | 1.74  |
| Sigma V          | 1.40  | 1.30  | 1.44  | 1.64  |
| Sigma W          | 0.27  | 0.33  | 0.33  | •     |
| Temperature (C)  | 14.0  | 13.0  | 12.6  | 12.2  |

Soil Temperature (C): 27.5  
 Dew Point (C): 0.2  
 Temperature (C): 12.8  
 Rel. Hum. (%): 42.0  
 Abs. Hum. (G/M\*\*3): 4.73  
 Rain Accumulation (MM): 0.00  
 Solar Flux (W/M\*\*2): 933.3  
 Visual Range (M): 30480.0  
 Vista Ranger Voltages:  
 Sky: 1.75  
 Target: 1.07  
 Sky-Target Contrast: -0.39

# CONE INDEX:

|           | X, Y Coord (M) | SPC | 15  | 30  | 45   |
|-----------|----------------|-----|-----|-----|------|
| Pre-Shot  | 65.0 -11.0     | 125 | 265 | 635 | 750+ |
| Post-Shot | 65.0 -11.0     | 40  | 220 | 500 | 590  |

## CRATER DATA

Moisture Content: 12.1

CRATER VOLUMES (M\*\*3):  
 True Crater: 1.674  
 Apparent Crater: 0.779  
 Flow: 0.896

DENSITIES (G/CM\*\*3):  
 Pre-Shot: 1.28  
 Flow: 1.206  
 Bottom: 1.308  
 Side: 1.104

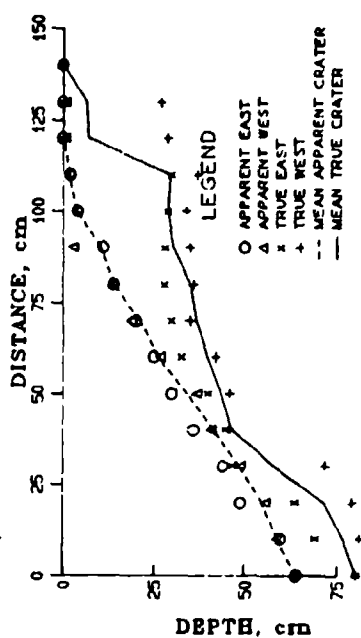
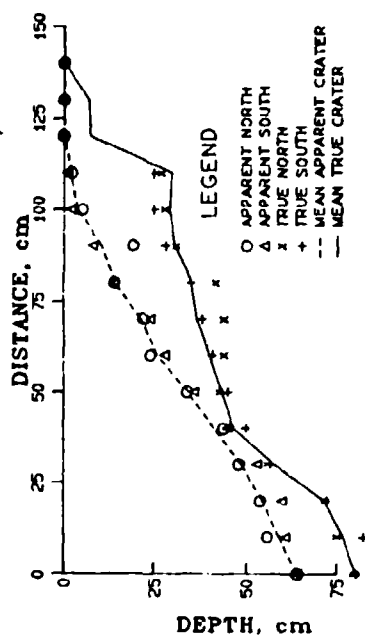
## HI VOL DATA (G):

| HV1         | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|-------------|--------|--------|--------|--------|--------|--------|--------|
| 0.0635      | 0.0537 | 0.1270 | 0.2827 | 0.6118 | 0.0638 | 0.0325 | 0.0154 |
| SUM: 1.2524 |        |        |        |        |        |        |        |

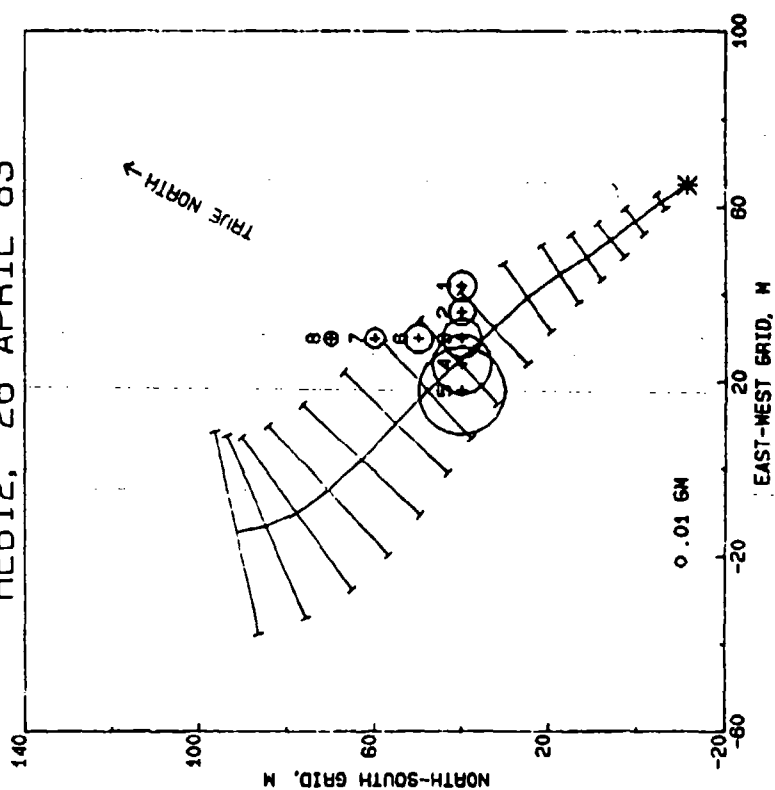
## GELMAN DOSAGE (G S/M\*\*3):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 0.000    | 0.000    |

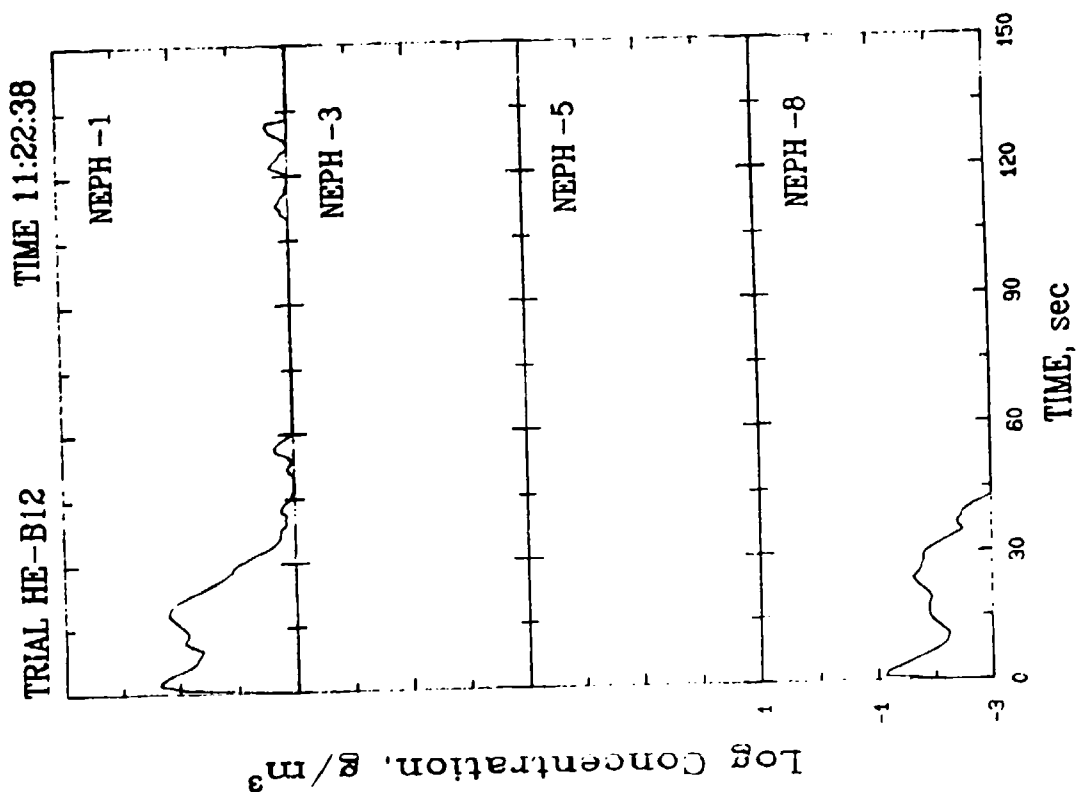
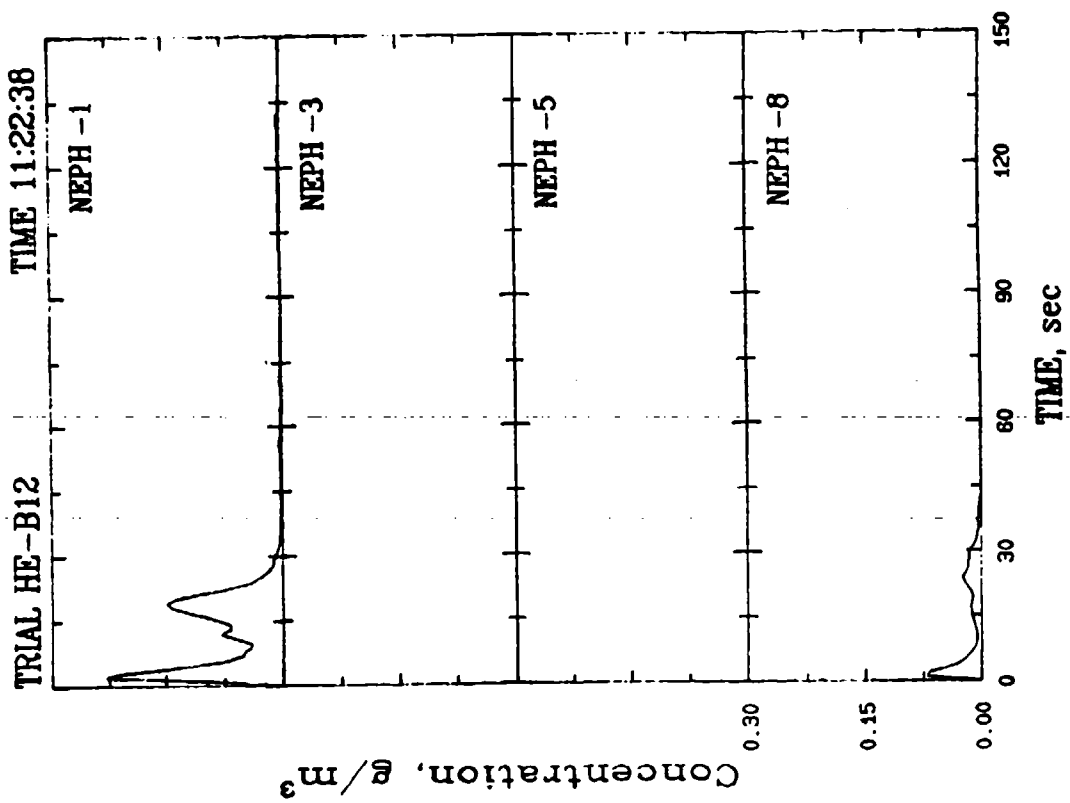
B12 15 LB 1122HR 26APR83 65,-11

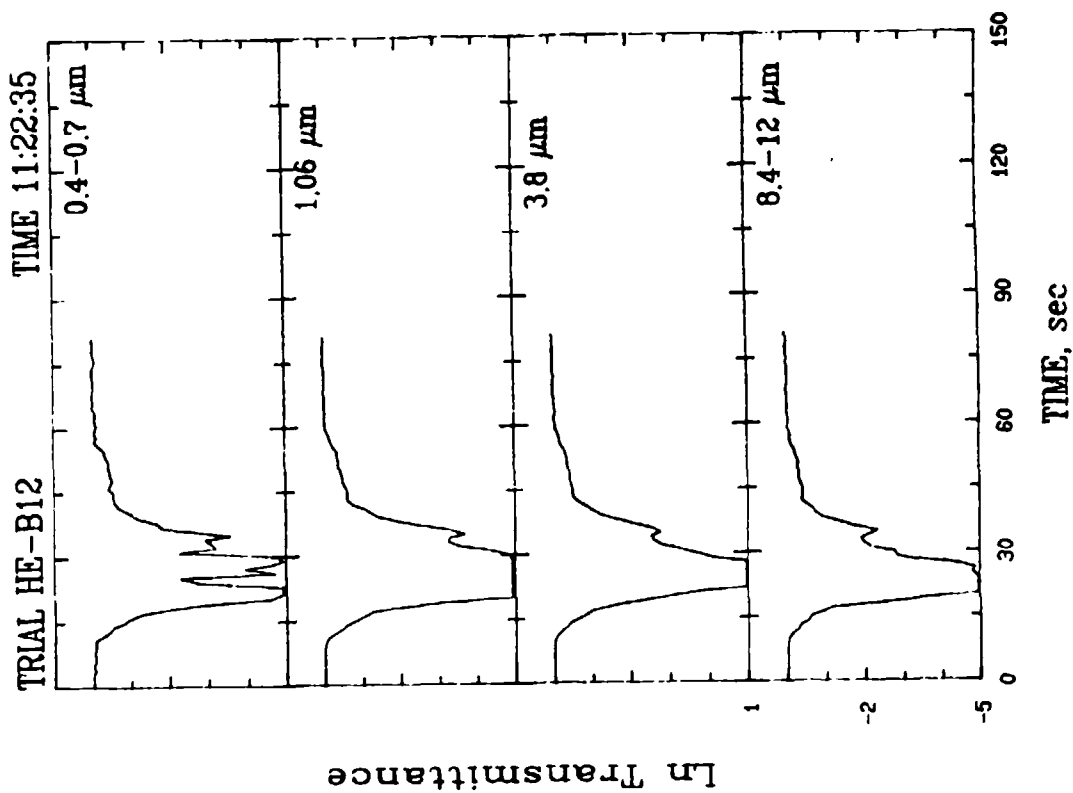
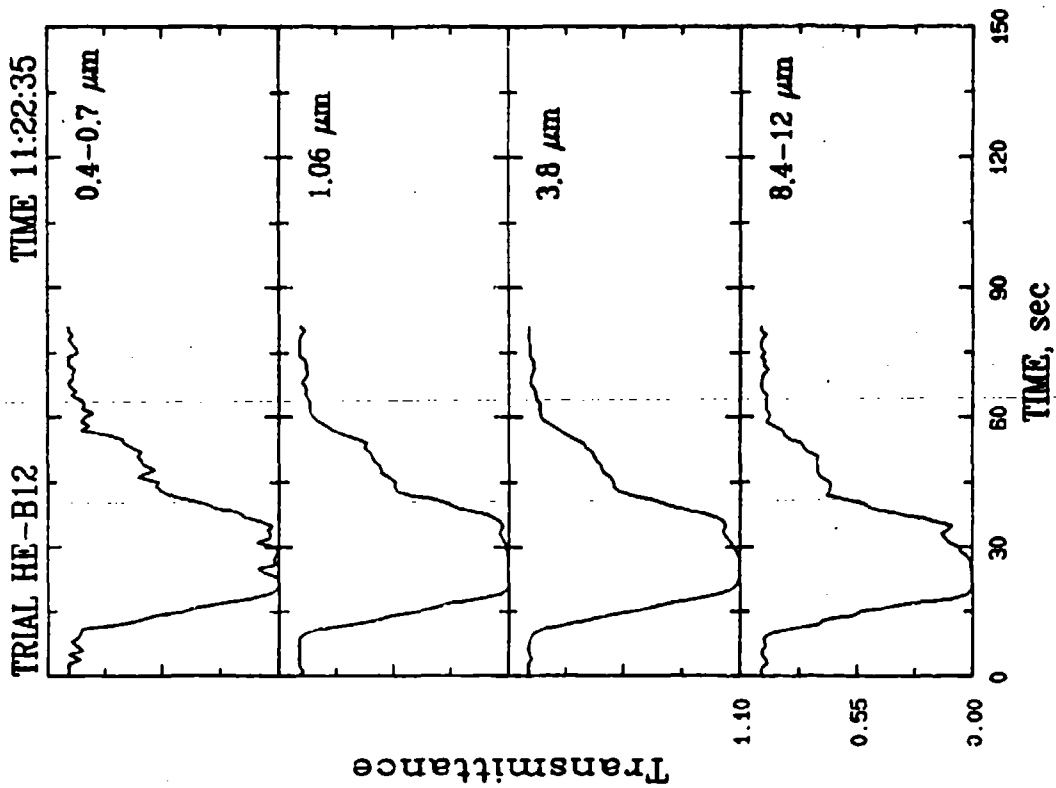


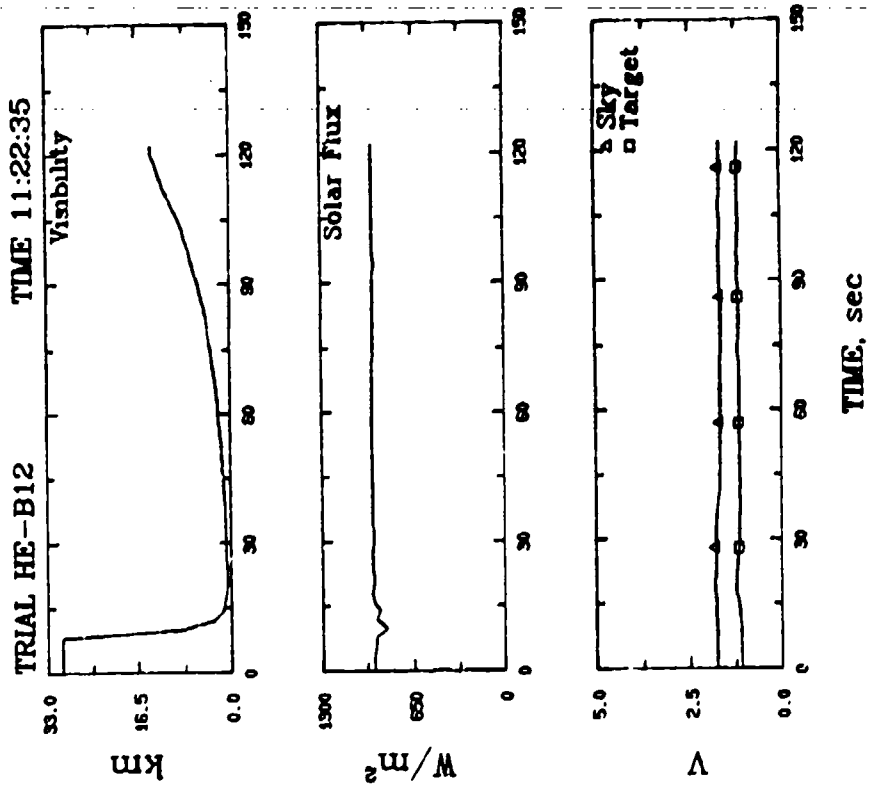
HEB12, 26 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEB13 Surface Tangent Buried  
 Date: 26 APRIL 83 Charge Shape: BLOCK  
 Detonation Coordinates (M):  
 X: 51.4 Charge Wt: 15.0 LB  
 Y: -11.5 Event Time: 12:25:35

## METEOROLOGICAL DATA:

Pasquill Category: B  
 Richardson Number: -1.142

16 Meter Tower (Means)  
 Start Time: 12:21:59 End Time: 12:27:40

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 5.14  | 5.40  | 5.77  | 6.41  |
| Wind Dir. (DEG)  | 125.2 | 124.5 | 125.1 | 122.1 |
| Sigma WSP        | 1.39  | 1.47  | 1.63  | 1.77  |
| Sigma WDIR       | 13.8  | 13.5  | 12.6  | 11.2  |
| UVI Components   |       |       |       |       |
| J (M-S)          | 2.79  | 2.91  | 3.16  | 3.30  |
| U (E-W)          | -4.12 | -4.34 | -4.63 | -5.33 |
| V (Vert)         | 0.32  | 0.42  | 0.37  | 0     |
| Sigma U          | 1.21  | 1.37  | 1.37  | 1.44  |
| Sigma V          | 1.45  | 1.45  | 1.62  | 1.69  |
| Sigma W          | 0.24  | 0.24  | 0.29  | 0     |
| Temperature (C)  | 15.0  | 14.1  | 13.7  | 13.1  |

Soil Temperature (C): 24.5 Solar Flux (W/M<sup>2</sup>): 791.2  
 Dew Point (C): 0.9 Visual Range (M): 30480.0  
 Temperature (C): 14.0 Vista Ranger Voltages:  
 Rel. Hum. (%): 40.9 Sky: 1.74  
 Target: 0.97  
 Abs. Hum. (G/M<sup>3</sup>): 4.96 Sky-Target Contrast: -0.44  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 51.0 -11.0    | 40  | 215 | 290 | 635 |
| Post-Shot | 51.0 -11.0    | 50  | 110 | 155 | 155 |

## CRATER DATA

Moisture Content: 7.2

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 2.013  
 Apparent Crater: 0.440  
 Flow: 1.573

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.44  
 Flow: 1.188  
 Bottom: 1.321  
 Side: 1.056

## HI VOL DATA (G):

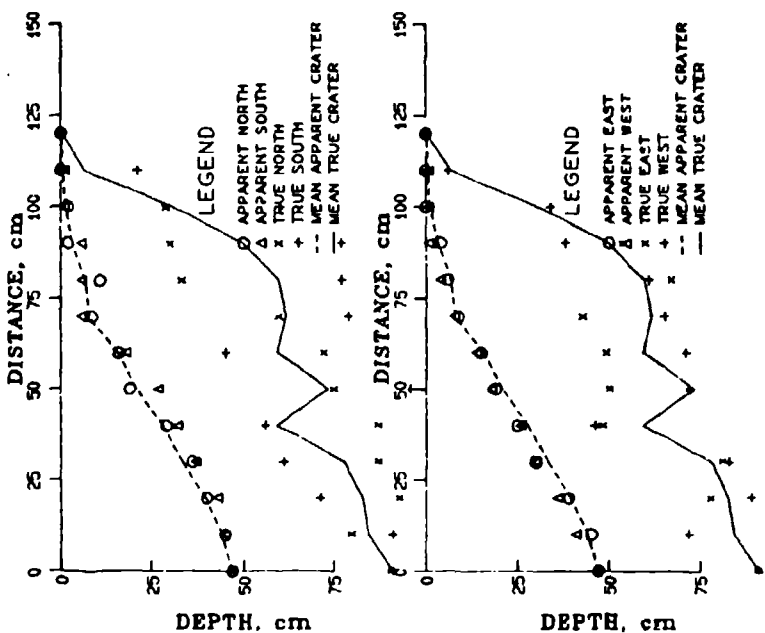
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.2382 | 0.3612 | 0.6893 | 0.3433 | 0.1490 | 0.5181 | 0.3210 | 0.0676 |

SOM: 2.6877

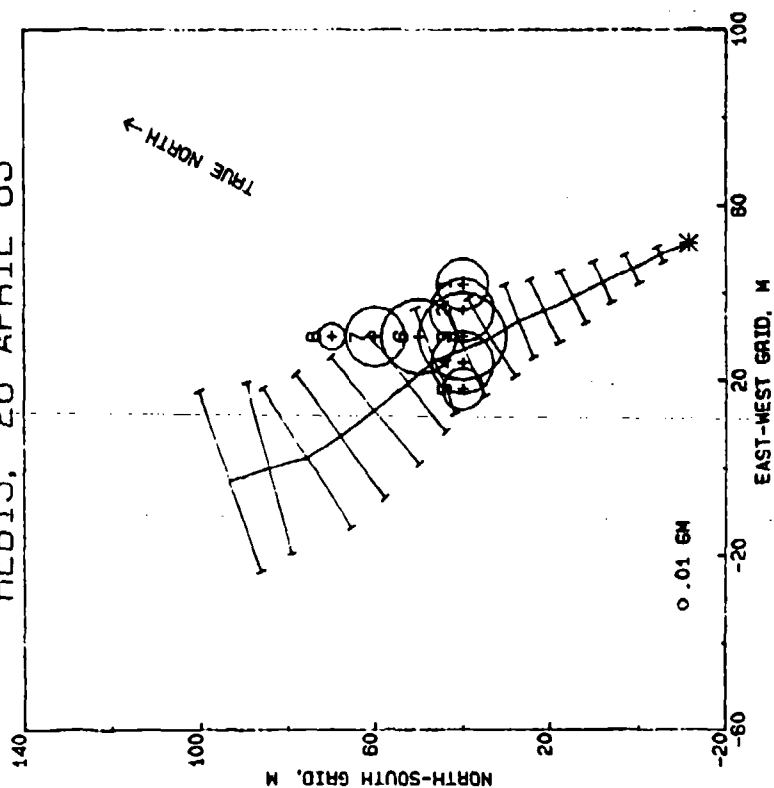
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 0.000    | 0.000    |

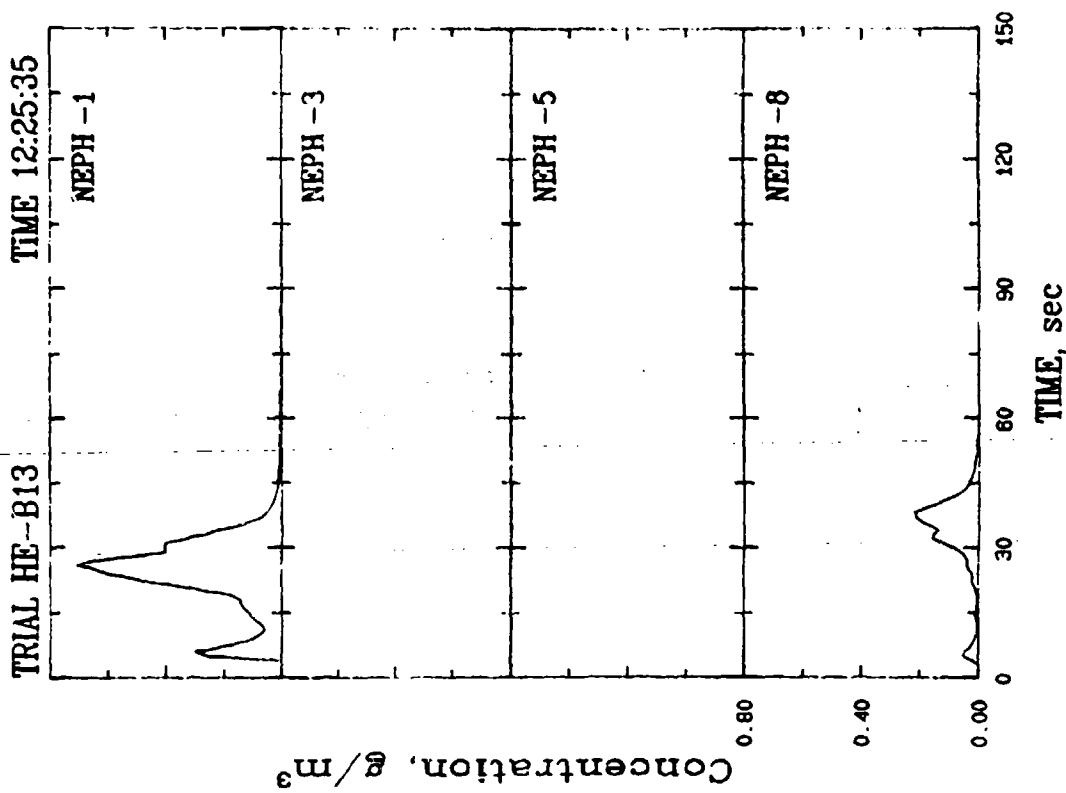
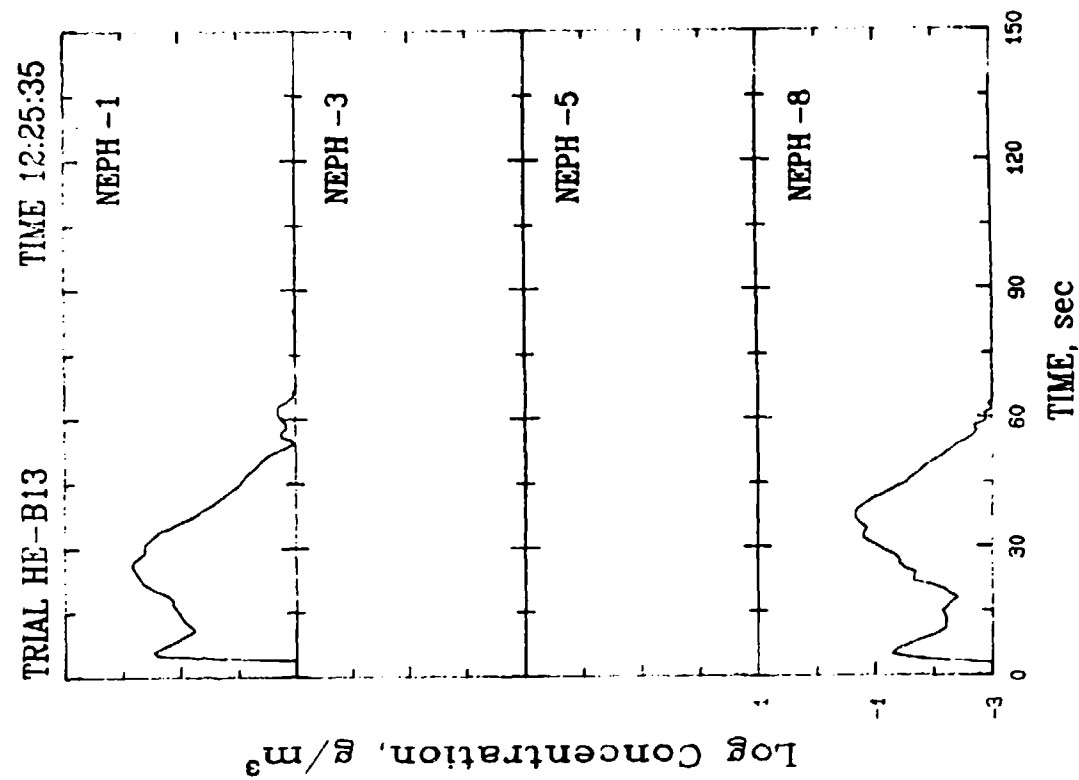
B13 15 LB 1225HR 26APR83 51,-11

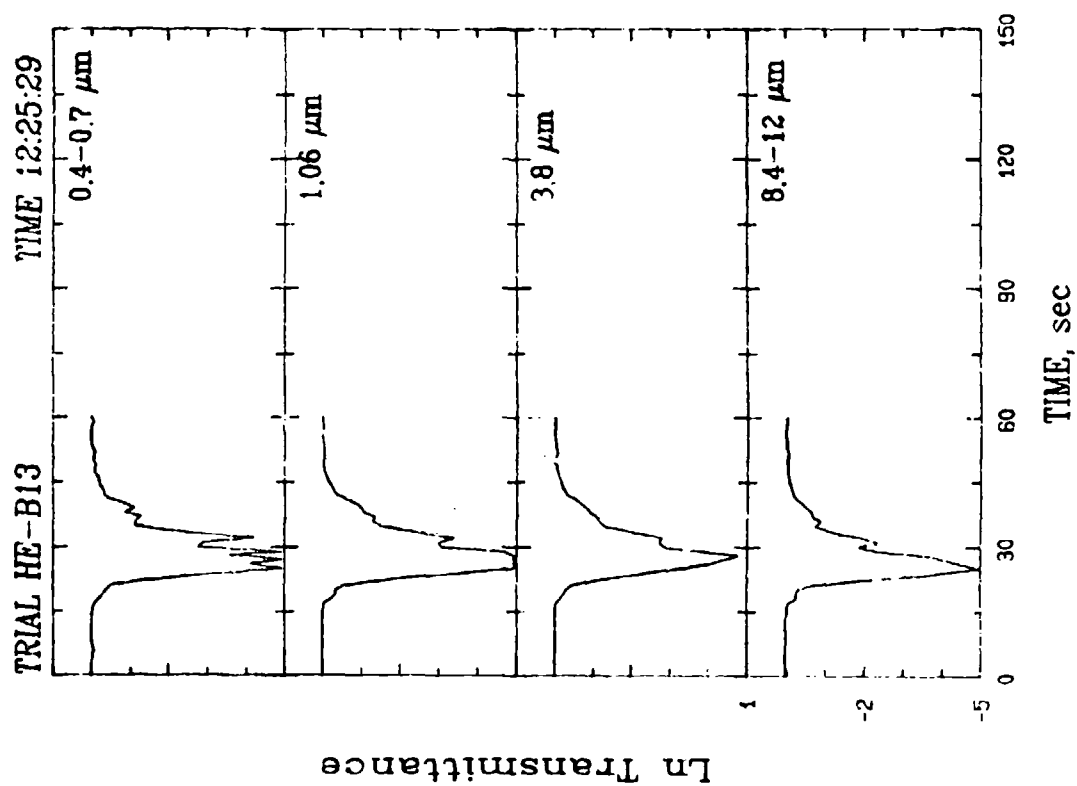
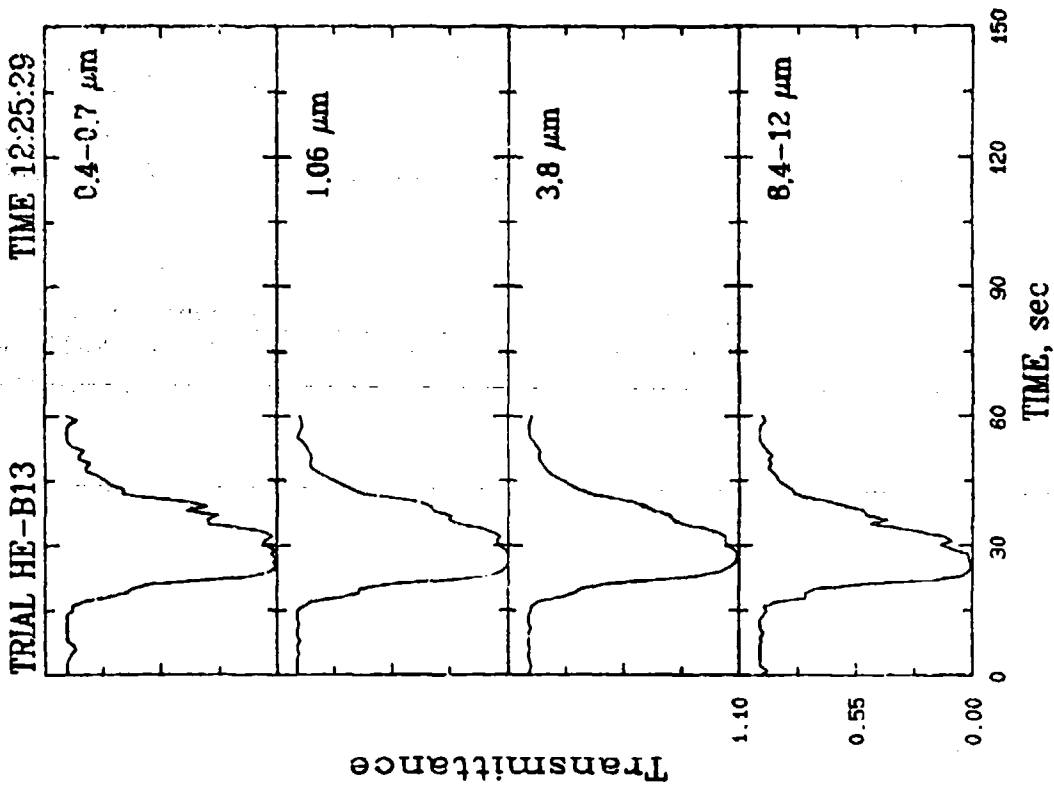


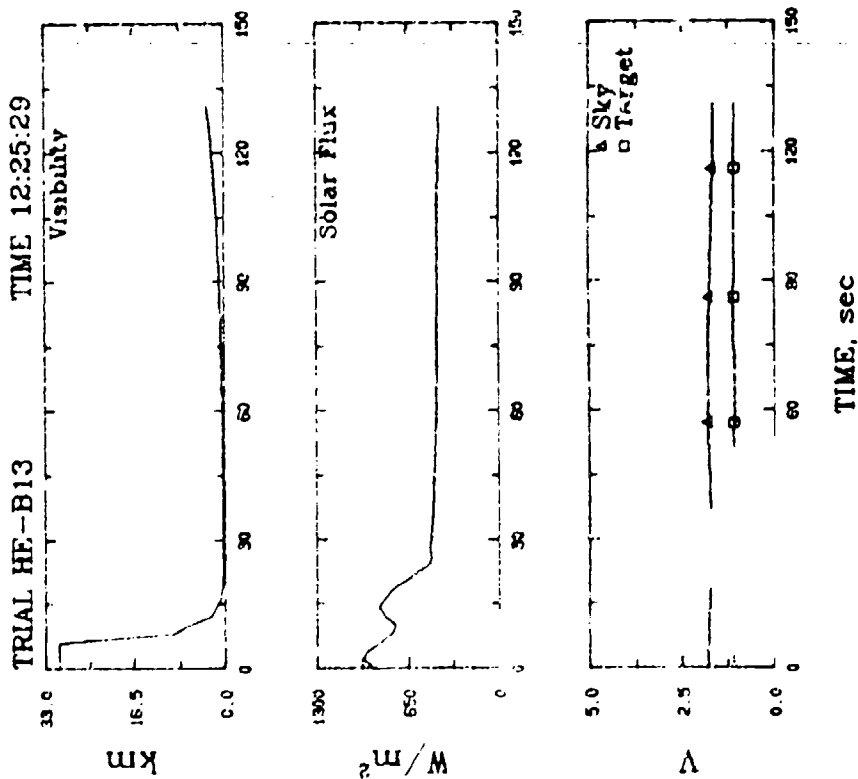
HEB13. 26 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEB14 Above Ground  
 Date: 26 APRIL 83 Charge Scope: BLOCK  
 Detonation Coordinates (M): Charge Wt: 15.0 LB  
 X: 40.5 Event Time: 13:34:01  
 Y: 4.8

## METEOROLOGICAL DATA:

Explosion Category: B  
 Explosive Number: -14.845

16 Meter Tower (Means)  
 Start Time: 13:30:37 End Time: 13:36:2

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 5.67  | 6.13  | 6.33  | 6.92  |
| Wind Dir. (DEG)  | 146.1 | 146.3 | 145.6 | 147.1 |
| Sigma WSP        | 2.02  | 2.24  | 2.12  | 2.39  |
| Sigma WSP        | 18.1  | 16.9  | 17.3  | 16.0  |
| Temp (C)         | 4.62  | 5.04  | 5.17  | 5.85  |
| W (E-W) (M/S)    | -2.81 | -3.03 | -3.16 | -3.31 |
| V (Vert) (M/S)   | 0.21  | 0.32  | 0.01  | .     |
| Sigma U          | 2.23  | 2.48  | 2.46  | 2.71  |
| Sigma V          | 1.42  | 1.77  | 1.33  | 1.08  |
| Sigma W          | 0.31  | 0.49  | 0.30  | .     |
| Temperature (C)  | 16.0  | 15.1  | 14.5  | 14.2  |

Solar Temperature (C): 32.2 Solar Flux (W/M<sup>2</sup>): 1003.2  
 Dew Point (C): -0.7 Visual Range (M): 30480.0  
 Temperature (C): 15.1 Vista Ranger Voltages:  
 Sky: 1.93  
 Rel. Hum. (%): 33.8 Target: 1.22  
 Abs. Hum. (G/M<sup>3</sup>): 4.37 Sky-Target Contrast: -0.37  
 Rain Accumulation (mm): 0.00

# CONE INDEX:

|           | X,Y Coord (M) | SPC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 60.0 10.0     | 25  | 175 | 265 | 430 |
| Post-Shot | 60.0 10.0     | 90  | 315 | 265 | 275 |

# CRATER DATA

Moisture Content: .

## CRATER VOLUMES (M<sup>3</sup>):

True Crater: .  
 Apparent Crater: .  
 Flow: .

## DENSITIES (G/CM<sup>3</sup>):

Pre-Shot: .  
 Flow: .  
 Bottom: .  
 Side: .

# HI VOL DATA (G):

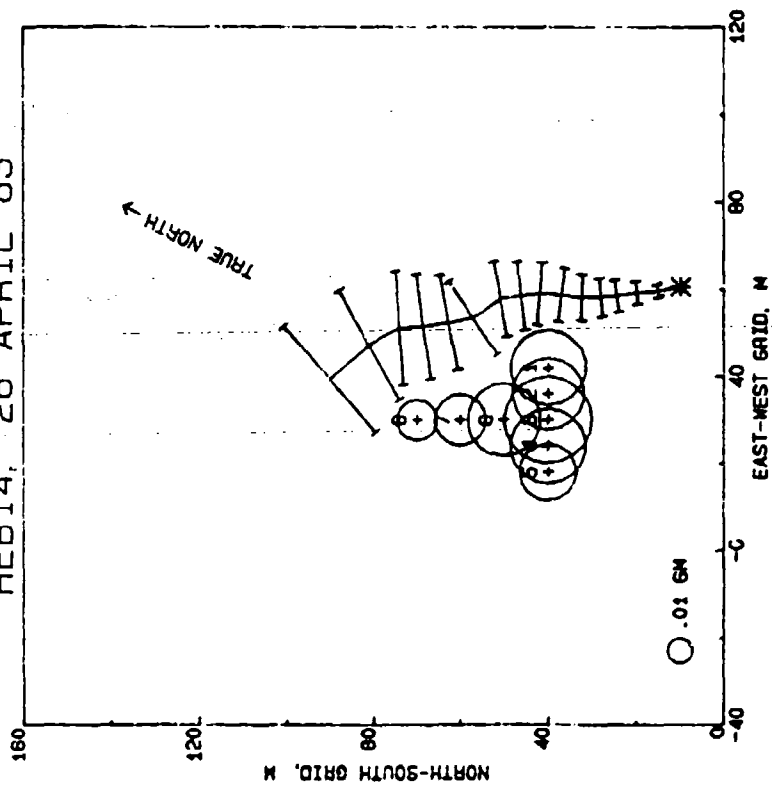
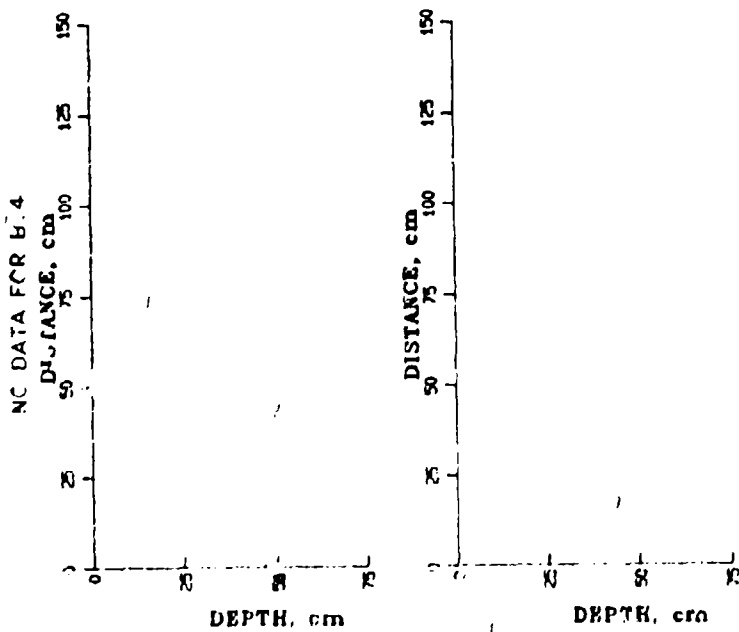
|  | HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--|--------|--------|--------|--------|--------|--------|--------|--------|
|  | 0.0897 | 0.0805 | 0.1194 | 0.0896 | 0.0513 | 0.0846 | 0.0421 | 0.0260 |

SUM: 0.5832

# GELMAN DOSAGE (G S/M<sup>3</sup>):

|  | GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|--|----------|----------|----------|----------|
|  | 0.000    | 0.000    | 0.000    | 0.000    |

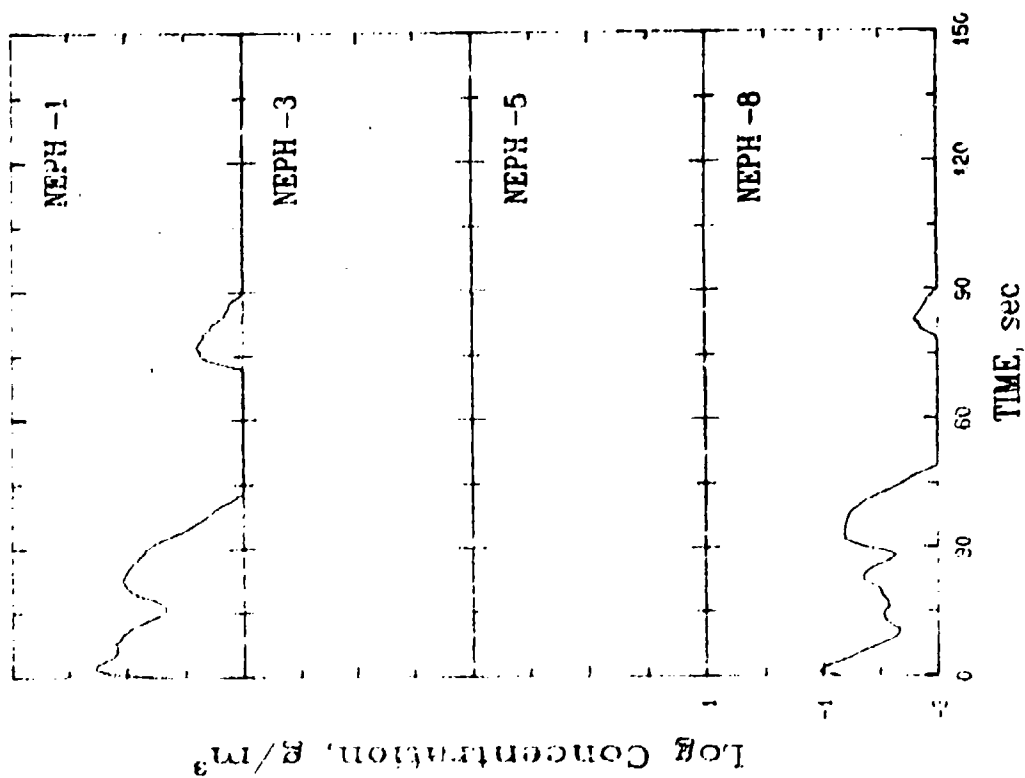
HEB14, 26 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS

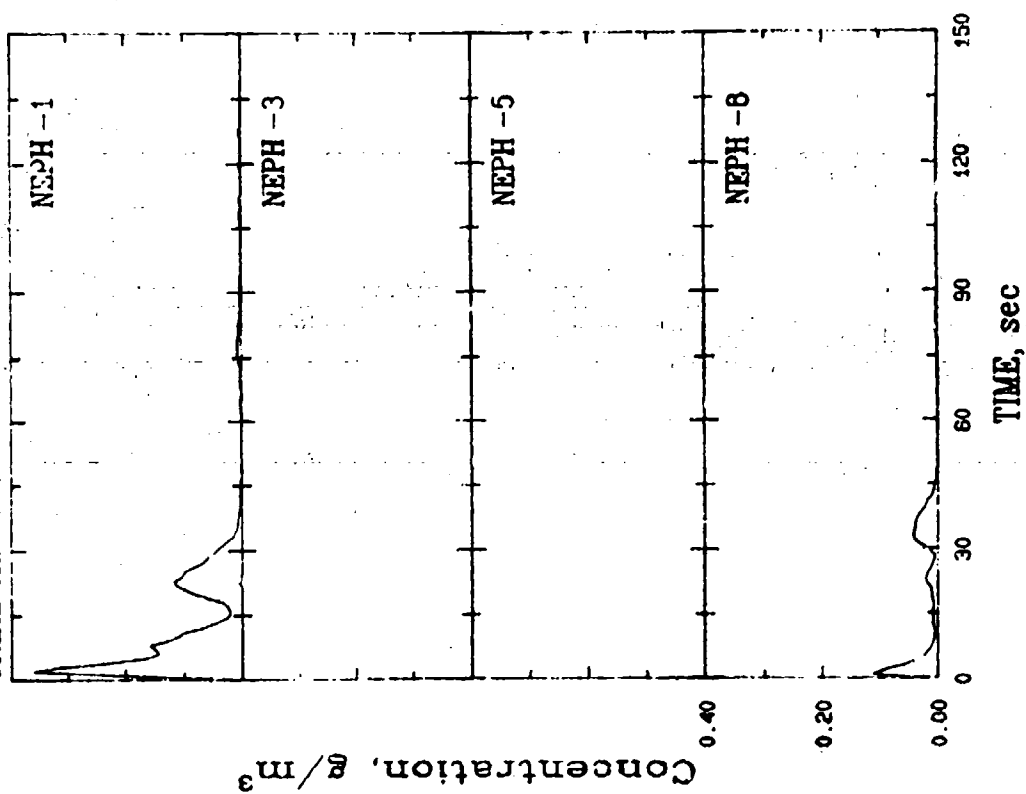
TRIAL HE-B14

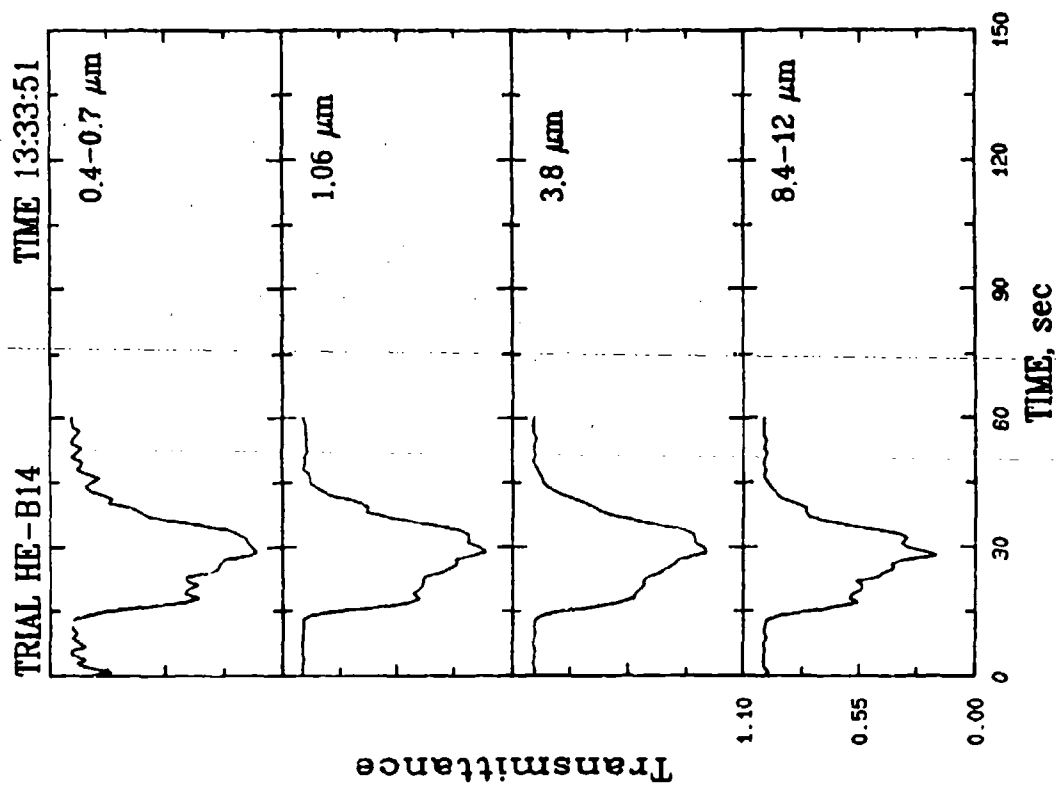
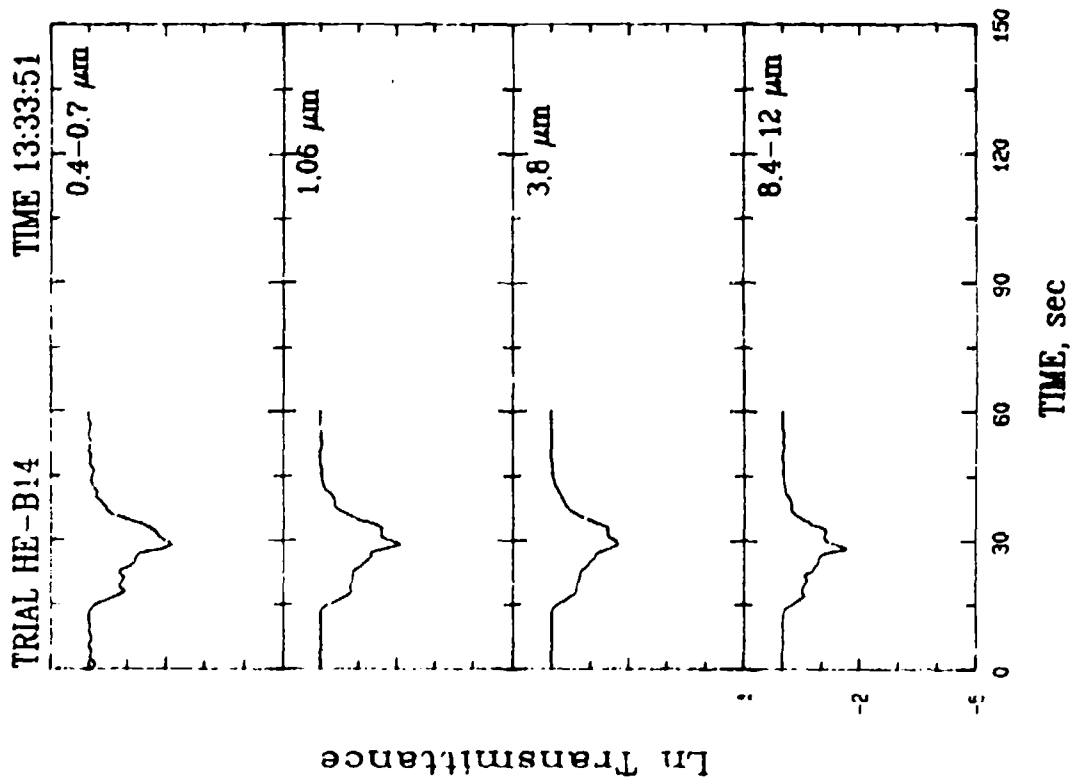
TIME 13:34:01

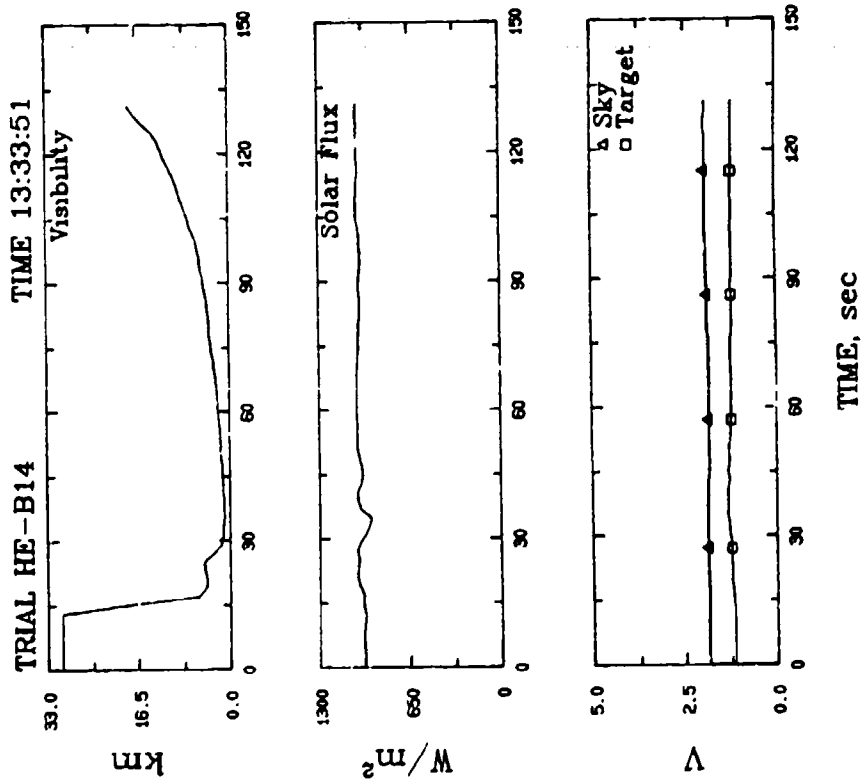


TRIAL HE-B14

TIME 13:34:01







# EVENT SUMMARY DATA

Test Number: HEB15  
 Date: 26 APRIL 83  
 Detonation Coordinates (M):  
 X: 36.1  
 Y: 2.8  
 Surface Tangent Buried  
 Charge Shape: BLOCK  
 Charge Wt: 15.0 LB  
 Event Time: 14:57:35

## METEOROLOGICAL DATA:

Pasquill Category: C  
 Richardson Number: -0.136

16 Meter Tower (Means)  
 Start Time: 14:56: 7 End Time: 14:59:43

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 5.80  | 6.25  | 6.47  | 7.76  |
| Wind Dir. (DEC)  | 155.4 | 156.8 | 157.7 | 157.8 |
| Sigma WSP        | 1.12  | 1.13  | 1.12  | 0.93  |
| Sigma WDIR       | 10.5  | 10.5  | 10.1  | 7.5   |
| UTV Components   |       |       |       |       |
| U (N-S)          | 5.19  | 5.64  | 5.88  | 7.11  |
| V (E-W)          | -2.37 | -2.45 | -2.47 | -2.95 |
| W (Vert)         | 0.18  | 0.41  | 0.05  | •     |
| Sigma U          | 1.14  | 1.12  | 1.05  | 0.88  |
| Sigma V          | 1.03  | 1.14  | 1.19  | 1.04  |
| Sigma W          | 0.24  | 0.35  | 0.40  | •     |
| Temperature (C)  | 17.3  | 16.6  | 16.1  | 15.3  |

Soil Temperature (C): 32.5 Solar Flux (W/m<sup>2</sup>): 776.8  
 Dew Point (C): -1.2 Visual Range (M): 30480.0  
 Temperature (C): 16.7 Vista Ranger Voltages:  
 Rel. Hum. (%): 29.3 Sky: 1.92  
 Target: 1.12  
 Abs. Hum. (G/m<sup>3</sup>): 4.17 Sky-Target Contrast: -0.41  
 Rain Accumulation (MM): 0.00

## CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 36.0 3.0      | 25  | 190 | 230 | 380 |
| Post-Shot | 36.0 3.0      | 25  | 165 | 350 | 685 |

## CRATER DATA

Moisture Content: •

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 1.832  
 Apparent Crater: 0.810  
 Flow: 1.021

DENSITIES (G/cm<sup>3</sup>):  
 Pre-Shot: 1.26  
 Flow: 1.12  
 Bottom: 1.122  
 Side: 1.113

## HI VOL DATA (G):

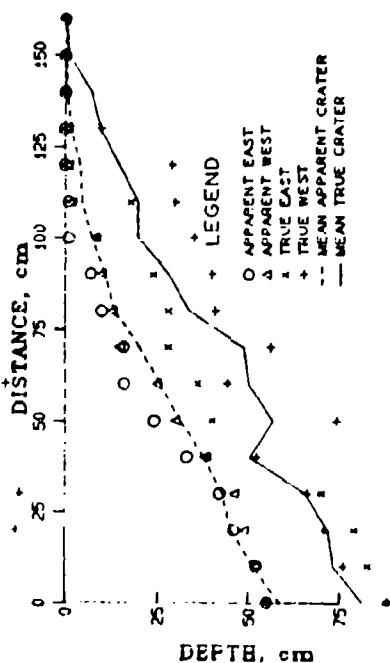
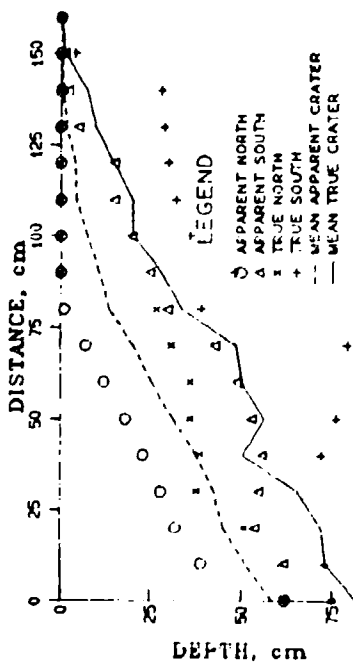
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.3737 | 1.0164 | 0.2213 | 0.0798 | 0.0174 | 0.6042 | 0.3817 | 0.6498 |

SUM: 3.3443

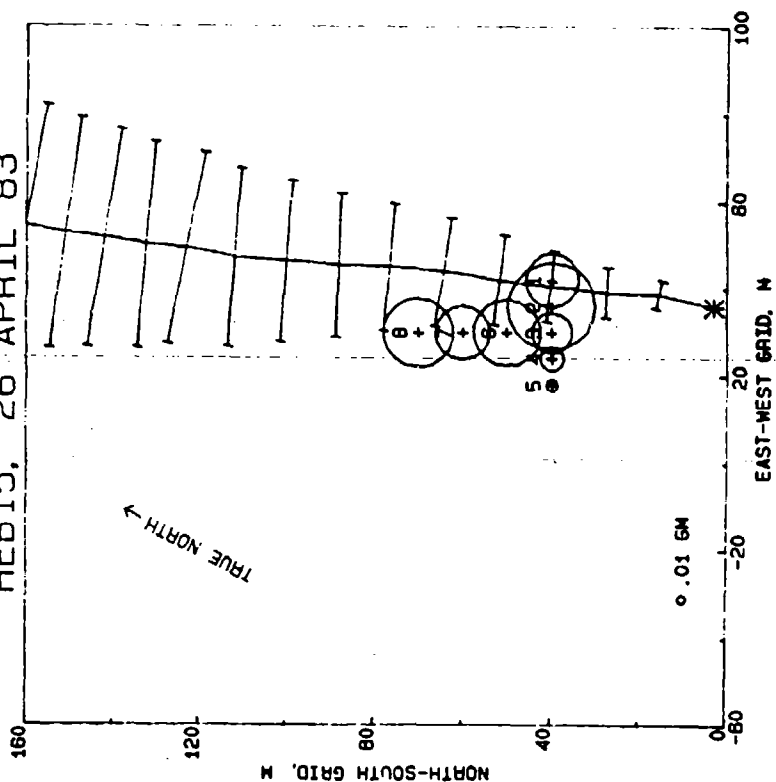
## GELMAN DOSAGE (G S/M<sup>2</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 79.621   | 153.600  | 183.064  | 72.973   |

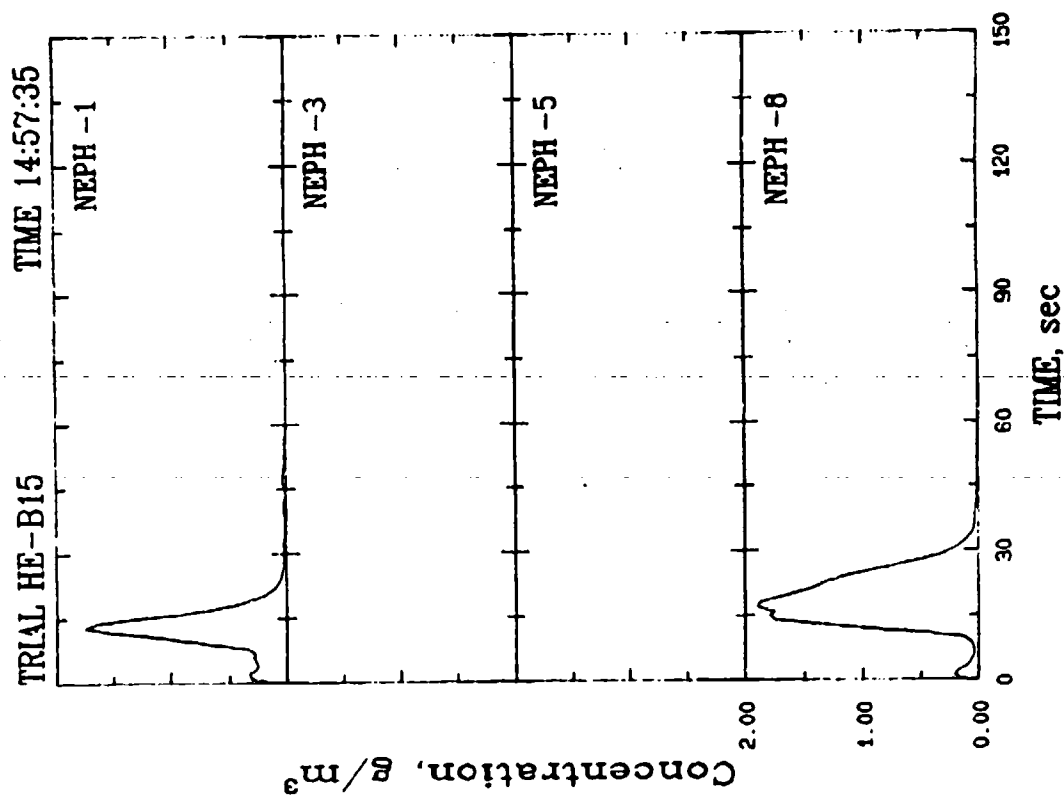
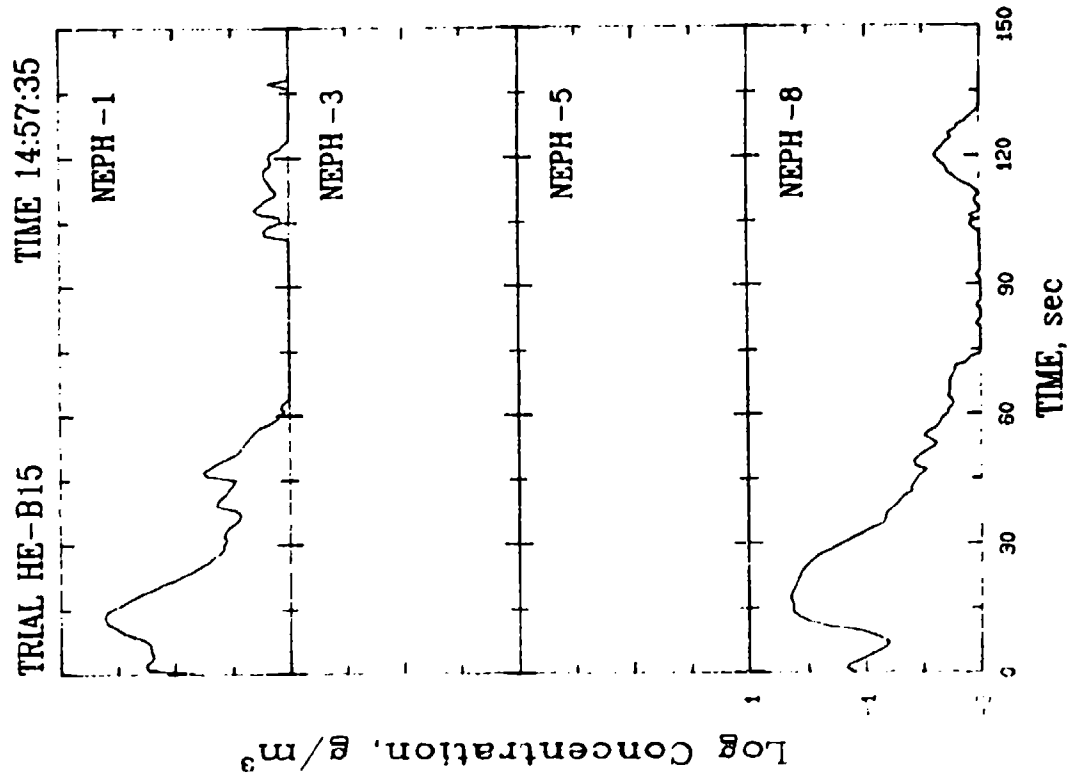
B15 15 LB 1457HR 26APR83 36,6 HB

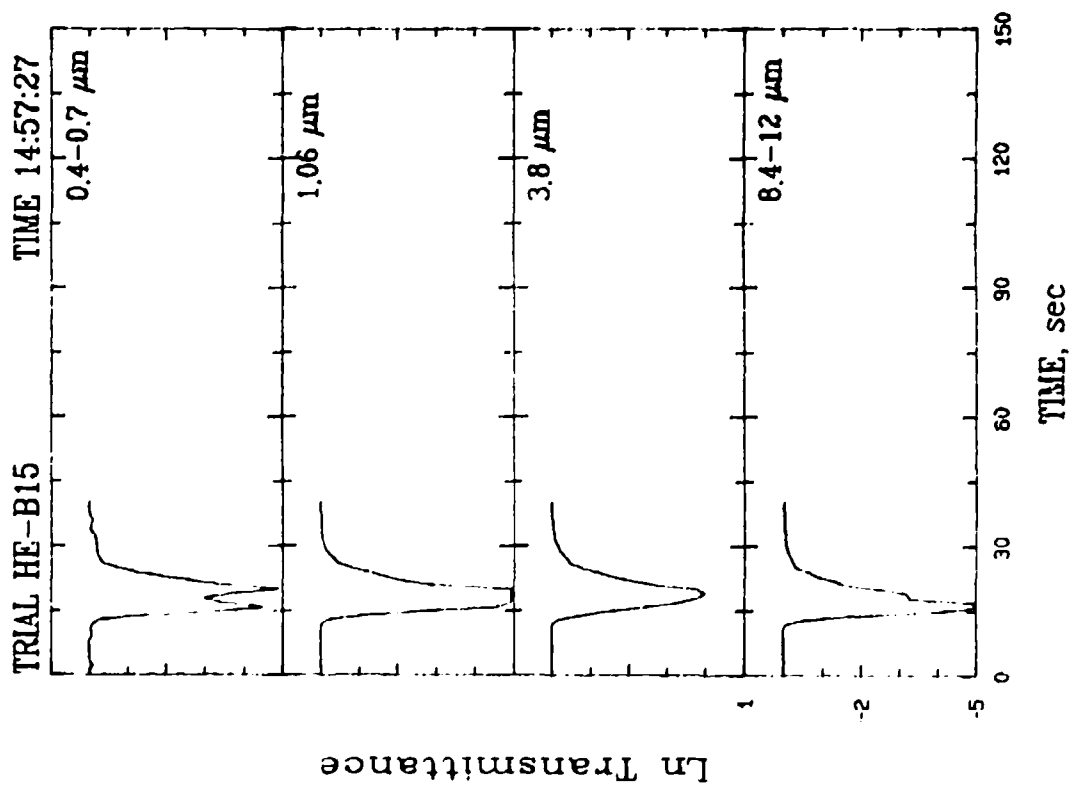
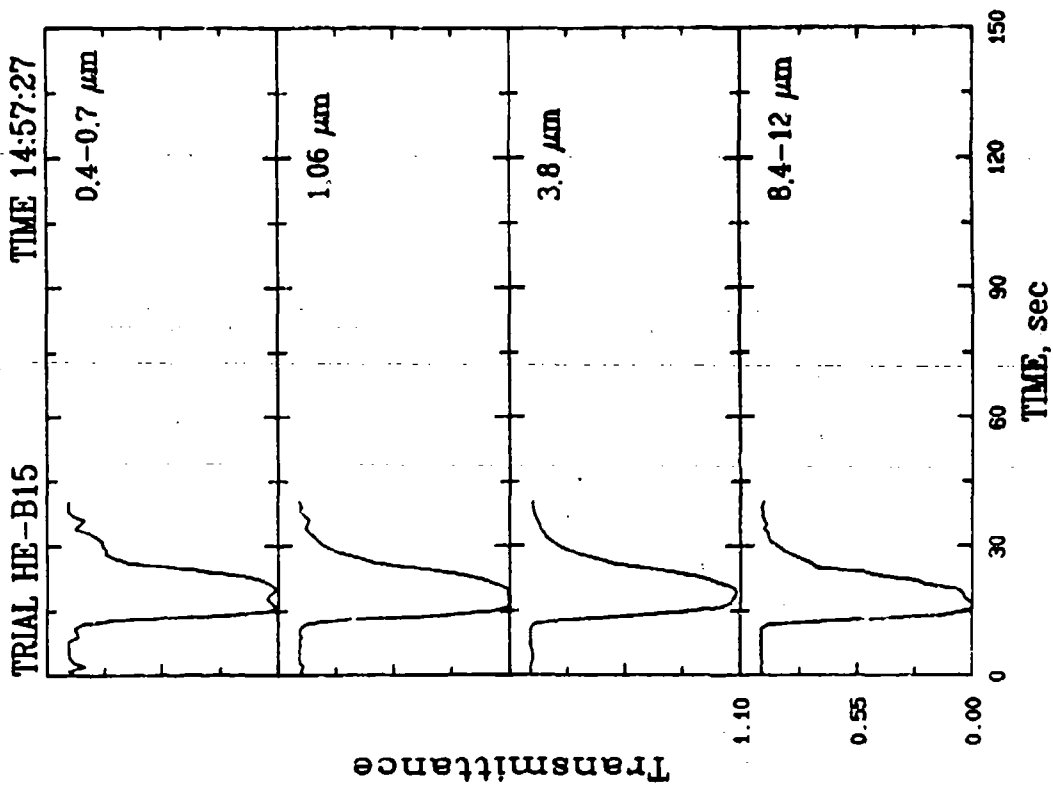


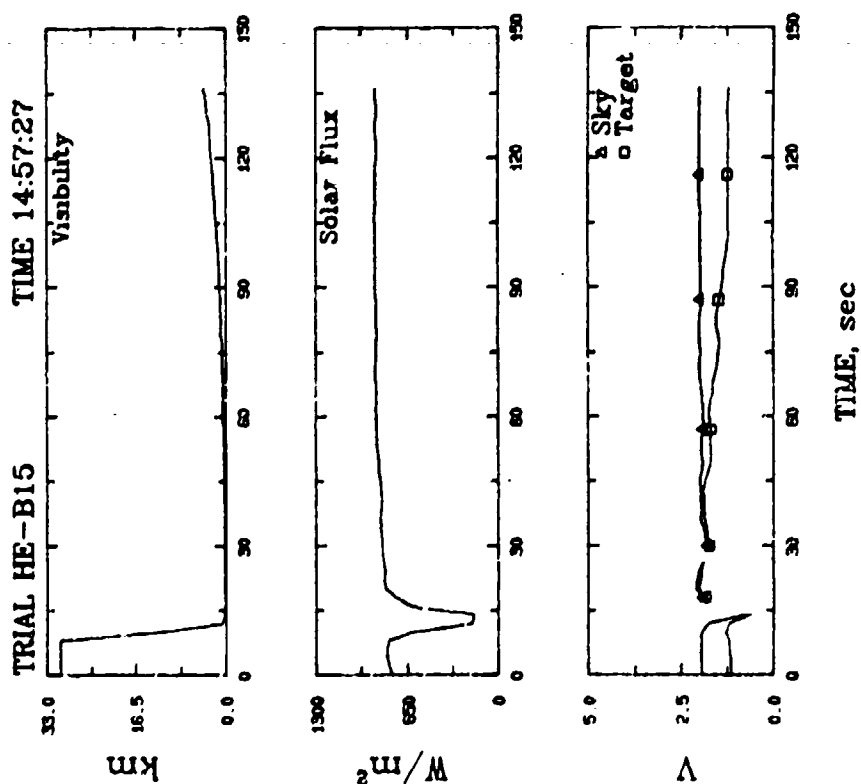
HEB15, 26 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEB16 (3 Charges) Surface Tangent:  
 Date: 26 APRIL 83 Charge Shape: BLOCK  
 Detonation Coordinates (M):  
 X: 44.0 54.8 65.9 Charge Wt: 15.0 LB  
 Y: 10.0 9.4 9.2 Event Time: 16:25:56  
 16:26:01  
 16:26:06

## METEOROLOGICAL DATA:

Pasquill Category: C  
 Richardson Number: -0.243

16 Meter Tower (Veans)  
 Start Time: 16:23:43 End Time: 16:28:18

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 3.03  | 3.26  | 3.33  | 3.65  |
| Wind Dir. (DEG)  | 145.0 | 146.1 | 145.8 | 141.0 |
| Sigma WSP        | 1.34  | 1.51  | 1.50  | 1.69  |
| Sigma WDP        | 11.0  | 9.9   | 10.2  | 13.0  |
| UW Components    |       |       |       |       |
| U (H-S) (M/S)    | 2.49  | 2.72  | 2.79  | 2.92  |
| V (H-W) (M/S)    | -1.63 | -1.71 | -1.74 | -2.03 |
| W (Vert) (M/S)   | 0.09  | 0.22  | 0.03  | •     |
| Sigma U          | 1.28  | 1.44  | 1.45  | 1.74  |
| Sigma V          | 0.67  | 0.71  | 0.68  | 0.72  |
| Sigma W          | 0.12  | 0.20  | 0.25  | •     |
| Temperature (C)  | 16.4  | 15.9  | 15.7  | 15.6  |

Sol: Temperature (C): 25.1 Solar Flux (W/M<sup>2</sup>): 266.2  
 Dew Point (C): -1.5 Visual Range (M): 30480.0  
 Temperature (C): 15.4 Vista Ranger Voltages:  
 Sky: 1.32  
 Target: 0.67  
 Rel. Hum. (%): 31.0  
 Abs. Hum. (G/M<sup>3</sup>): 4.08 Sky-Target Contrast: -0.49  
 Rain Accumulation (MM): 0.00

## CONE INDEX:

|           | X,Y Coord (M) | SPC | 15 | 30 | 45 |
|-----------|---------------|-----|----|----|----|
| Pre-Shot  | 44.0 10.0     | •   | •  | •  | •  |
| Post-Shot | 44.0 10.0     | •   | •  | •  | •  |

## CRATER DATA

Moisture Content: •

## CRATER VOLUMES (M<sup>3</sup>):

True Crater: •  
 Apparent Crater: •  
 Flow: •

## DENSITIES (G/CM<sup>3</sup>):

Pre-Shot: •  
 Flow: •  
 Bottom: •  
 Side: •

## HI VOL DATA (G):

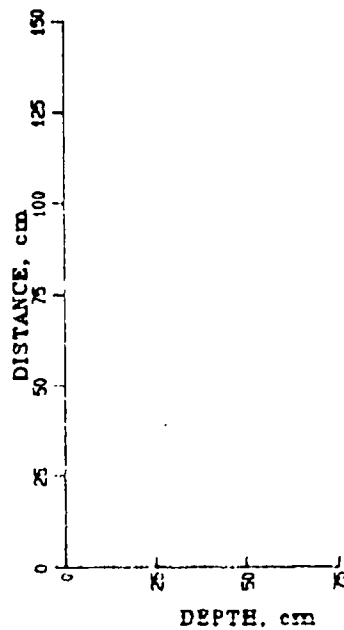
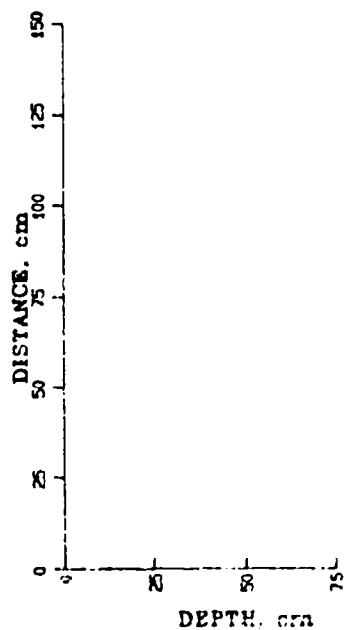
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.4340 | 0.4678 | 0.2088 | 0.0399 | 0.1217 | 0.3024 | 0.2406 | 0.2321 |

SUM: 2.0673

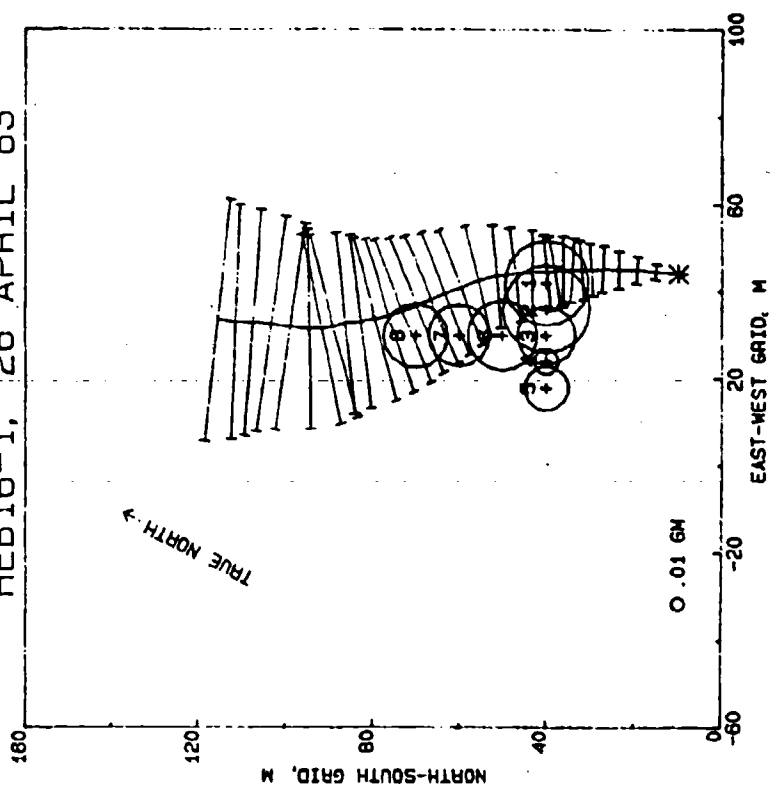
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 152.607  | 27.200   | 29.888   | 8.108    |

NO DATA FOR B16

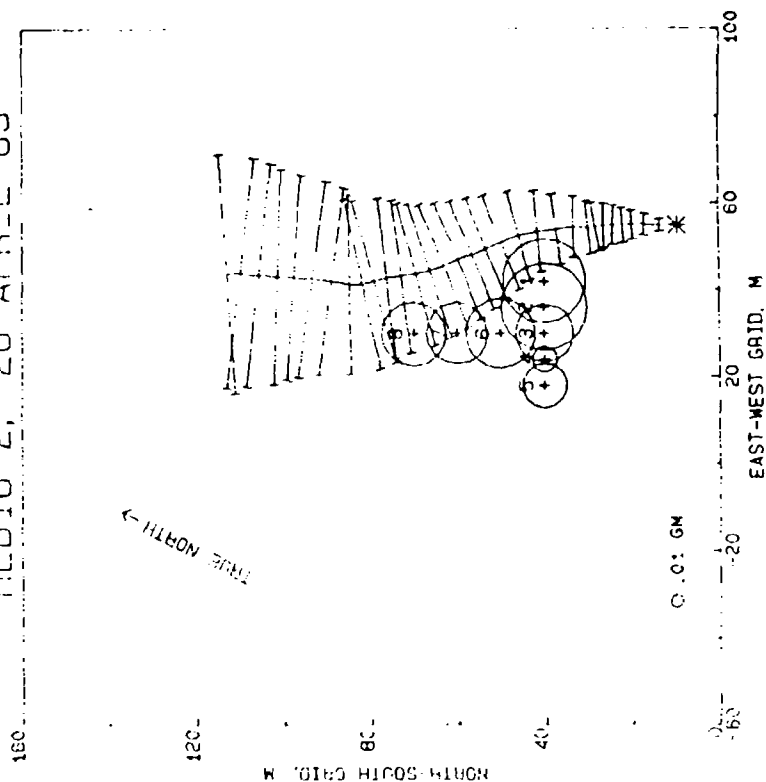


HEB16-1, 26 APRIL 83



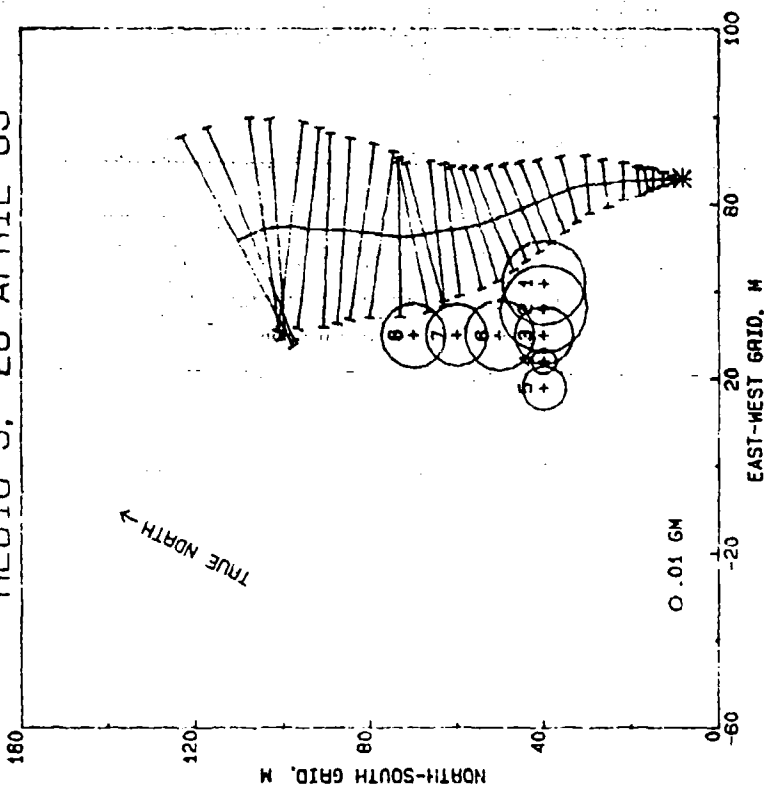
MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS

HEB16-2, 26 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS

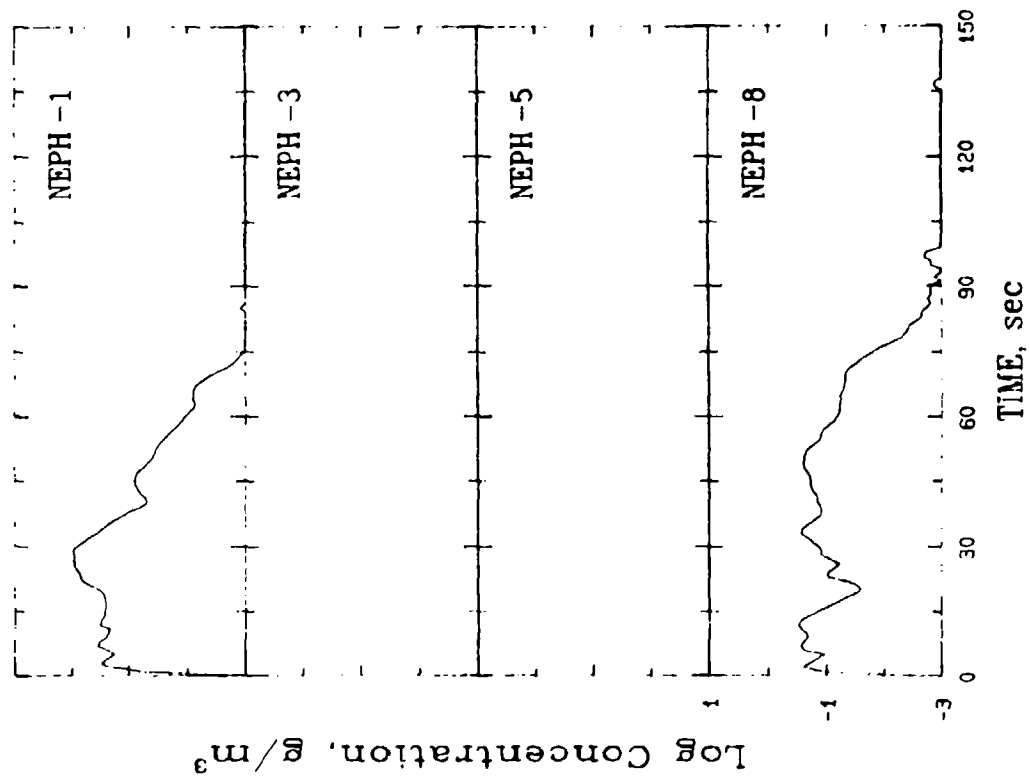
HEB16-3, 26 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS

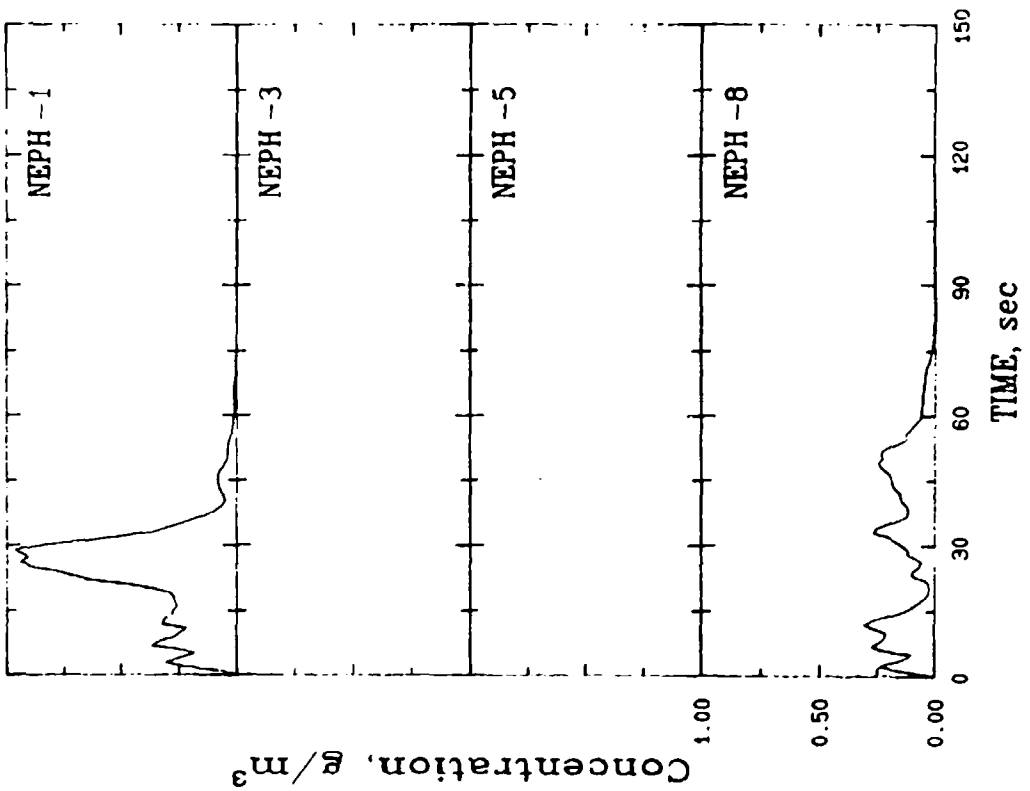
TRIAL HE-B16

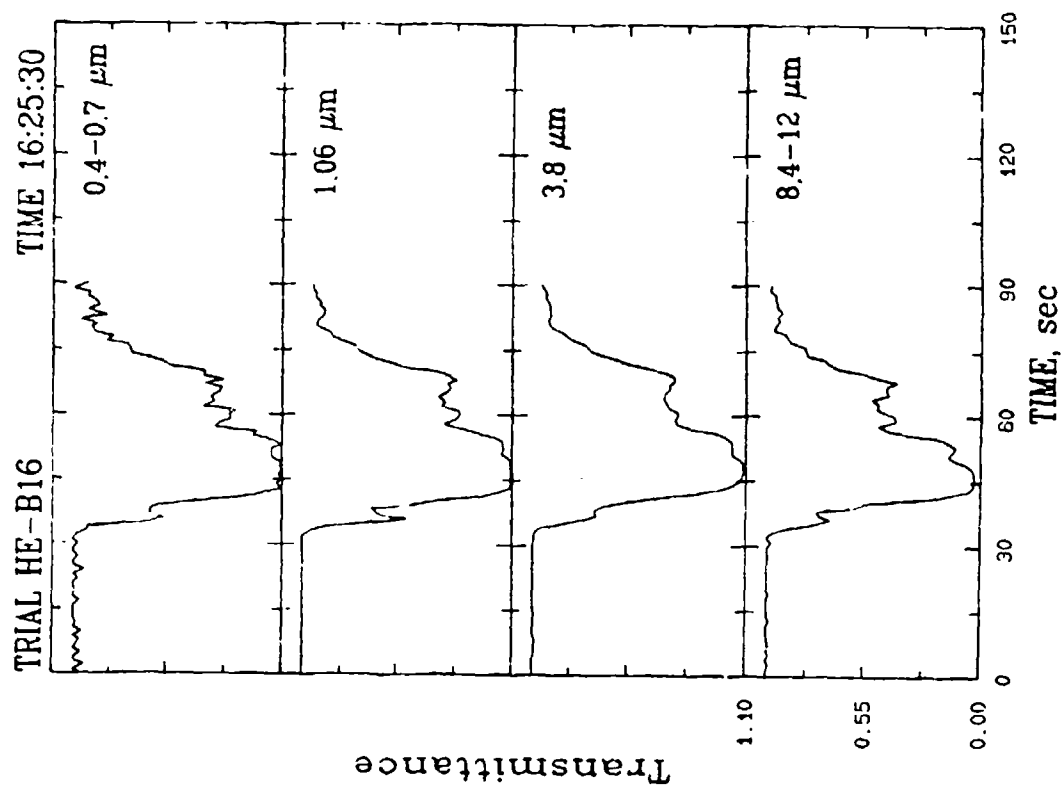
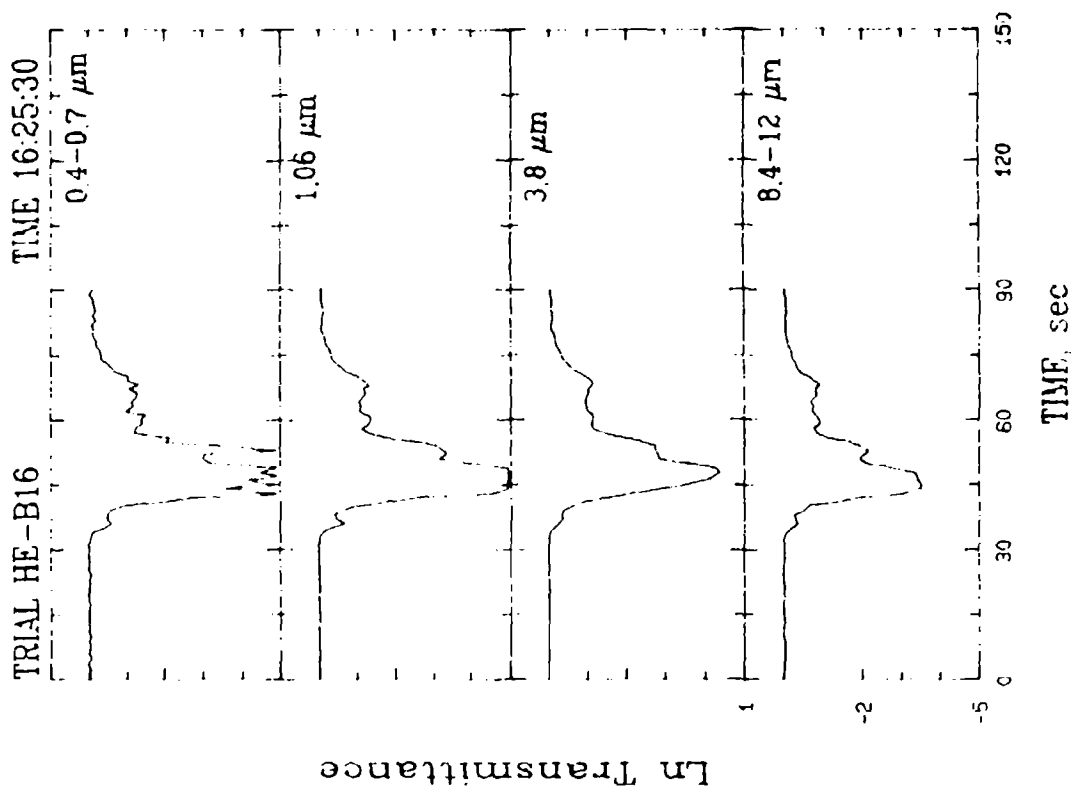
TIME 16:25:55

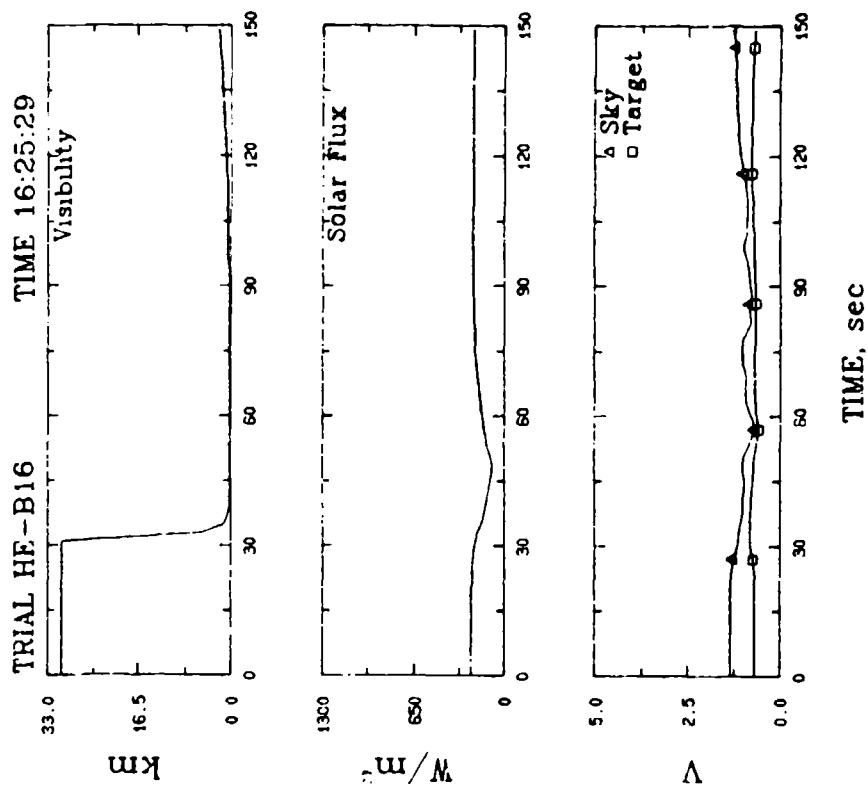


TRIAL HE-B16

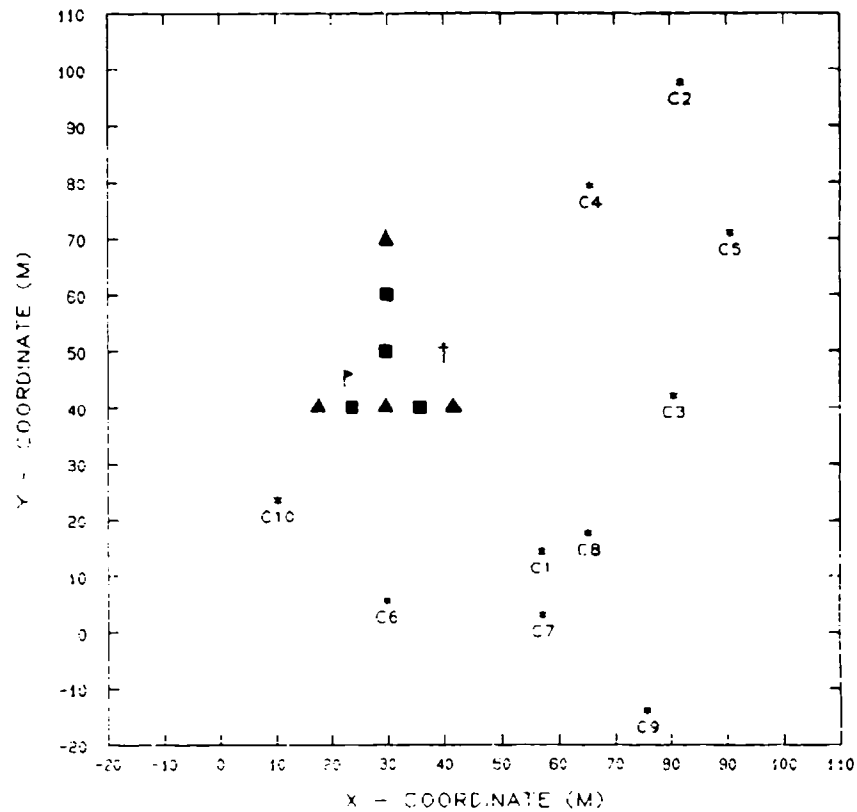
TIME 16:25:55







# APRIL (DOT I) 25 LB SHOTS



- — HI-VOL SAMPLERS
- ▲ — NEPHELOMETER AND HI-VOL SAMPLERS
- — POINT OF BURST FOR 25-LB SHOTS
- — 2-M MET TOWER
- — 4-M MET TOWER

# EVENT SUMMARY DATA

Test Number: JEC1  
 Date: 20 APRIL 93  
 Detonation Coordinates (M):  
 : 57.0  
 : 4  
 Surface Tangent  
 Charge Shape: SPHERICAL  
 Charge Wt: 25.0 LB  
 Event Time: 14:43:01

## METEOROLOGICAL DATA:

Pasquill Category: D  
 Richardson Number: -0.636

15 Meter Tower (Means)  
 Start Time: 14:41:1 End Time: 14:44:57

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 2.81  | 2.90  | 3.09  | 3.44  |
| Wind Dir. (DEG)  | 108.9 | 110.8 | 111.5 | 114.6 |
| Sigma WSP        | 0.73  | 0.87  | 0.94  | 1.17  |
| Sigma WDIR       | 14.2  | 14.0  | 12.4  | 10.7  |
| UNW Components   |       |       |       |       |
| U (N-S) (M/S)    | 0.85  | 0.97  | 1.07  | 1.45  |
| V (E-W) (M/S)    | -2.58 | -2.64 | -2.83 | -3.06 |
| W (Vert) (M/S)   | 0.10  | 0.08  | 0.12  | *     |
| Sigma U          | 0.67  | 0.71  | 0.64  | 0.80  |
| Sigma V          | 0.77  | 0.88  | 0.96  | 1.06  |
| Sigma W          | 0.13  | 0.16  | 0.20  | *     |
| Temperature (C)  | 19.7  | 19.3  | 19.1  | 18.9  |

Soil Temperature (C): 27.8 Solar Flux (W/M<sup>2</sup>): 142.6  
 Dew Point (C): -1.6 Visual Range (M): 30480.0  
 Temperature (C): 18.6 Vista Ranger Voltages:  
 Rel. Hum. (%): 25.0 Sky: 1.60  
 Target: 0.70  
 Abs. Hum. (G/M<sup>3</sup>): 4.00 Sky-Target Contrast: -0.56  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

| X,Y Coord (M) | SPC | 15  | 30  | 45  |
|---------------|-----|-----|-----|-----|
| Pre-Shot      | 50  | 104 | 160 | 260 |
| Post-Shot     | 38  | 118 | 175 | 215 |

## CRATER DATA

Moisture Content: 23.6

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.893  
 Apparent Crater: 0.465  
 Flow: 0.428

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.440  
 Flow: 0.986  
 Bottom: 0.970  
 Side: 1.018

## HI VOL DATA (G):

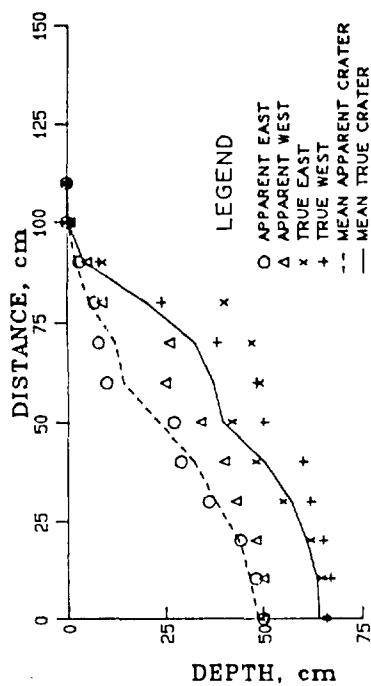
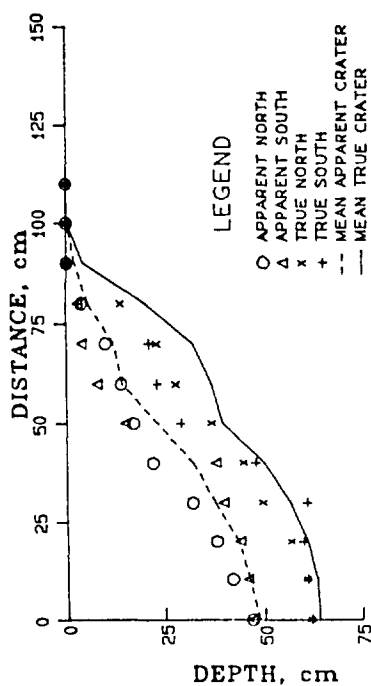
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.7296 | 0.6773 | 0.2279 | 0.0770 | 0.0601 | 0.5893 | 0.4019 | 0.0756 |

SUM: 2.8387

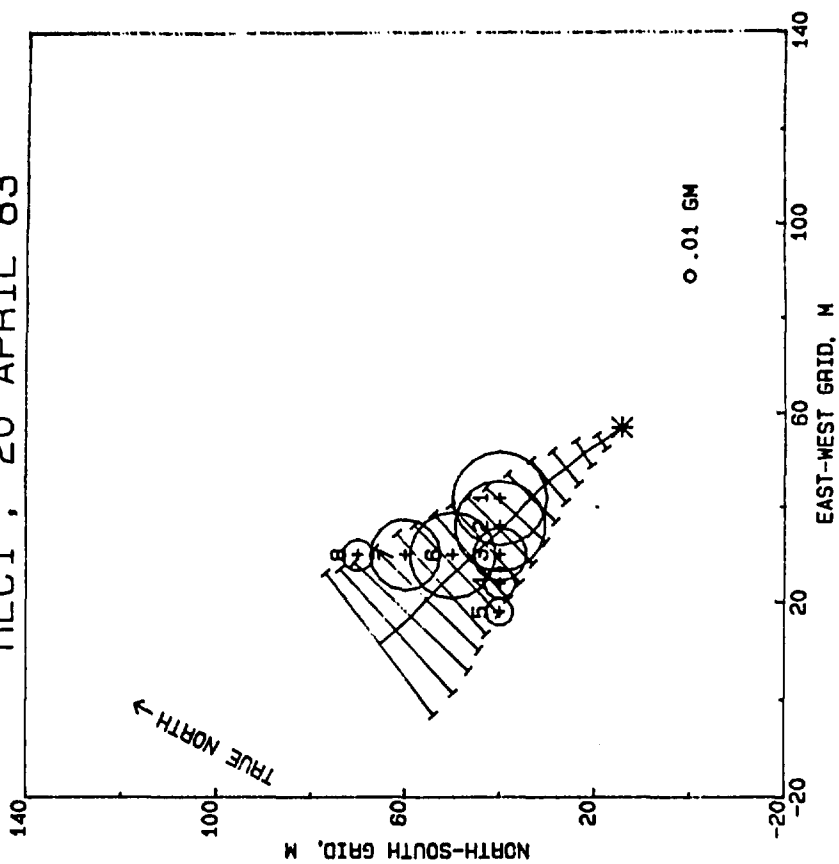
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 50.113   | 46.400   | 41.843   | 8.108    |

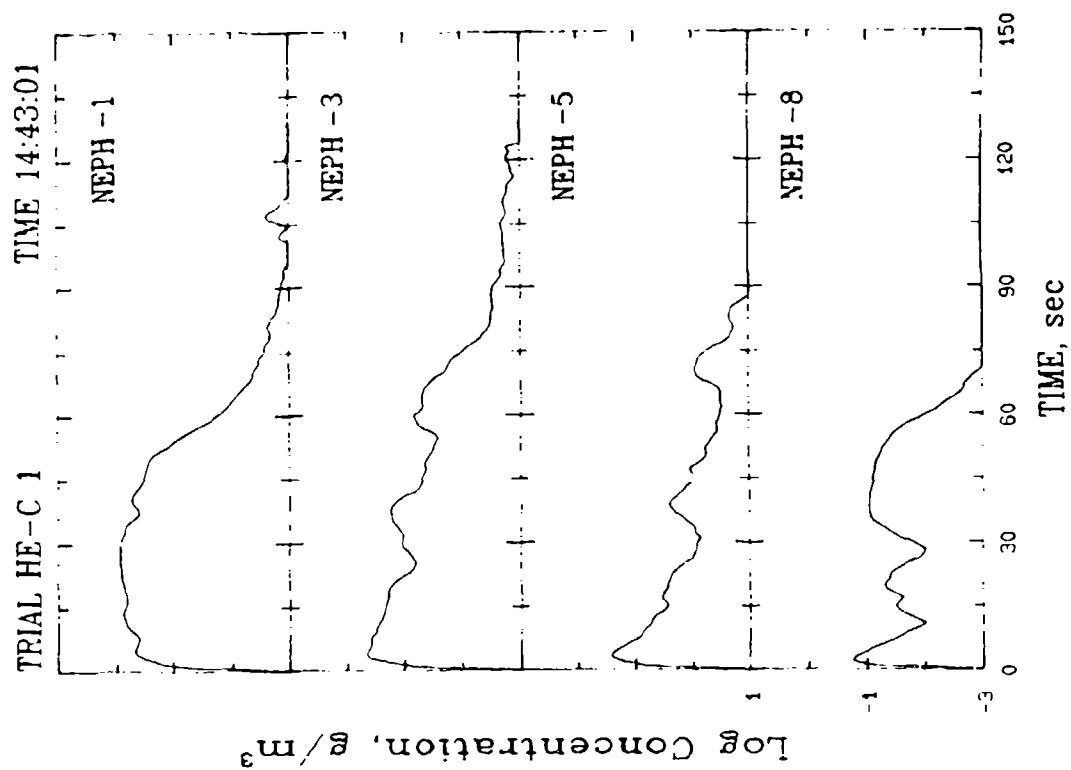
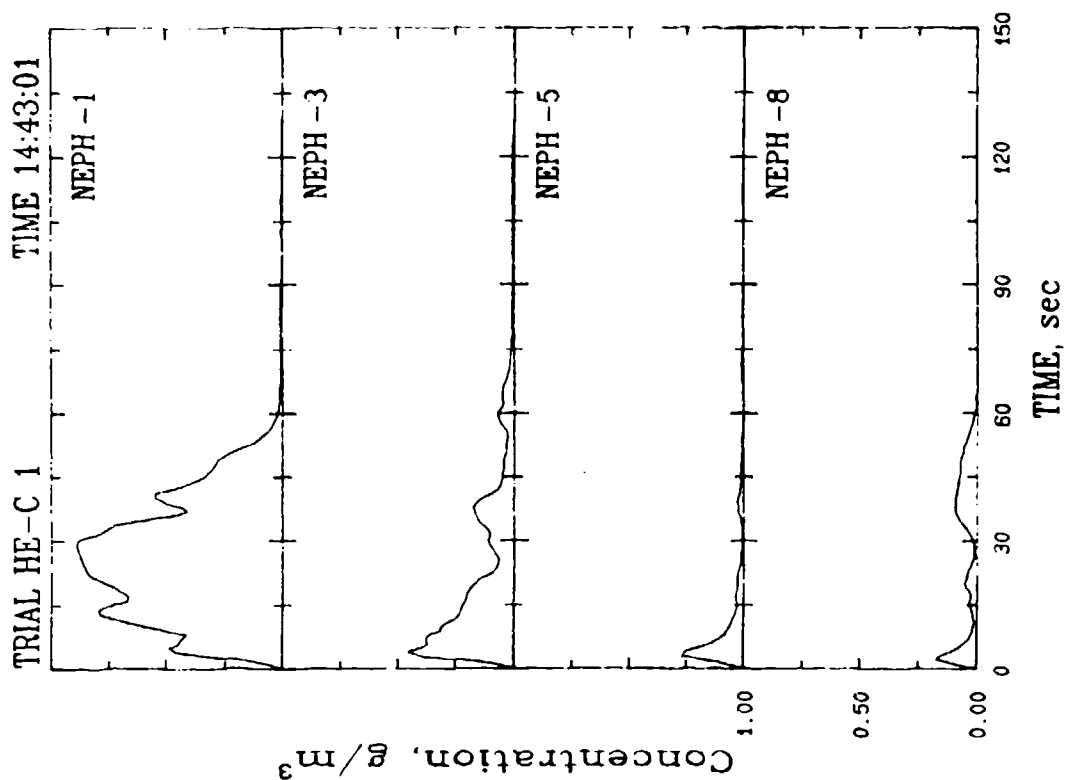
C1 25LB 1443HR 20APR83 60,20

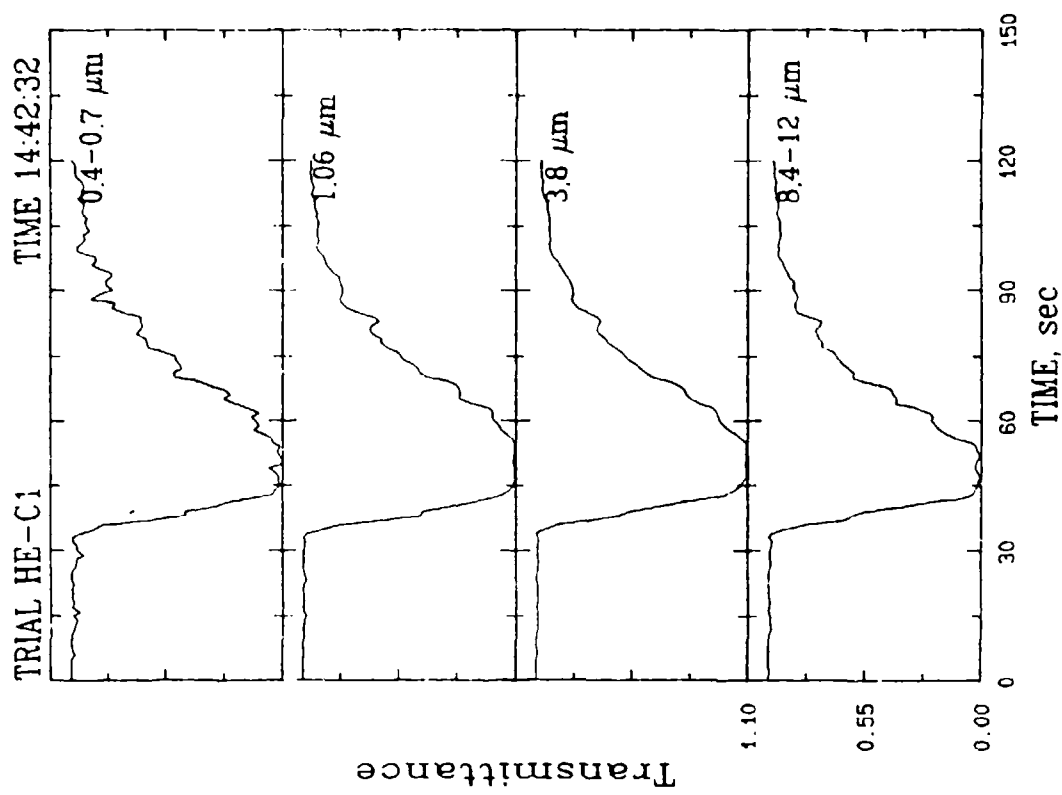
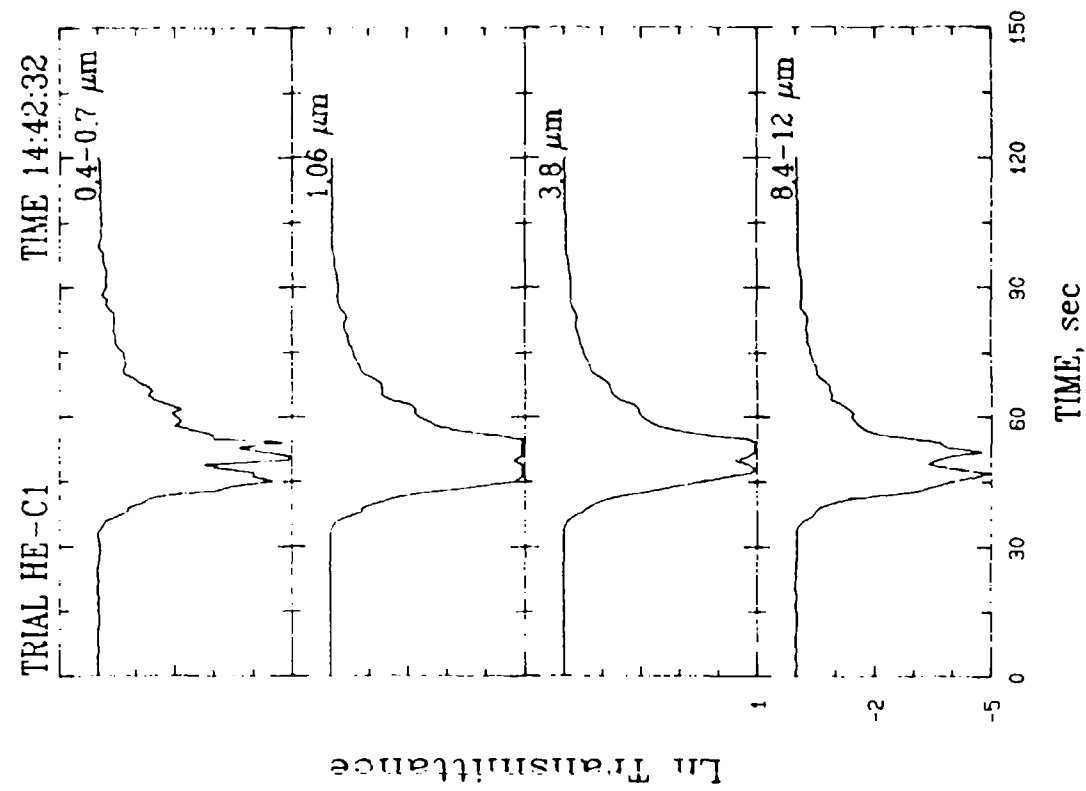


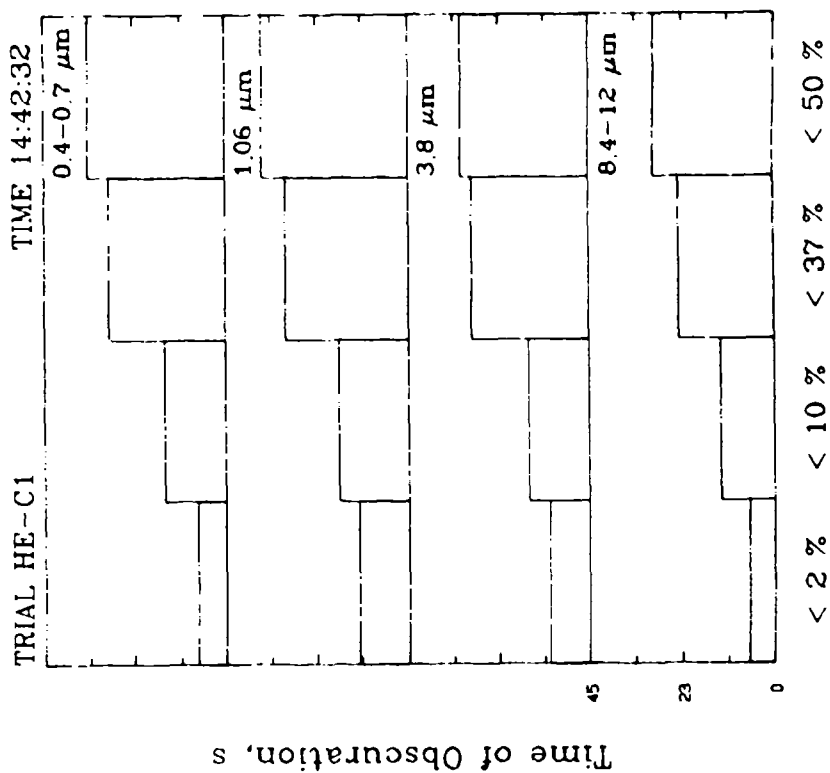
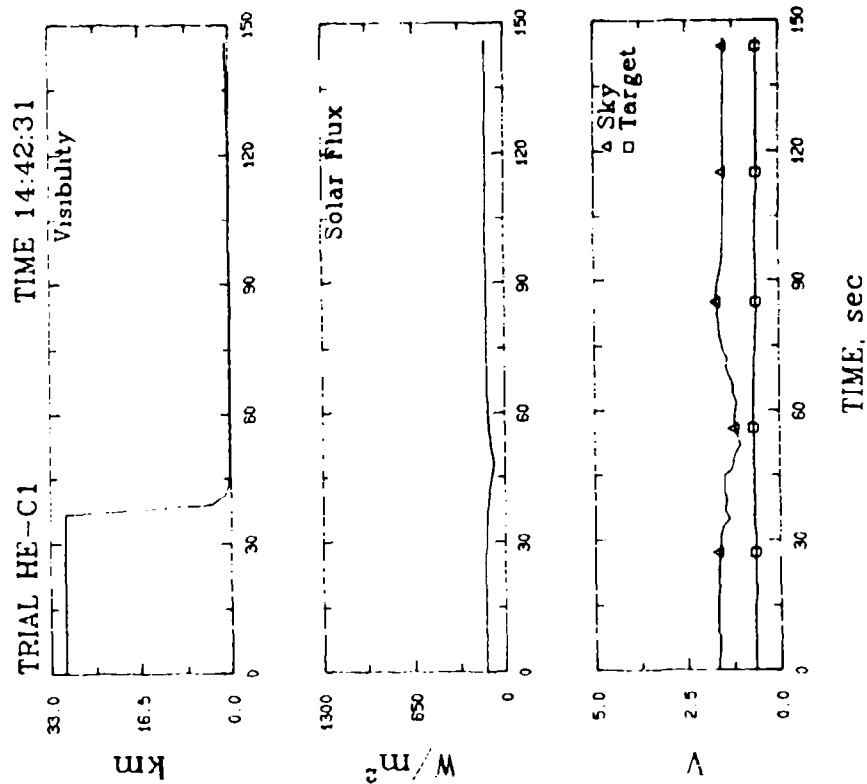
HEC1, 20 APRIL 83



MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEC2  
 Date: 21 APRIL 83  
 Detonation Coordinates (M):  
 X: 81.7  
 Y: 97.7  
 Surface Tangent  
 Charge Shape: BLOCK  
 Charge Wt: 25.0 LB  
 Event Time: 14:27:45

## METEOROLOGICAL DATA:

Pasquill Category: B  
 Richardson Number: -0.858

16 Meter Tower (Means)  
 Start Time: 14:26:37  
 End Time: 14:29:48

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 4.43  | 4.83  | 4.96  | 5.56  |
| Wind Dir. (DEG)  | 55.7  | 52.8  | 56.7  | 53.4  |
| Sigma WSP        | 0.88  | 0.87  | 0.94  | 0.91  |
| Sigma WDIR       | 14.1  | 12.8  | 12.6  | 14.7  |
| UVW Components   |       |       |       |       |
| U (N-S) (M/S)    | -2.37 | -2.82 | -2.62 | -3.25 |
| V (E-W) (M/S)    | -3.60 | -3.78 | -4.08 | -4.29 |
| W (Vert) (M/S)   | 0.39  | 0.16  | 0.62  | *     |
| Sigma U          | 0.85  | 0.90  | 0.88  | 1.35  |
| Sigma V          | 1.07  | 1.00  | 1.09  | 0.96  |
| Sigma W          | 0.24  | 0.34  | 0.37  | *     |
| Temperature (C)  | 19.1  | 18.4  | 18.0  | 17.5  |

Soil Temperature (C): 27.2  
 Dew Point (C): 1.1  
 Temperature (C): 18.3  
 Rel. Hum. (%): 31.6  
 Abs. Hum. (G/M\*\*3): 4.95  
 Rain Accumulation (MM): 0.00  
 Solar Flux (W/M\*\*2): 756.4  
 Visual Range (M): 30480.0  
 Vista Ranger Voltages:  
 Sky: 1.95  
 Target: 0.80  
 Sky-Target Contrast: -0.59

# CONE INDEX:

|           | X, Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|----------------|-----|-----|-----|-----|
| Pre-Shot  | 83.0 98.0      | *   | *   | *   | *   |
| Post-Shot | 83.0 98.0      | 25  | 138 | 163 | 167 |

## CRATER DATA

Moisture Content: 11.2

## CRATER VOLUMES (M\*\*3):

True Crater: 1.350  
 Apparent Crater: 0.440  
 Flow: 0.910

DENSITIES (G/CM\*\*3):  
 Pre-Shot: 1.840  
 Flow: 0.958  
 Bottom: 1.056  
 Side: 0.860

## HI VOL DATA (G):

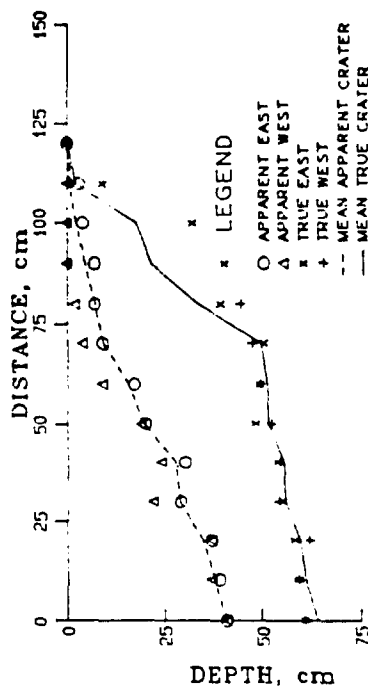
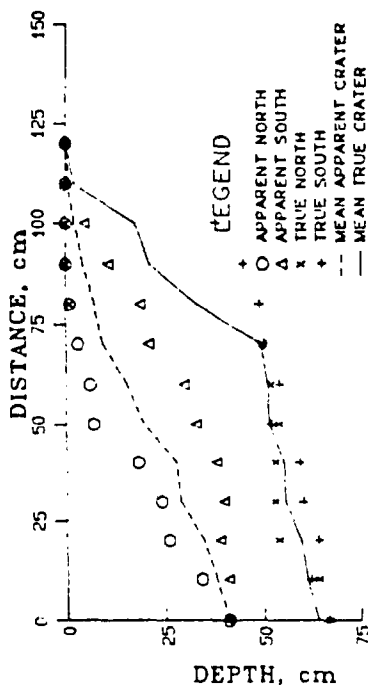
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0218 | 0.0344 | 0.0438 | 0.0042 | 0.0256 | 0.0362 | 0.0196 | 0.0138 |

SUM: 0.1994

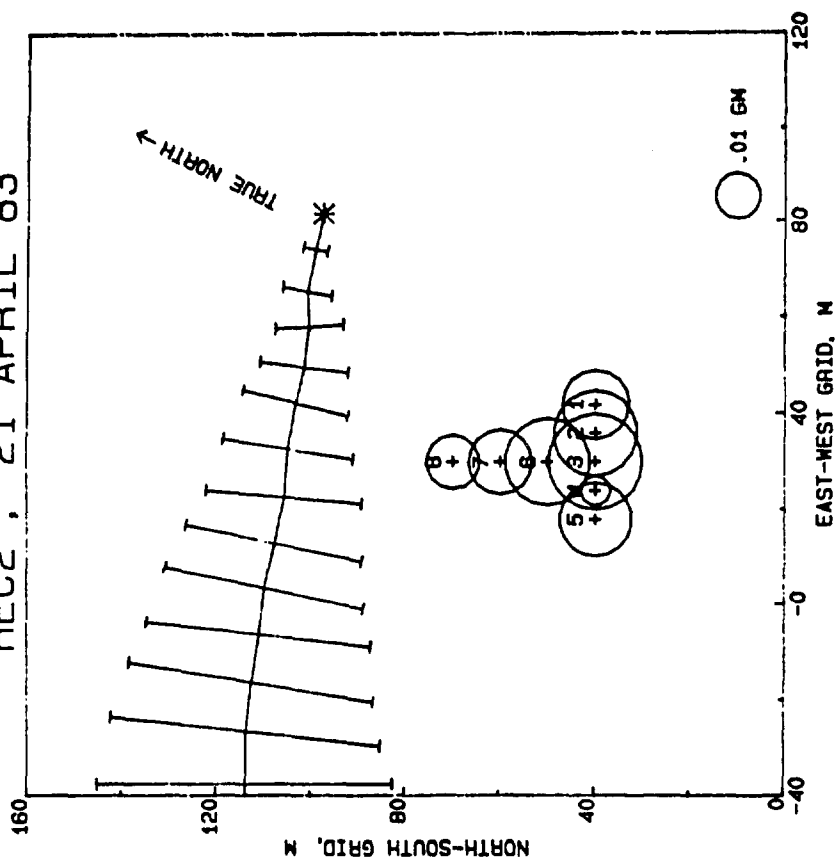
## GELMAN DOSAGE (G S/M\*\*3):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 0.000    | 0.000    | 0.000    | 0.000    |

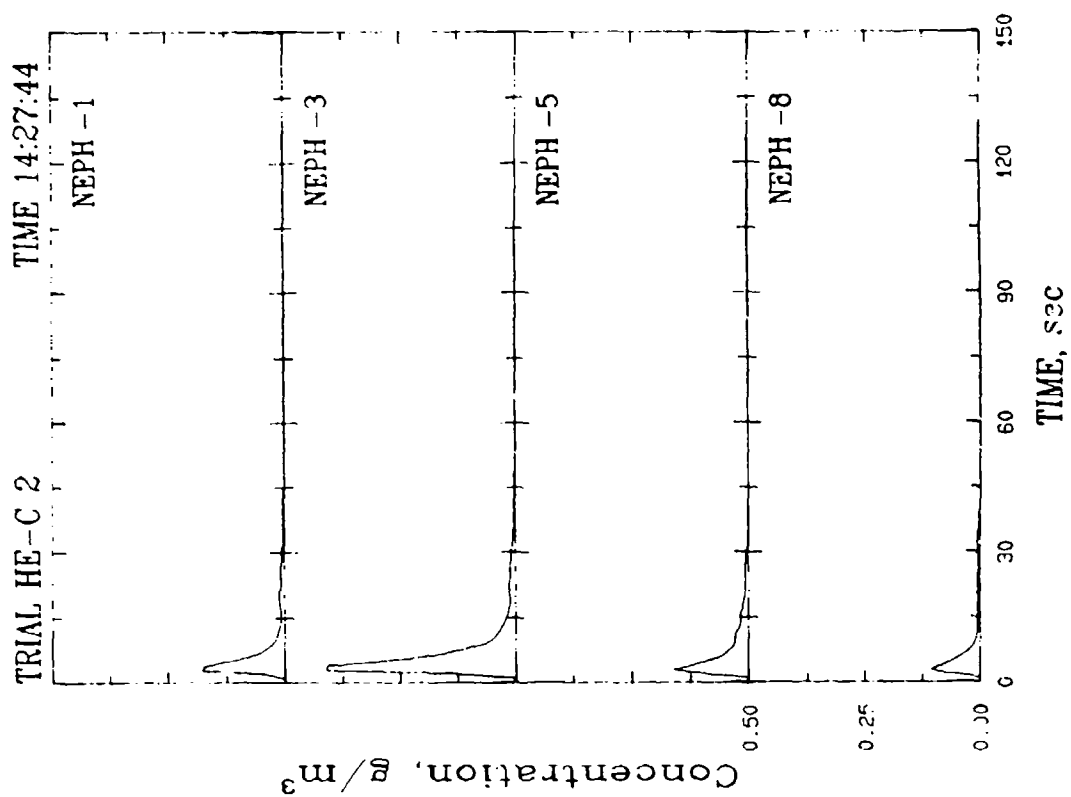
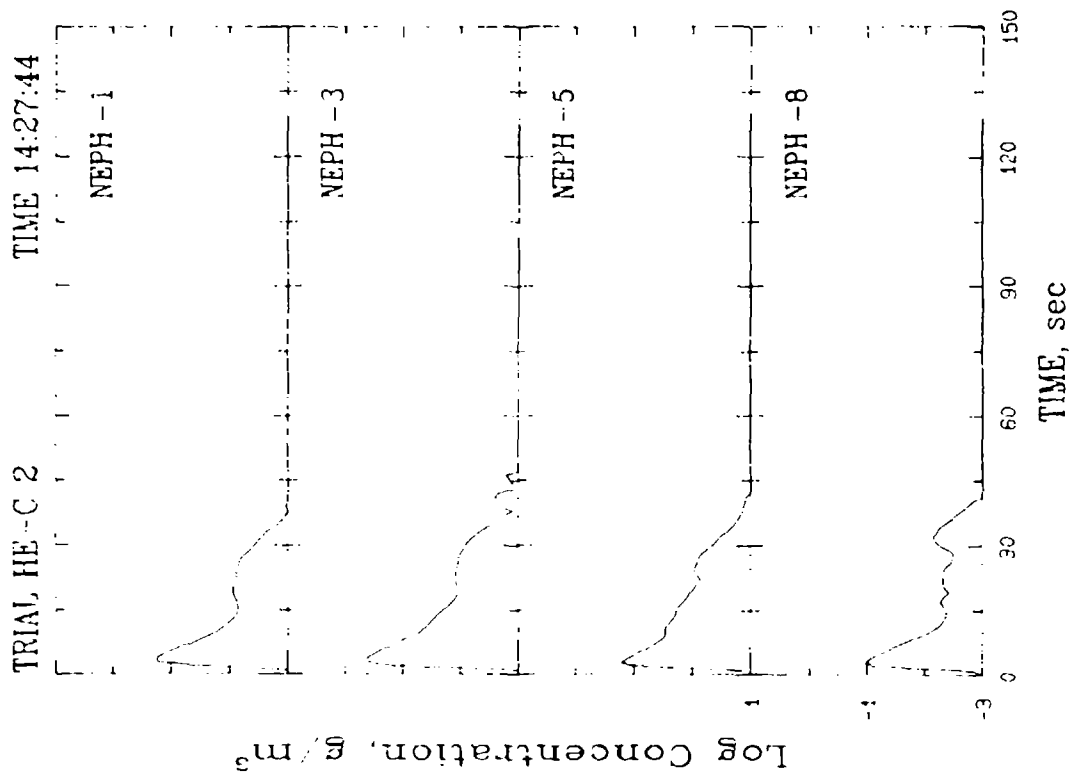
C2 25LB 1427HR 21APR83 83,98

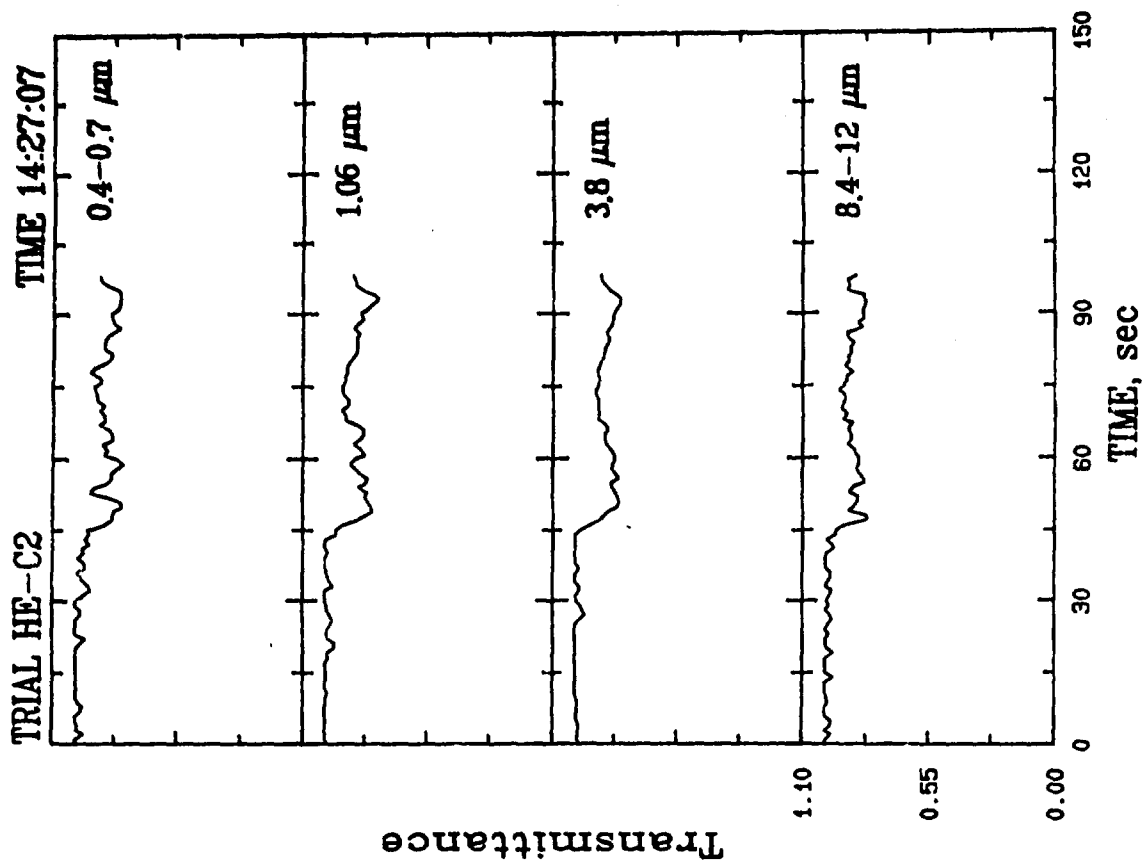
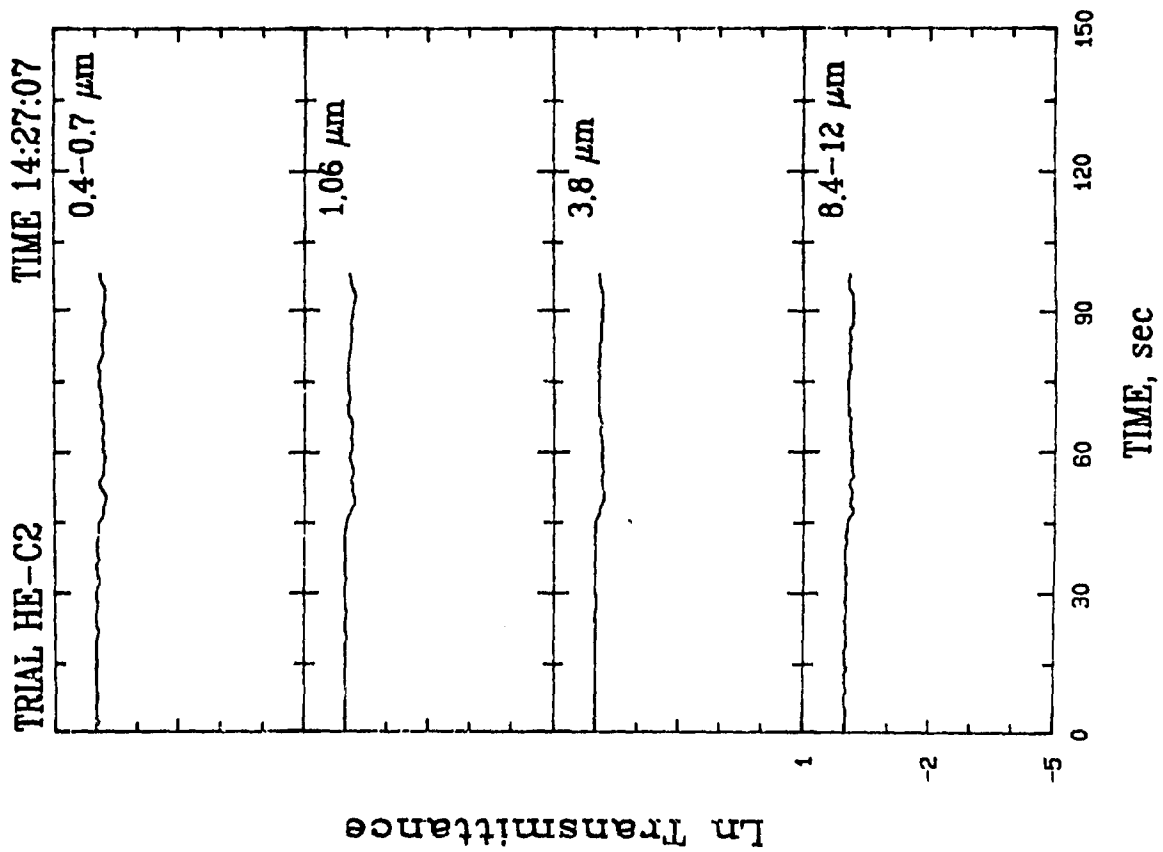


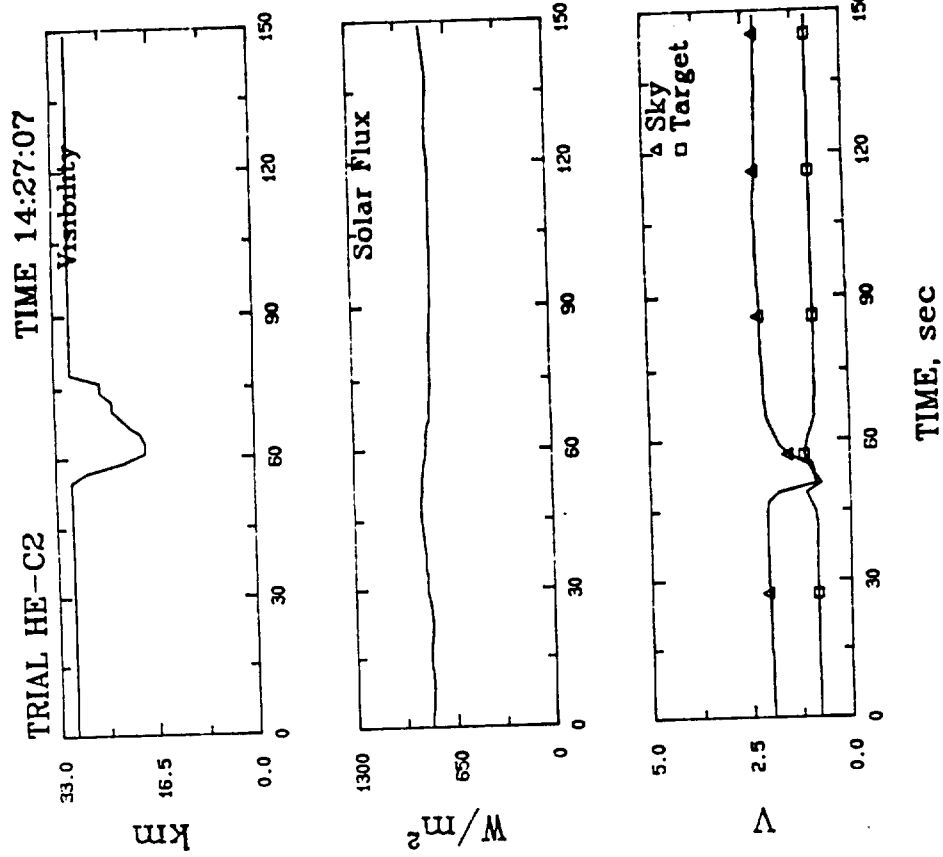
HEC2 . 21 APRIL 83



MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEC3  
 Date: 21 APRIL 83  
 Detonation Coordinates (M):  
 X: 80.6  
 Y: 42.1  
 Surface Tangent  
 Charge Shape: BLOCK  
 Charge Wt: 25.0 LB  
 Event Time: 15:23:00

## METEOROLOGICAL DATA:

Pasquill Category: D  
 Richardson Number: -0.051

16 Meter Tower (Means)  
 Start Time: 15:21:37 End Time: 15:25: 1

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 5.91  | 6.64  | 7.06  | 7.95  |
| Wind Dir. (DEG)  | 70.3  | 67.2  | 69.8  | 67.0  |
| Sigma WSP        | 0.96  | 1.03  | 1.12  | 0.95  |
| Sigma WDIR       | 6.2   | 5.5   | 5.7   | 5.3   |
| UVW Components   |       |       |       |       |
| U (N-S) (M/S)    | -1.96 | -2.54 | -2.41 | -3.08 |
| V (E-W) (M/S)    | -5.54 | -6.10 | -6.60 | -7.29 |
| W (Vert) (M/S)   | 0.52  | 0.09  | 0.65  | 0.73  |
| Sigma U          | 0.63  | 0.65  | 0.72  | 0.73  |
| Sigma V          | 0.96  | 1.02  | 1.11  | 0.96  |
| Sigma W          | 0.21  | 0.25  | 0.26  | 0.26  |
| Temperature (C)  | 17.9  | 17.6  | 17.4  | 17.1  |

Soil Temperature (C): 25.5 Solar Flux (W/M<sup>2</sup>): 195.4  
 Dew Point (C): 0.9 Visual Range (M): 30480.0  
 Temperature (C): 17.2 Vista Ranger Voltages:  
 Rel. Hum. (%): 33.2 Sky: 1.16  
 Target: 0.68  
 Abs. Hum. (G/M<sup>3</sup>): 4.88 Sky-Target Contrast: -0.41  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X, Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|----------------|-----|-----|-----|-----|
| Pre-Shot  | 80.0 47.0      | 25  | 203 | 372 | 567 |
| Post-Shot | 80.0 47.0      | 25  | 142 | 205 | 310 |

## CRATER DATA

Moisture Content: 12.8

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 1.139  
 Apparent Crater: 0.510  
 Flow: 0.629

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.260  
 Flow: 1.046  
 Bottom: 1.016  
 Side: 1.075

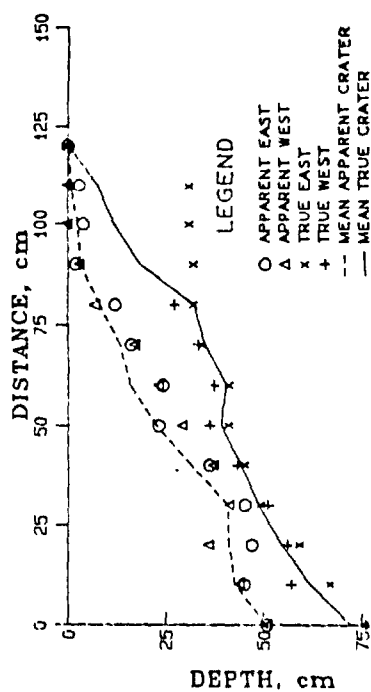
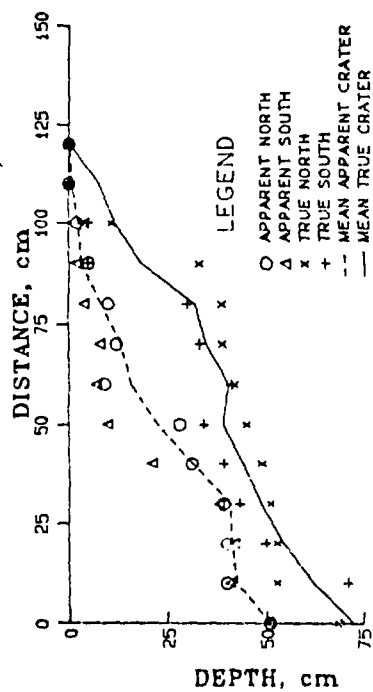
## HI VOL DATA (G):

|      | HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|------|--------|--------|--------|--------|--------|--------|--------|--------|
|      | 0.5066 | 0.2522 | 0.4886 | 0.3970 | 0.4908 | 0.2299 | 0.0543 | 0.0122 |
| SUM: | 2.4316 |        |        |        |        |        |        |        |

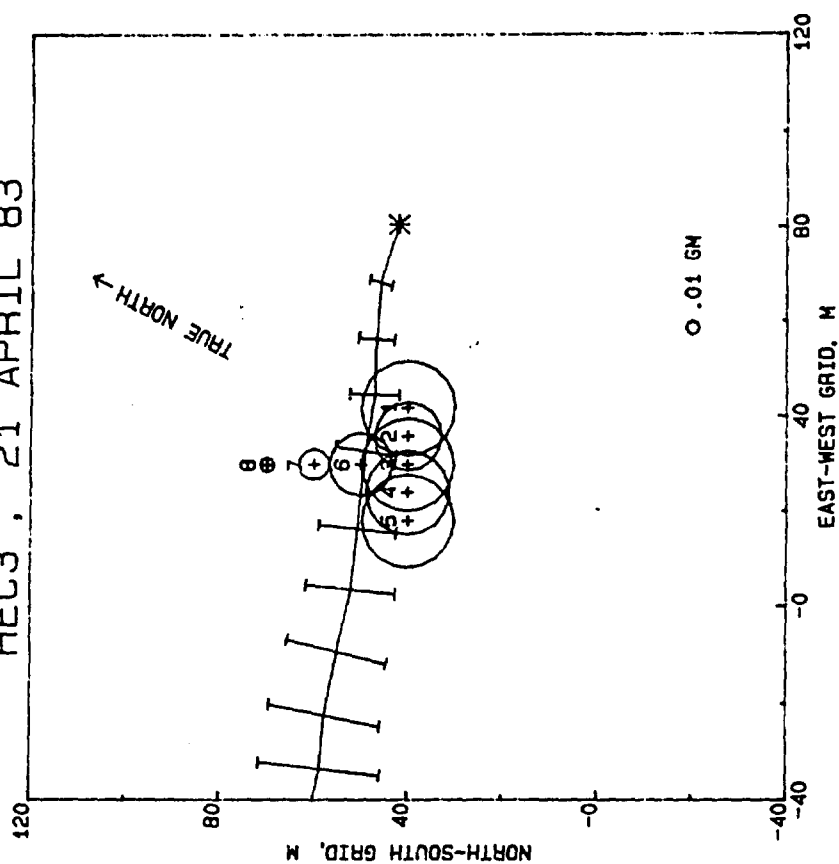
## GELMAN DOSAGE (G S/M<sup>3</sup>):

|  | GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|--|----------|----------|----------|----------|
|  | 10.427   | 145.600  | 132.254  | 47.027   |

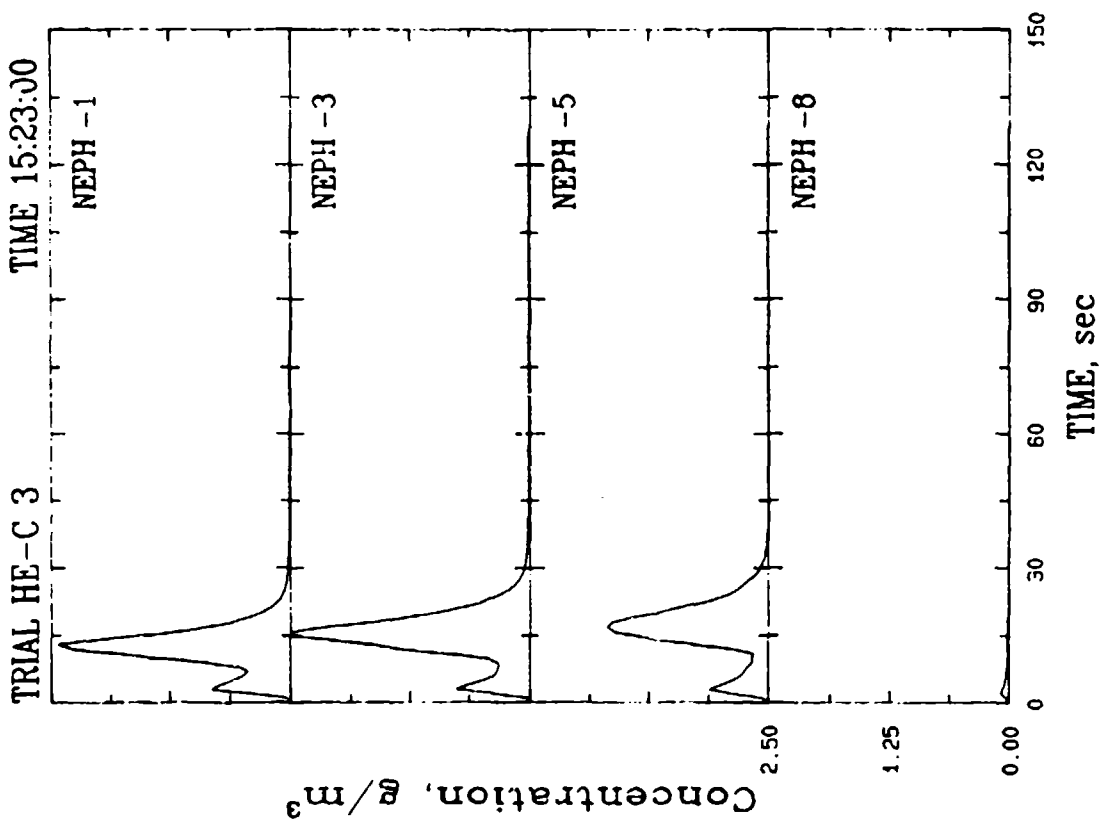
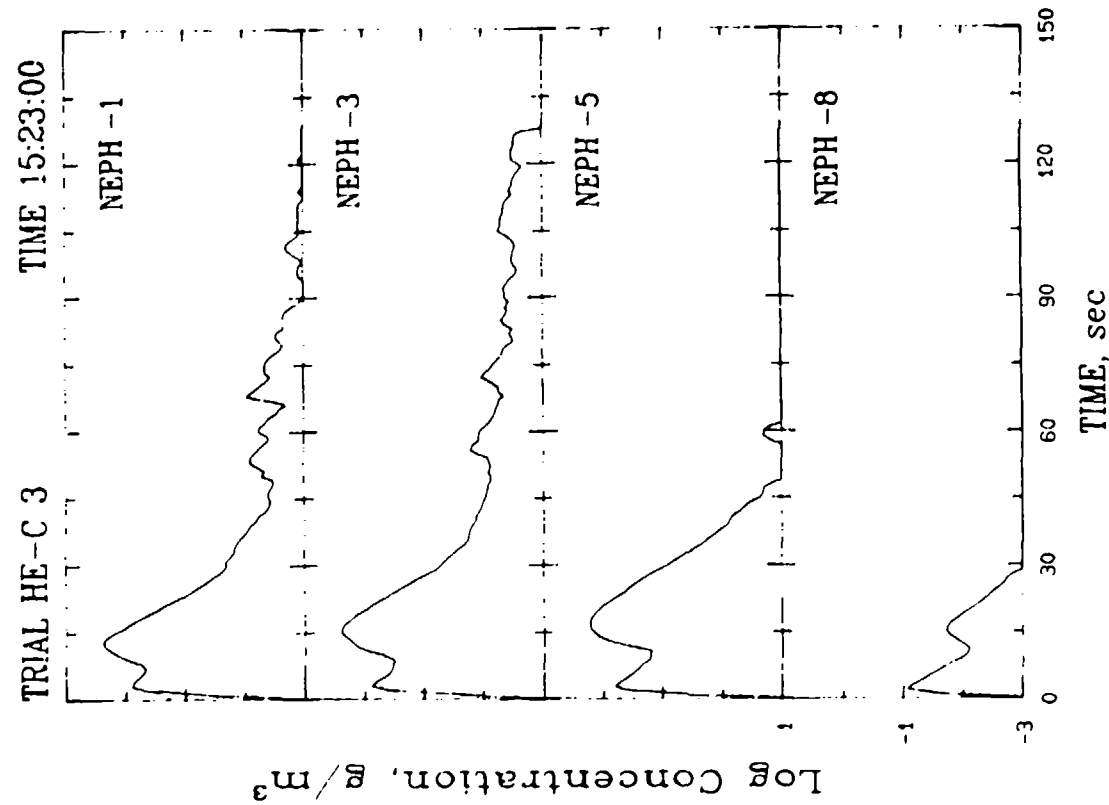
C3 25LB 1523HR 21APR83 80,47

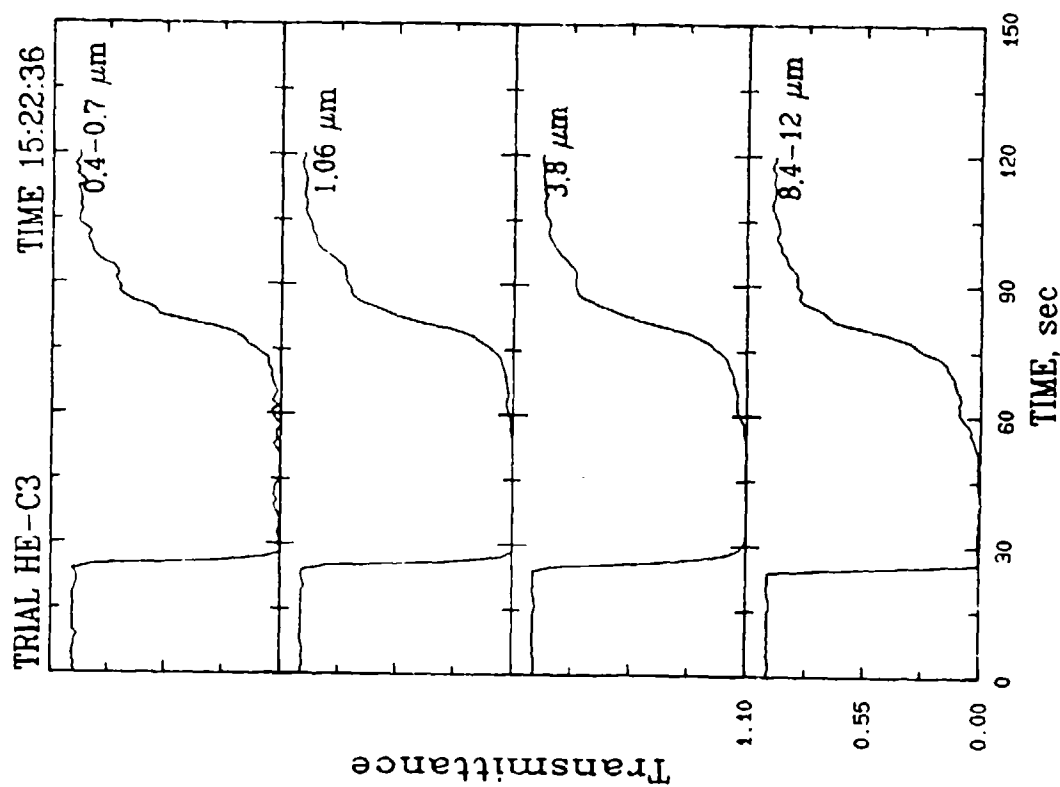
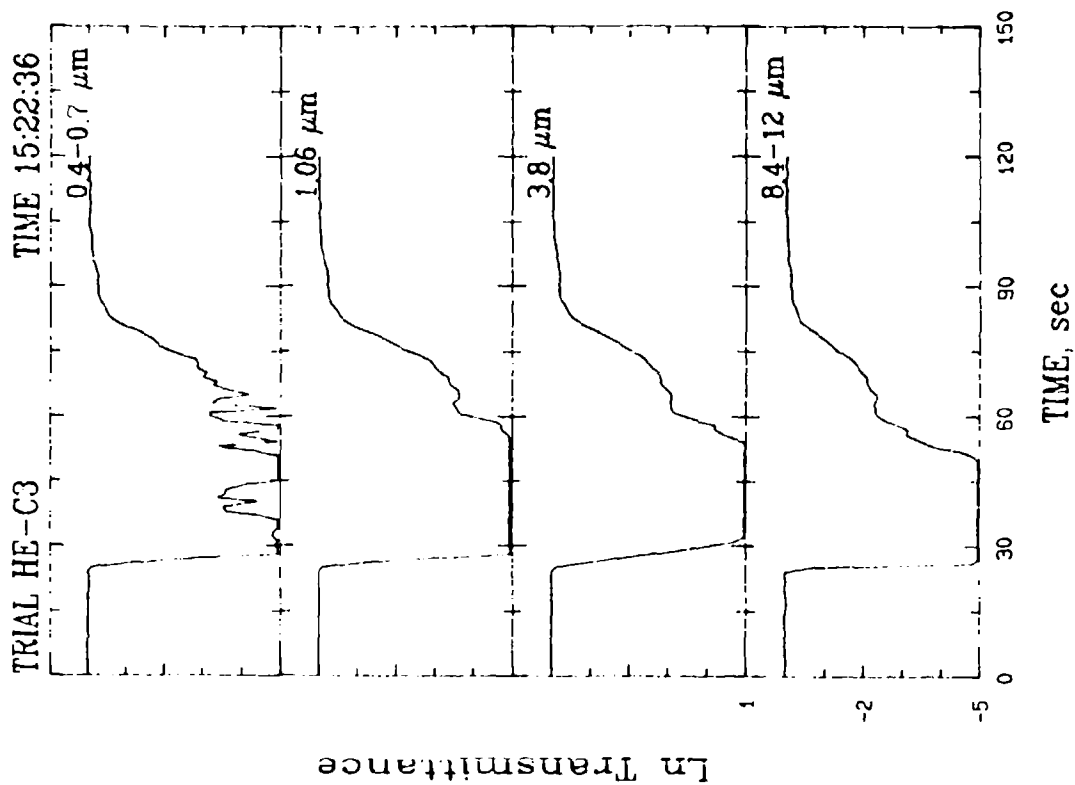


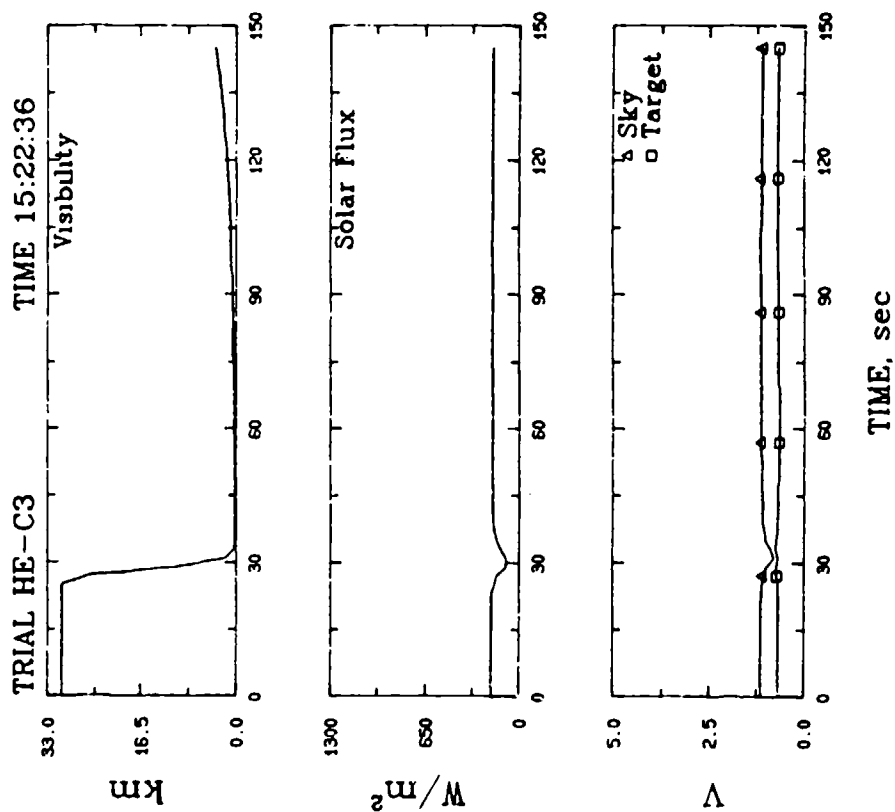
HEC3, 21 APRIL 83



MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEC4  
 Date: 22 APRIL 83  
 Detonation Coordinates (M):  
 X: 65.7  
 Y: 79.3  
 Surface Tangent  
 Charge Shape: BLOCK  
 Charge Wt: 25.0 LB  
 Event Time: 12:57:01

## METEOROLOGICAL DATA:

Paraboli Category: D  
 Richardson Number: -0.036

16 Meter Tower (Means)  
 Start Time: 12:55:43 End Time: 12:59: 1

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 7.02  | 8.07  | 8.06  | 9.31  |
| Wind Dir. (DEG)  | 24.9  | 23.5  | 25.8  | 23.0  |
| Sigma WSP        | 0.99  | 1.03  | 1.03  | 1.14  |
| Sigma WDIR       | 8.8   | 8.3   | 8.8   | 8.5   |
| BVM Components   |       |       |       |       |
| U (N-S) (M/S)    | -6.30 | -7.35 | -7.19 | -8.50 |
| V (E-W) (M/S)    | -2.89 | -3.11 | -3.43 | -3.55 |
| W (Vert) (M/S)   | 0.45  | -0.05 | 0.68  | .     |
| Sigma U          | 1.09  | 1.15  | 1.16  | 1.30  |
| Sigma V          | 0.97  | 1.07  | 1.11  | 1.20  |
| Sigma W          | 0.23  | 0.32  | 0.36  | .     |
| Temperature (C)  | 12.6  | 12.3  | 12.1  | 11.9  |

Soil Temperature (C): 14.5 Solar Flux (W/M\*\*2): 414.8  
 Dew Point (C): 1.8 Visual Range (M): 30480.0  
 Temperature (C): 11.9 Vista Ranger Voltages:  
 Rel. Hum. (%): 50.0 Sky: 1.16  
 Target: 0.83  
 Abs. Hum. (G/M\*\*3): 5.32 Sky-Target Contrast: -0.29  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 65.0 79.0     | 153 | 263 | 463 | 550 |
| Post-Shot | 65.0 79.0     | 25  | 70  | 80  | 150 |

## CRATER DATA

Moisture Content: 13.5

CRATER VOLUMES (M\*\*3):  
 True Crater: 0.800  
 Apparent Crater: 0.310  
 Flow: 0.490

DENSITIES (G/CM\*\*3):  
 Pre-Shot: 1.360  
 Flow: 1.131  
 Bottom: 1.167  
 Side: 1.095

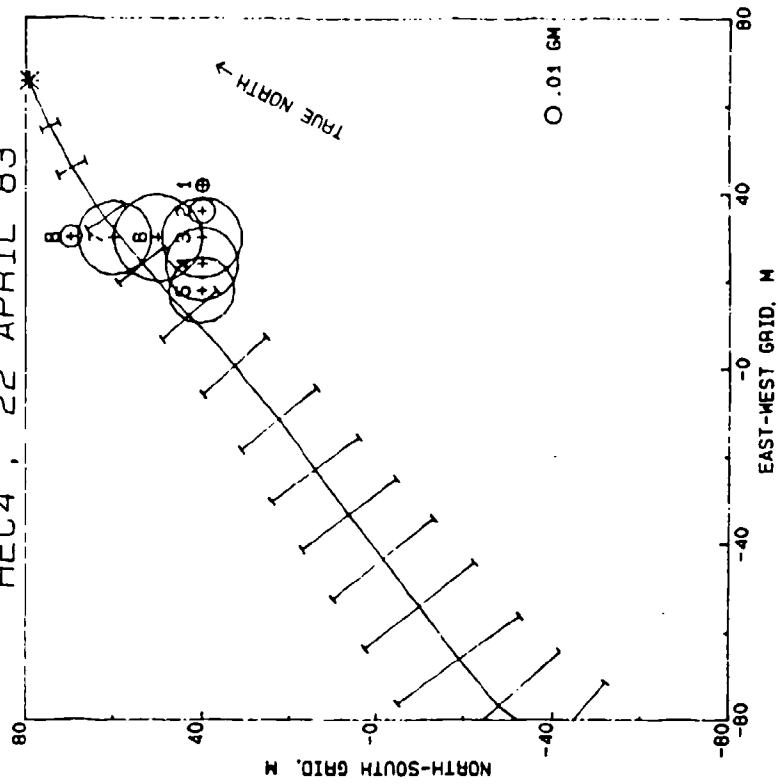
## HI VOL DATA (G):

|        | HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8 |
|--------|--------|--------|--------|--------|--------|--------|--------|-----|
| 0.0057 | 0.0219 | 0.2140 | 0.1715 | 0.1400 | 0.2560 | 0.1866 | 0.0170 |     |
| SUM:   | 1.0127 |        |        |        |        |        |        |     |

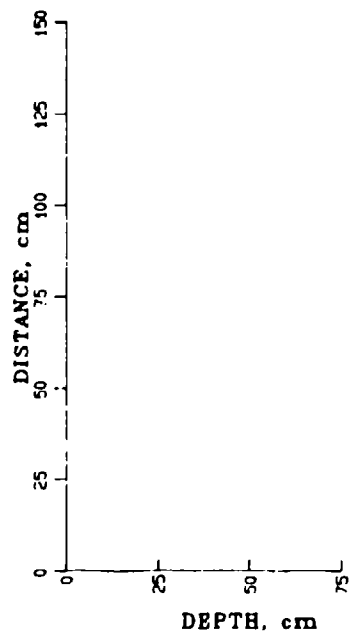
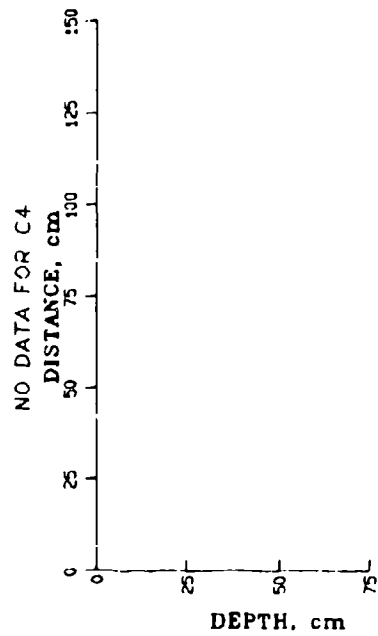
## GELMAN DOSAGE (G S/M\*\*3):

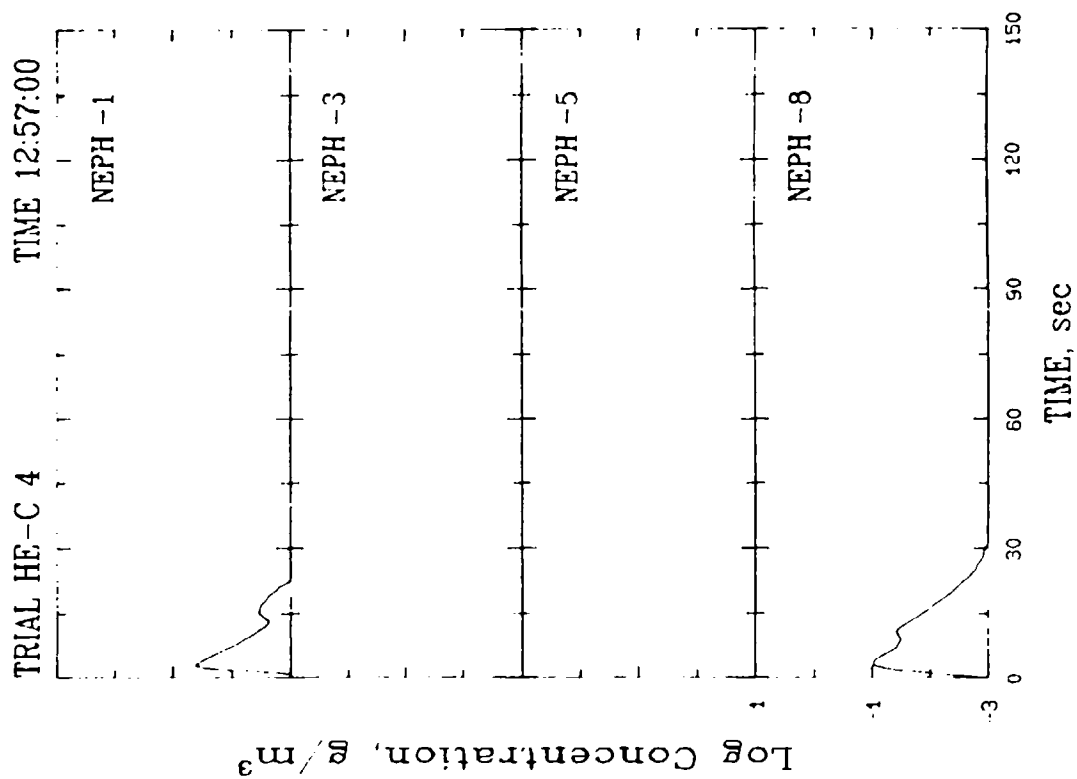
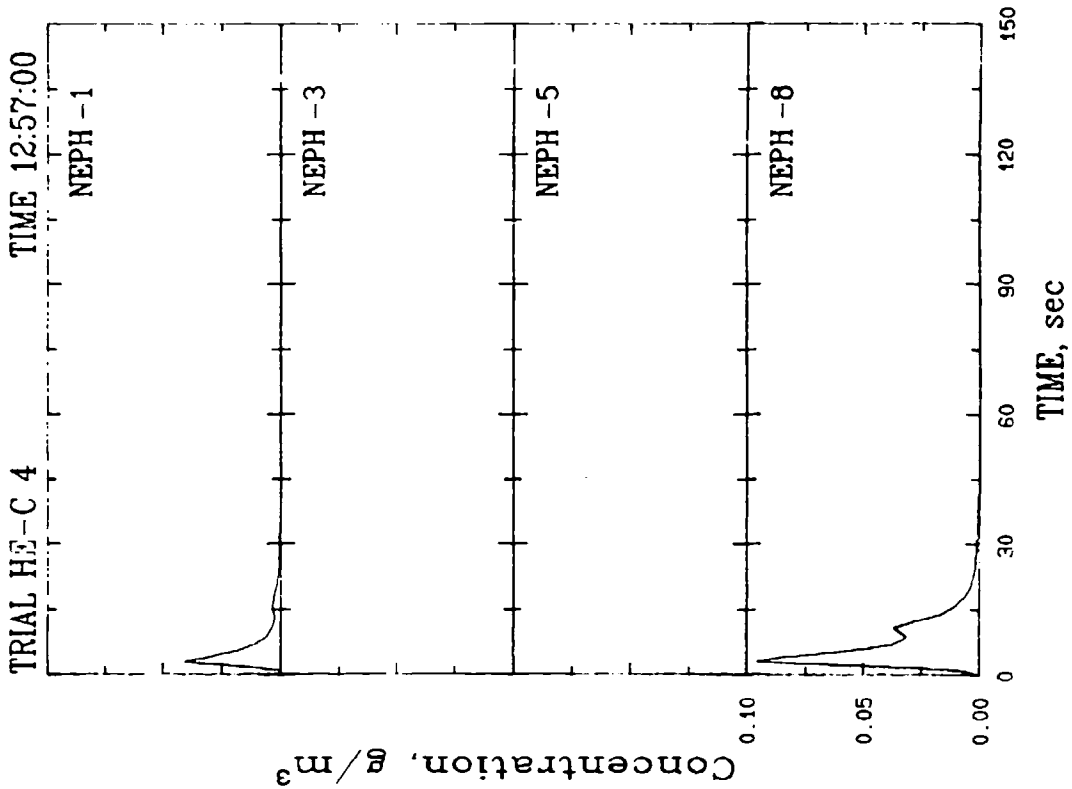
| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 19.905   | 66.400   | 73.225   | 137.838  |

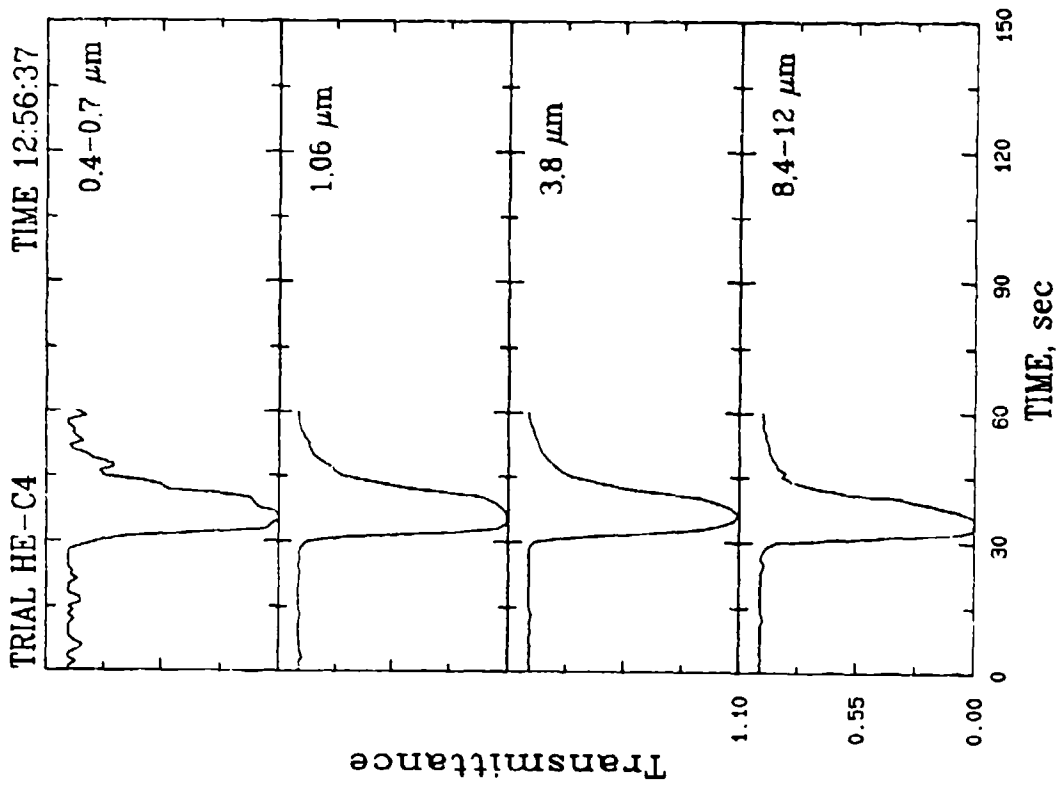
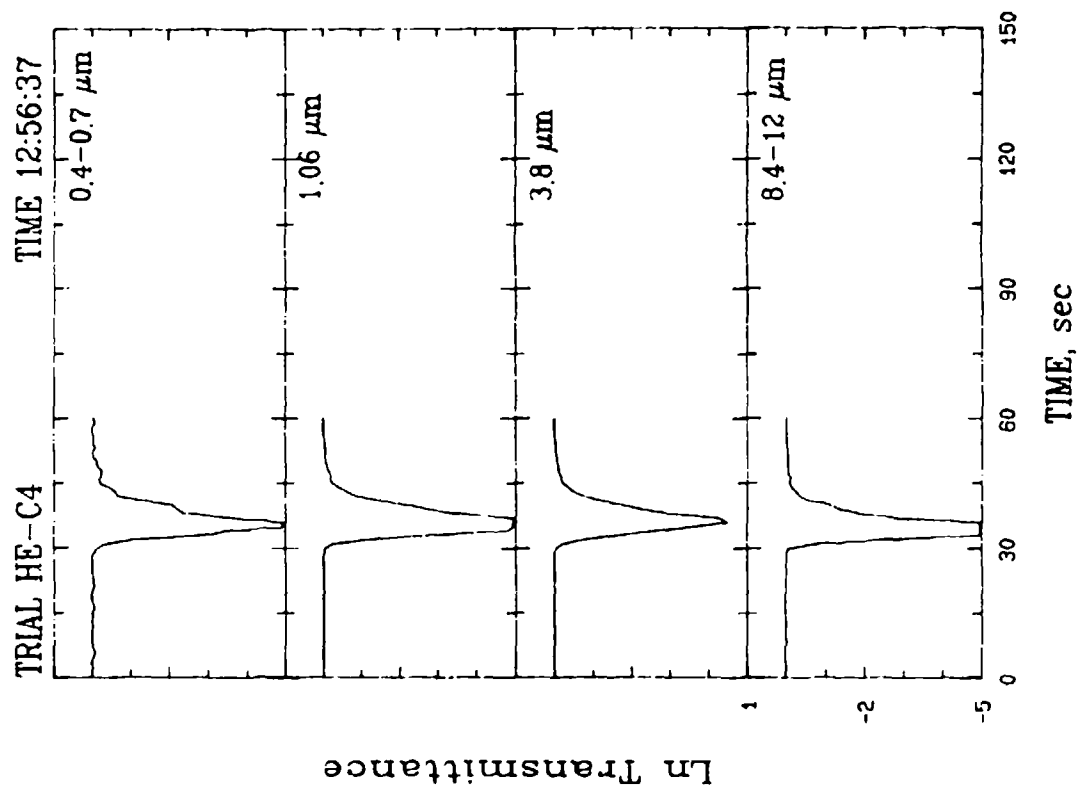
HEC4, 22 APRIL 83

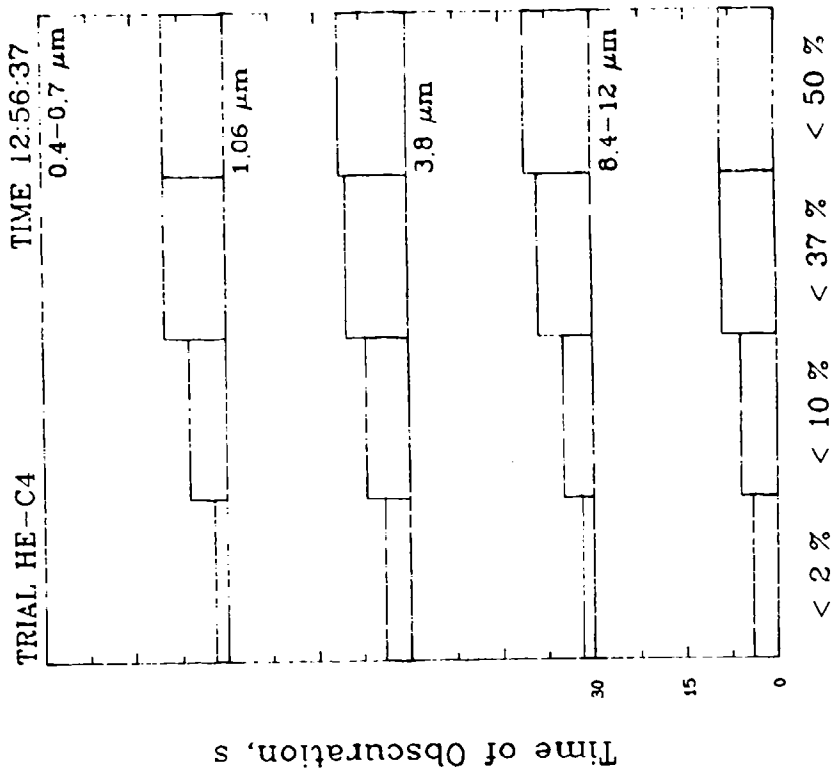
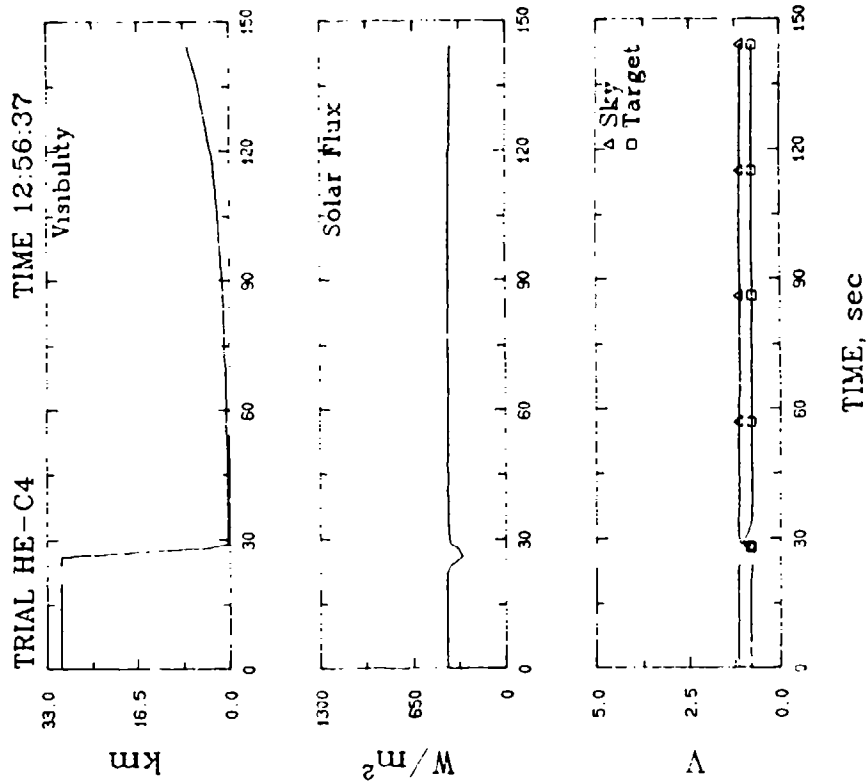


MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS









# EVENT SUMMARY DATA

Test Number: HEC5  
 Date: 22 APRIL 83  
 Detonation Coordinates (M):  
 X: 90.6  
 Y: 71.0  
 Surface Tangent  
 Charge Shape: BLOCK  
 Charge Wt: 25.0 LB  
 Event Time: 14:17:00

## METEOROLOGICAL DATA:

Pasquill Category: C  
 Richardson Number: -0.111

16 Meter Tower (Means)  
 Start Time: 14:15:50 End Time: 14:19:15

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 8.82  | 9.83  | 10.21 | 11.54 |
| Wind Dir. (DEG)  | 52.4  | 49.0  | 52.8  | 47.7  |
| Sigma WSP        | 1.51  | 1.55  | 1.47  | 1.26  |
| Sigma WDIR       | 8.3   | 7.9   | 7.7   | 7.4   |
| UVM Components   |       |       |       |       |
| U (N-S) (M/S)    | -5.34 | -6.40 | -6.13 | -7.73 |
| V (E-W) (M/S)    | -6.91 | -7.33 | -8.06 | -8.44 |
| W (Vert) (M/S)   | 0.77  | 0.14  | 1.04  | •     |
| Sigma U          | 1.43  | 1.54  | 1.42  | 1.54  |
| Sigma V          | 1.36  | 1.39  | 1.42  | 1.21  |
| Sigma W          | 0.28  | 0.38  | 0.43  | •     |
| Temperature (C)  | 13.5  | 12.8  | 12.6  | 11.7  |

Soil Temperature (C): 20.5 Solar Flux (W/M<sup>2</sup>): 870.6  
 Dew Point (C): 2.5 Visual Range (M): 30480.0  
 Temperature (C): 13.2 Vista Ranger Voltages:  
 Rel. Hum. (%): 48.3 Sky: 0.74  
 Target: 0.61  
 Ats. Hum. (G/M<sup>3</sup>): 5.56 Sky-Target Contrast: -0.17  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45 |
|-----------|---------------|-----|-----|-----|----|
| Pre-Shot  | 91.0 71.0     | 25  | 130 | 170 | •  |
| Post-Shot | 91.0 71.0     | •   | •   | •   | •  |

## CRATER DATA

Moisture Content: 12.7

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 1.300  
 Apparent Crater: 0.560  
 Flow: 0.740  
 DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.230  
 Flow: 1.123  
 Bottom: 1.196  
 Side: 1.051

## HI VOL DATA (G):

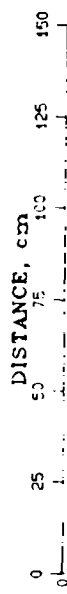
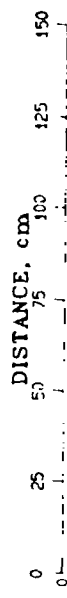
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0074 | 0.0111 | 0.0323 | 0.0952 | 0.1109 | 0.1832 | 0.2767 | 0.1463 |

SUM: 0.8631

## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 18.009   | 36.000   | 58.281   | 55.676   |

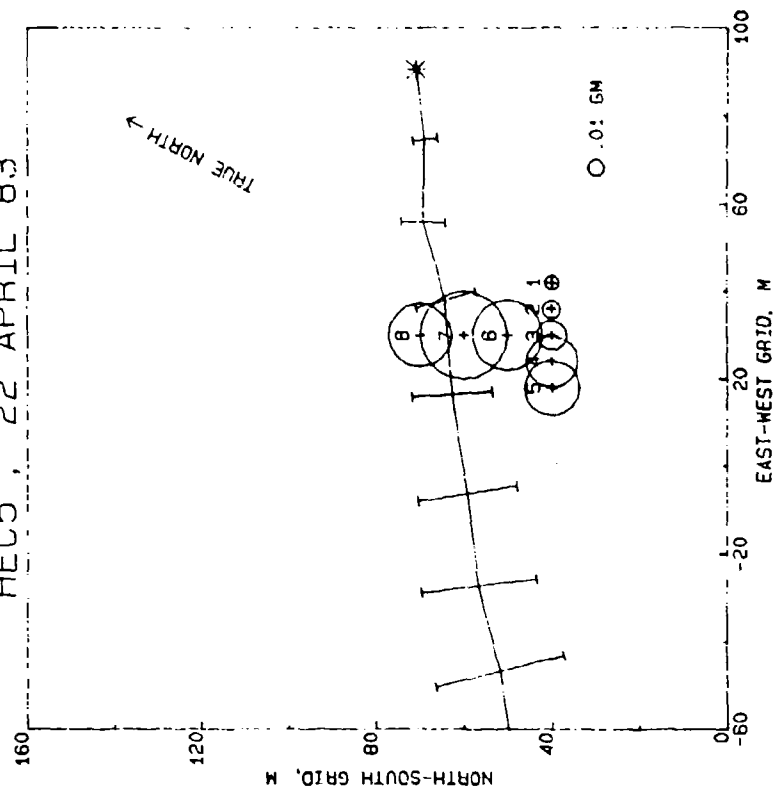
NO DATA FOR C5



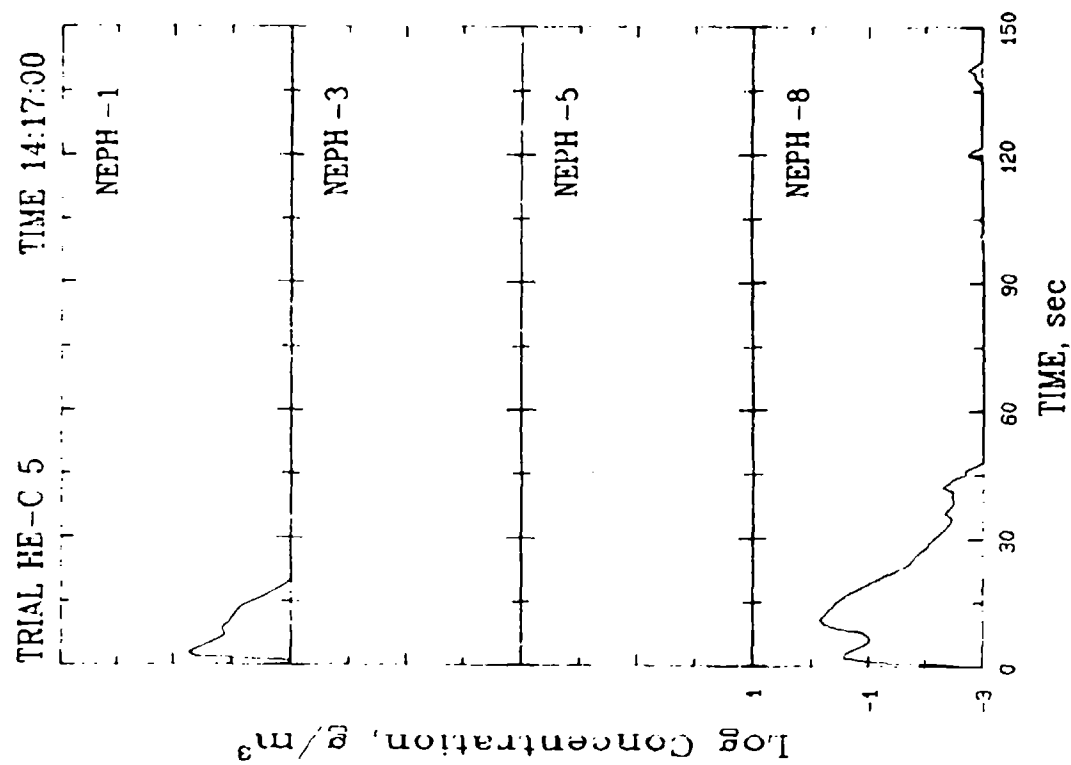
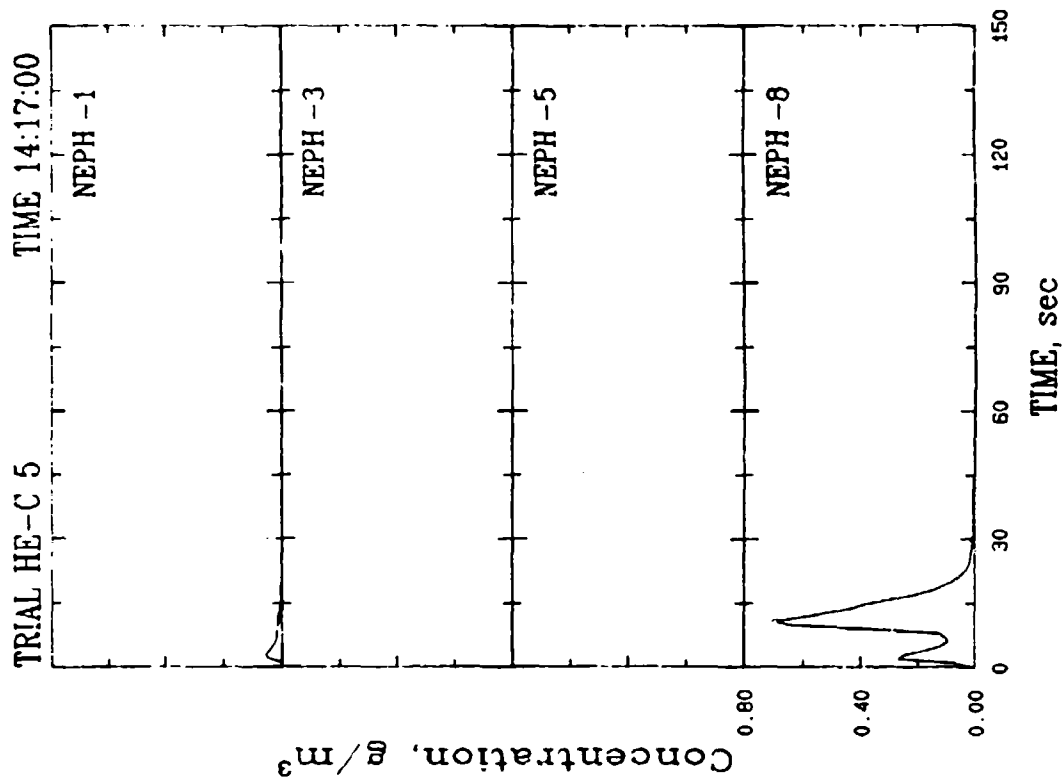
DEPTH, cm

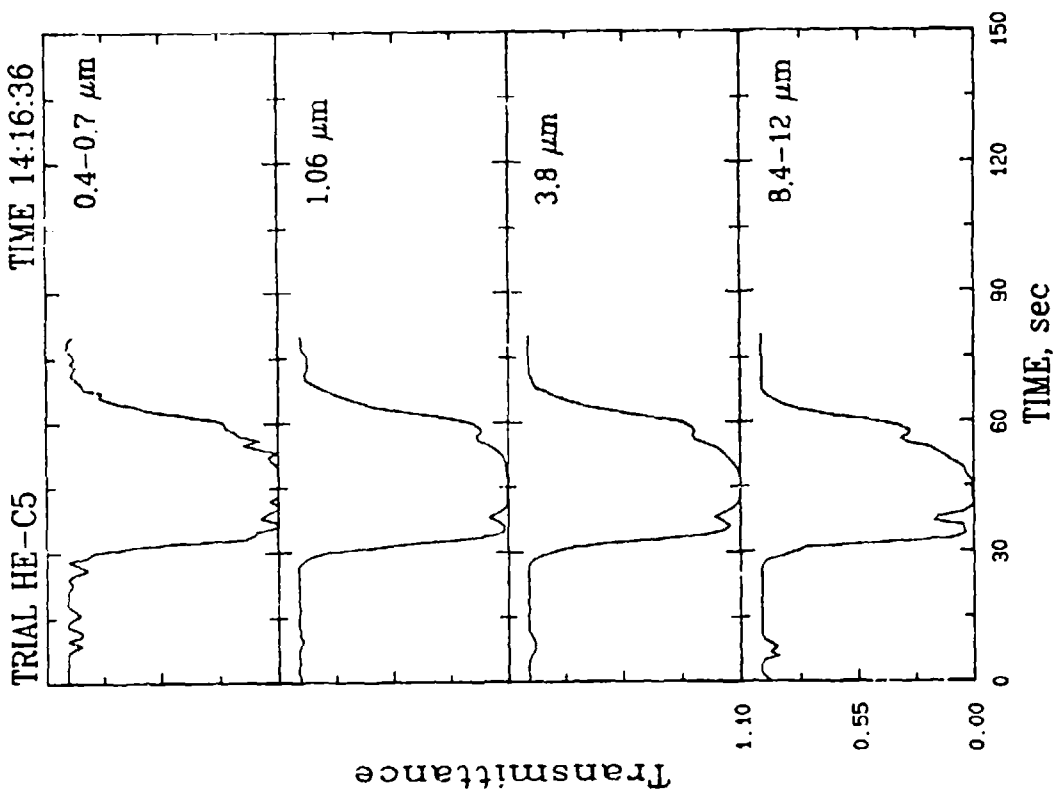
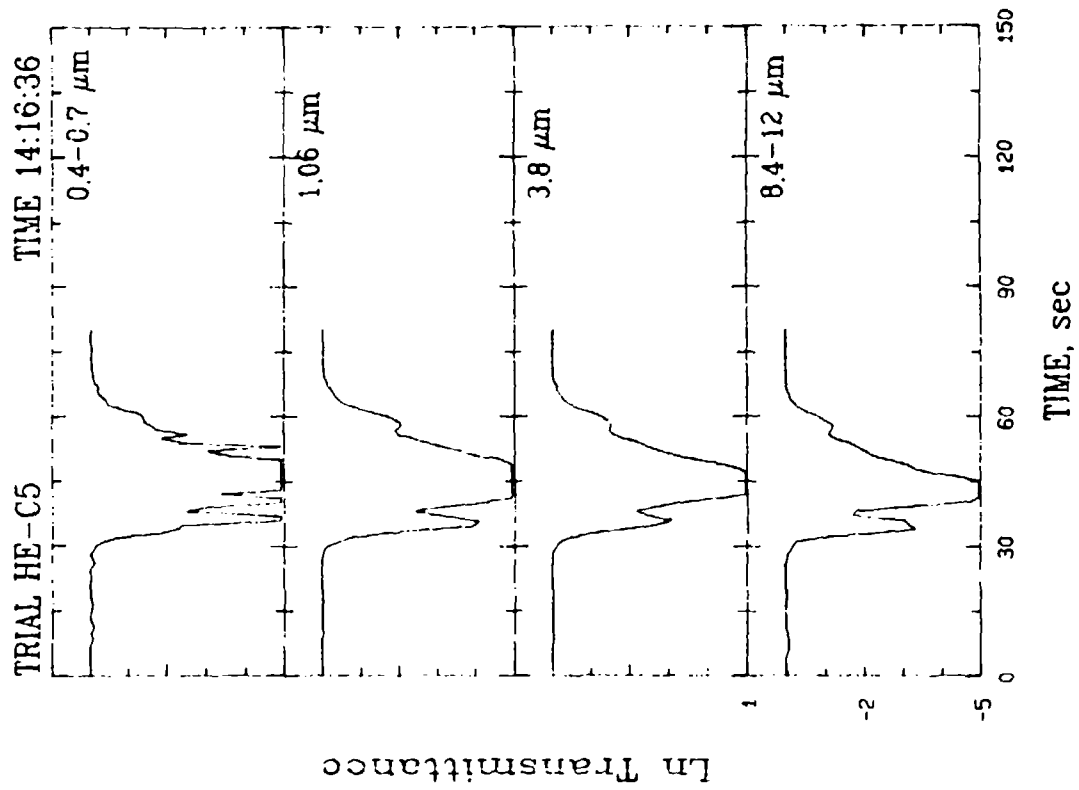
DEPTH, cm

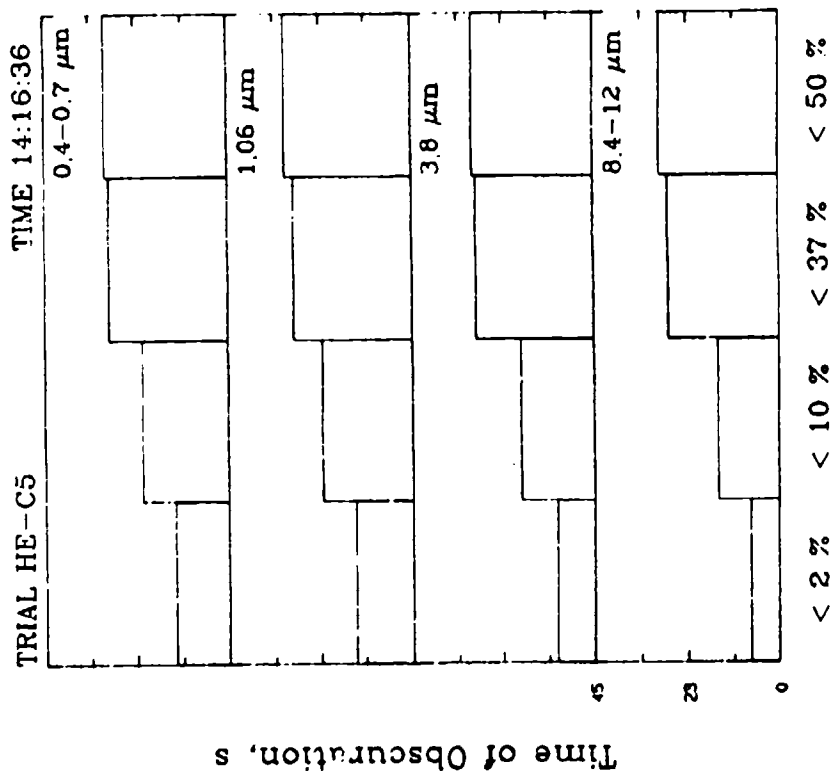
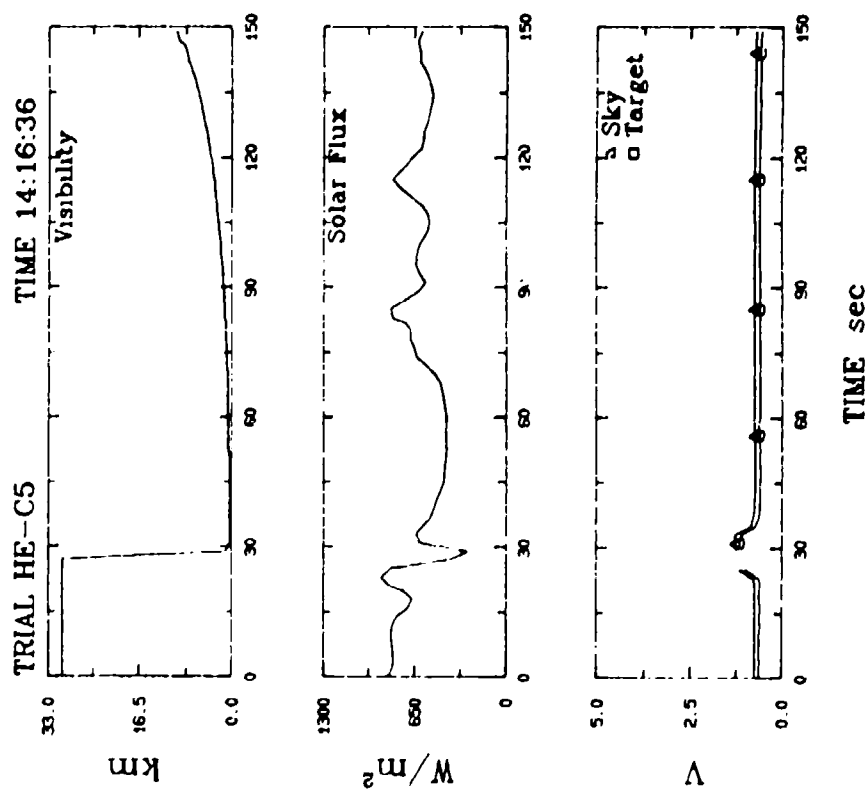
HEC5, 22 APRIL 83



MASSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEC6  
 Date: 23 APRIL 83  
 Detonation Coordinates (M):  
 X: 29.8  
 Y: 5.6  
 Surface Tangent  
 Charge Shape: BLOCK  
 Charge Wt: 25.0 LB  
 Event Time: 10:22:16

## METEOROLOGICAL DATA:

Barquill Category: B  
 Richardson Number: -0.194  
 16 Meter Tower (Means)  
 Start Time: 10:16:57  
 End Time: 10:24:13

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 3.50  | 3.80  | 3.92  | 4.46  |
| Wind Dir. (DEG)  | 156.6 | 156.1 | 156.2 | 152.8 |
| Sigma WSP        | 1.45  | 1.51  | 1.51  | 1.59  |
| Sigma WSP        | 22.0  | 20.8  | 20.7  | 14.8  |
| UNW Components   |       |       |       |       |
| U (N-S)          | 2.98  | 3.25  | 3.34  | 3.83  |
| V (E-W)          | -1.39 | -1.53 | -1.60 | -2.04 |
| W (Vert)         | 0.11  | 0.27  | 0.05  | 0     |
| Sigma U          | 1.38  | 1.45  | 1.42  | 1.48  |
| Sigma V          | 1.28  | 1.31  | 1.38  | 1.19  |
| Sigma W          | 0.24  | 0.35  | 0.40  | 0     |
| Temperature (C)  | 13.5  | 12.6  | 12.2  | 11.8  |

Soil Temperature (C): 23.9  
 Dew Point (C): 3.1  
 Temperature (C): 12.1  
 Rel. Hum. (%): 54.4  
 Abs. Hum. (G/M<sup>3</sup>): 5.84  
 Rain Accumulation (MM): 0.00  
 Solar Flux (W/M<sup>2</sup>): 353.4  
 Visual Range (M): 30480.0  
 Vista Ranger Voltages:  
 Sky: 1.26  
 Target: 1.17  
 Sky-Target Contrast: -0.07

# CONE INDEX:

|           | X, Y Coord (M) | SPC | 15  | 30  | 45  |
|-----------|----------------|-----|-----|-----|-----|
| Pre-Shot  | 29.8 5.5       | 67  | 190 | 327 | 540 |
| Post-Shot | 29.8 5.5       | 25  | 83  | 395 | 550 |

## CRATER DATA

Moisture Content: 13.9  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 1.284  
 Apparent Crater: 0.484  
 Flow: 0.800  
 DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.340  
 Flow: 1.137  
 Bottom: 1.163  
 Side: 1.111

## HI YOL DATA (G):

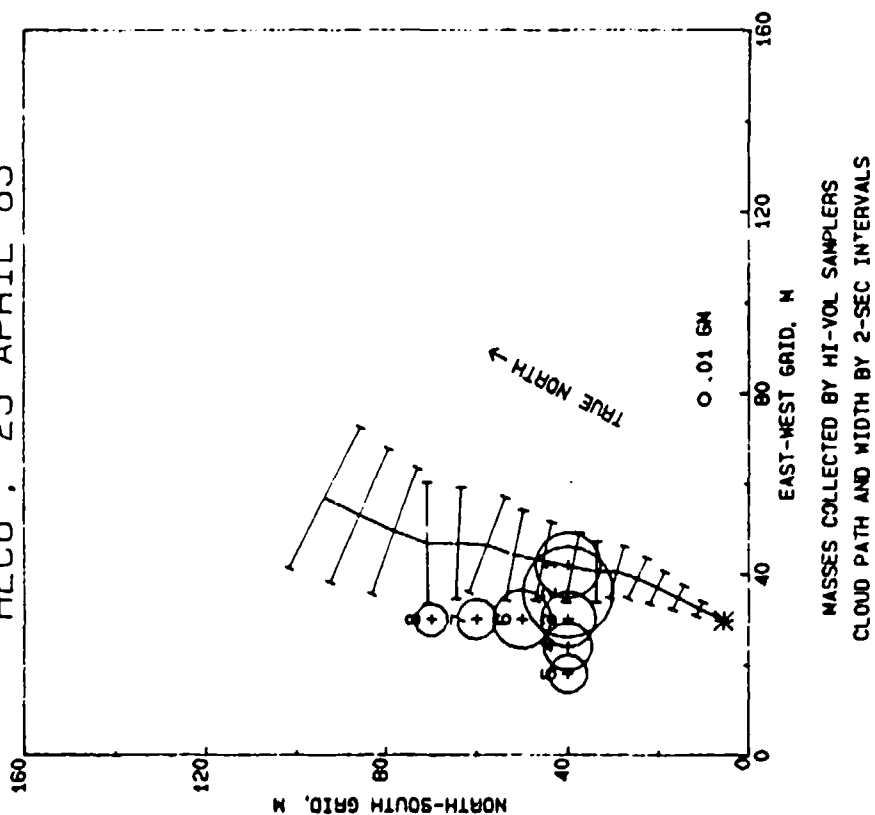
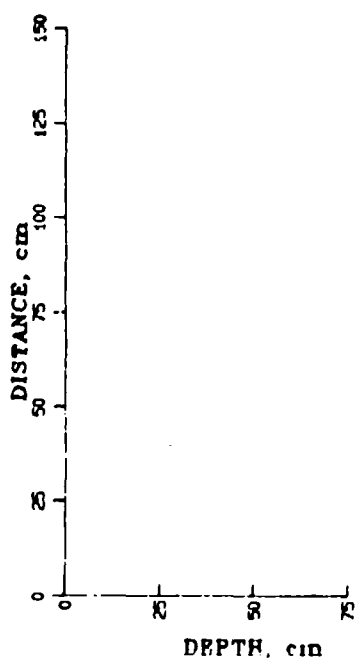
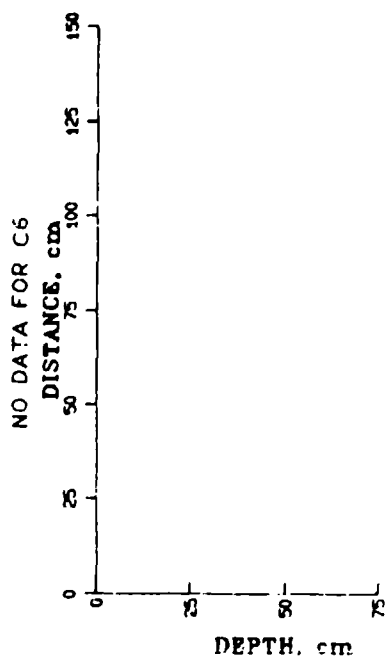
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.2544 | 0.5555 | 0.2016 | 0.1612 | 0.1004 | 0.2252 | 0.1089 | 0.0691 |

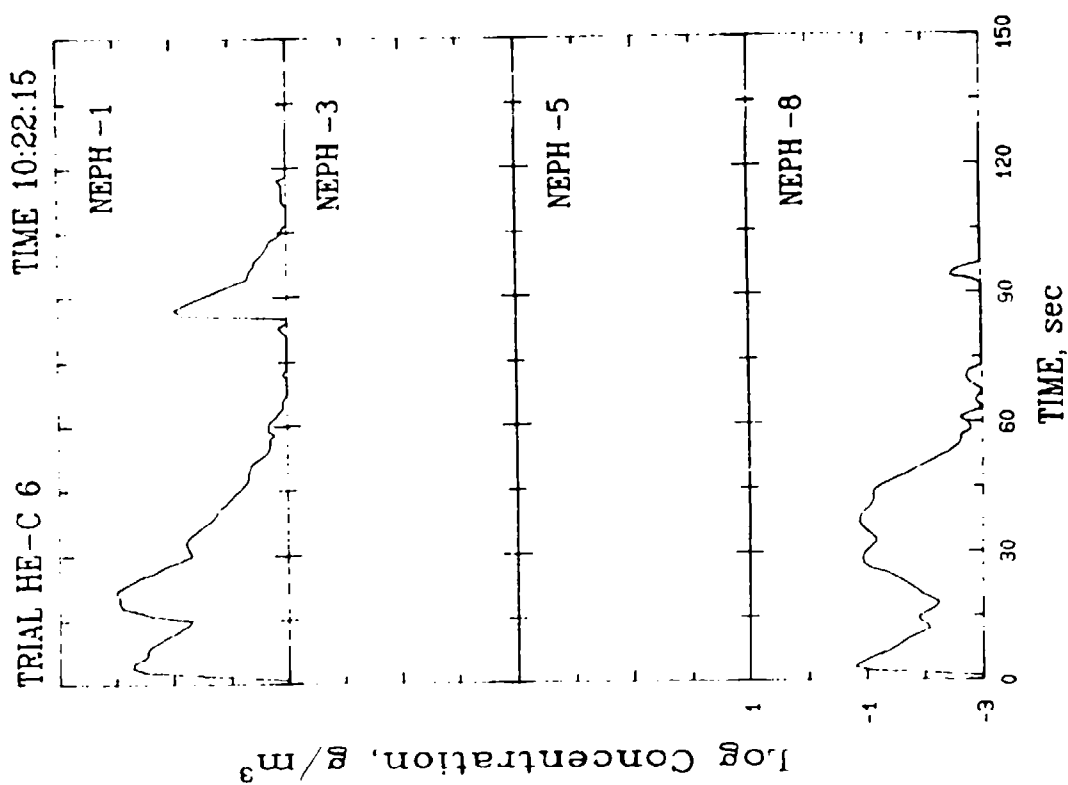
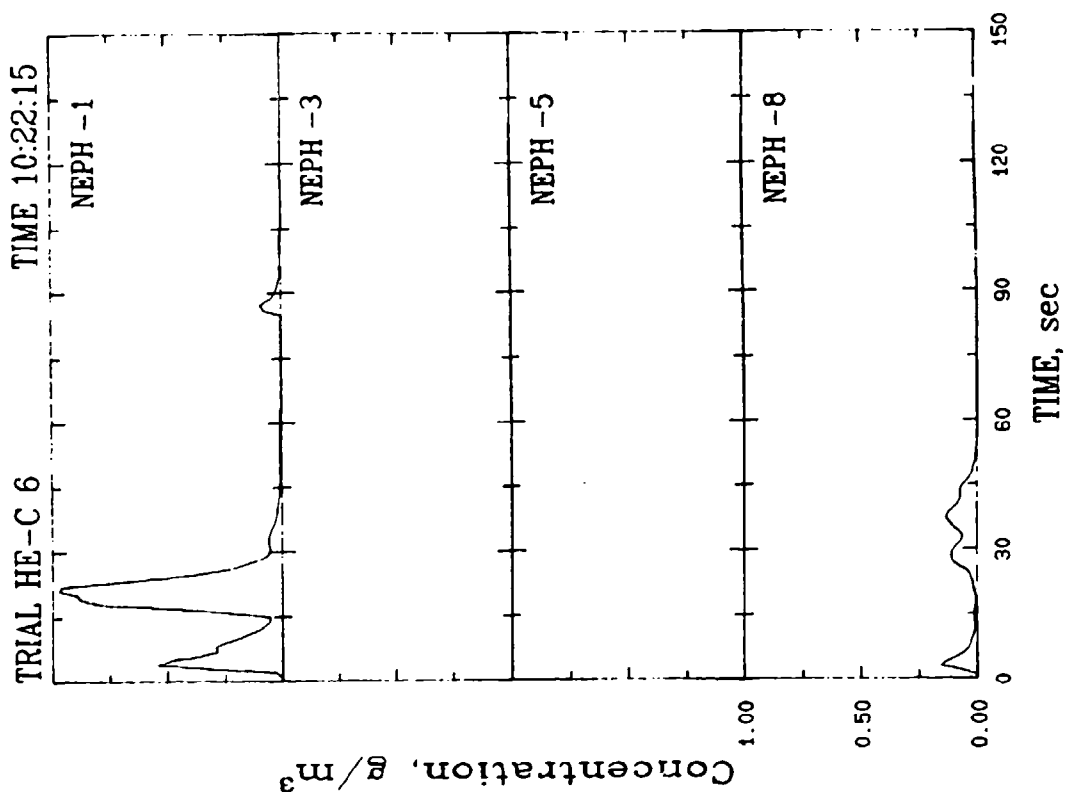
SUM: 1.7203

## GELMAN DOSAGE (G S/M<sup>3</sup>):

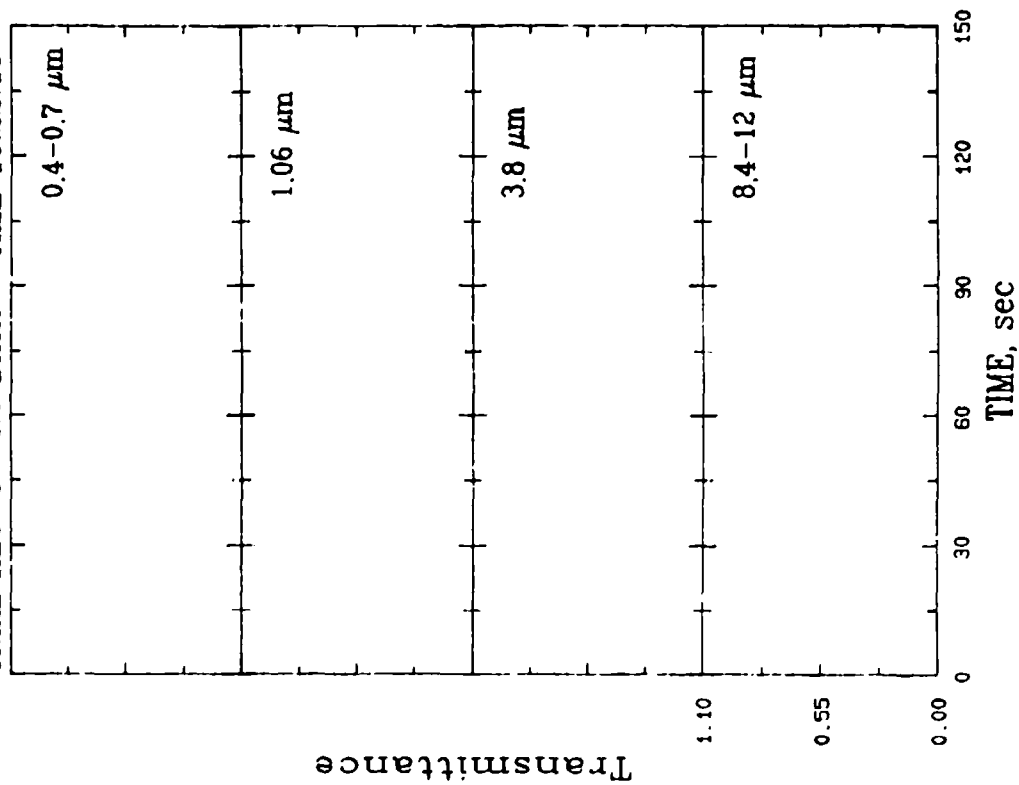
| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 59.716   | 93.600   | 71.731   | 75.676   |

HEC6 . 23 APRIL 83



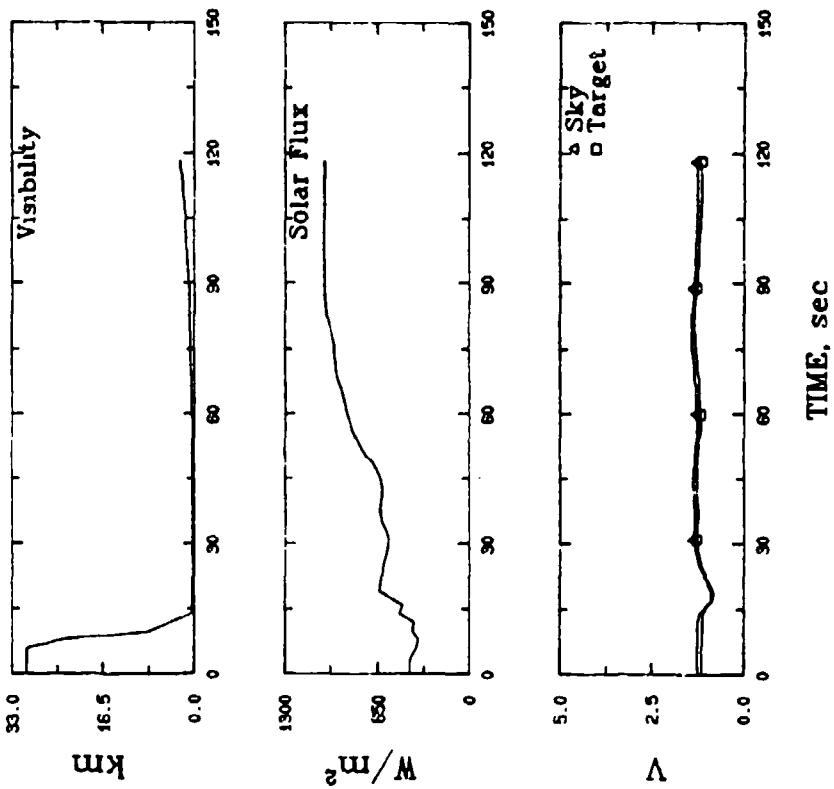


TRIAL HEC-6 NO DATA TIME 10:22:15



TRIAL HE-C6

TIME 10:22:15



# EVENT SUMMARY DATA

Test Number: HEC7  
 Date: 23 APRIL 83  
 Detonation Coordinates (M):  
 X: 57.2  
 Y: 3.1  
 Surface Tangent  
 Charge Shape: BLOCK  
 Charge Wt: 25.0 LB  
 Event Time: 12:37:11

## METEOROLOGICAL DATA:

Pasquill Category: D  
 Richardson Number: -0.235

16 Meter Tower (Means)  
 Start Time: 12:35:58 End Time: 12:39:24

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 5.32  | 5.63  | 5.95  | 6.78  |
| Wind Dir. (DEG)  | 117.3 | 117.5 | 118.8 | 119.2 |
| Sigma WSP        | 1.01  | 1.07  | 1.19  | 1.14  |
| Sigma WDIR       | 14.3  | 13.8  | 12.2  | 10.8  |
| UVW Components   |       |       |       |       |
| U (N-S) (M/S)    | 2.35  | 2.52  | 2.78  | 3.16  |
| V (E-W) (M/S)    | -4.59 | -4.86 | -5.11 | -5.86 |
| W (Vert) (M/S)   | 0.40  | 0.44  | 0.39  | •     |
| Sigma U          | 1.18  | 1.22  | 1.14  | 1.02  |
| Sigma V          | 1.14  | 1.19  | 1.30  | 1.37  |
| Sigma W          | 0.26  | 0.35  | 0.37  | •     |
| Temperature (C)  | 15.0  | 14.3  | 13.9  | 13.5  |

Soil Temperature (C): 27.2 Solar Flux (W/M<sup>2</sup>): 367.9  
 Dew Point (C): 3.1 Visual Range (M): 30480.0  
 Temperature (C): 14.2 Vista Range Voltages:  
 Rel. Hum. (%): 47.2 Sky: 1.27  
 Target: 1.10  
 Abs. Hum. (G/M<sup>3</sup>): 5.77 Sky-Target Contrast: -0.14  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

X,Y Coord (M) SFC 15 30 45  
 Pre-Shot 57.0 3.0 50 240 350 465  
 Post-Shot 57.0 3.0 • • • •

## CRATER DATA

Moisture Content: 11.6

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 1.862  
 Apparent Crater: 0.392  
 Flow: 1.470

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.310  
 Flow: 1.101  
 Bottom: 1.140  
 Side: 1.062

## HI VOL DATA (G):

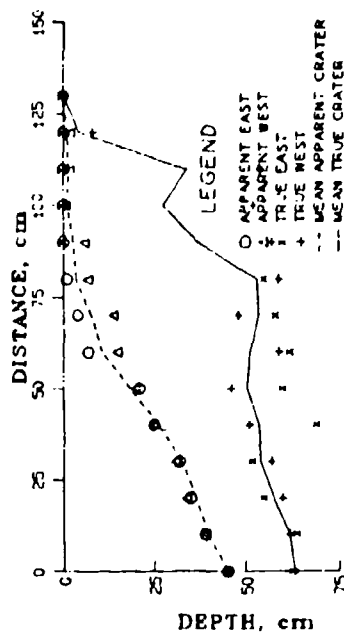
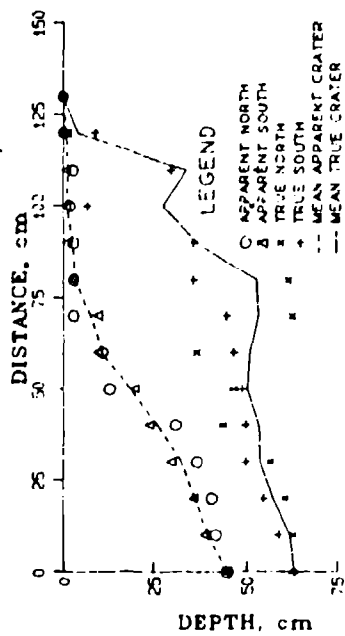
HV1 HV2 HV3 HV4 HV5 HV6 HV7 HV8  
 0.0048 0.0248 0.0531 0.2121 0.2838 0.0241 0.0163 0.0071

SUN: 0.6261

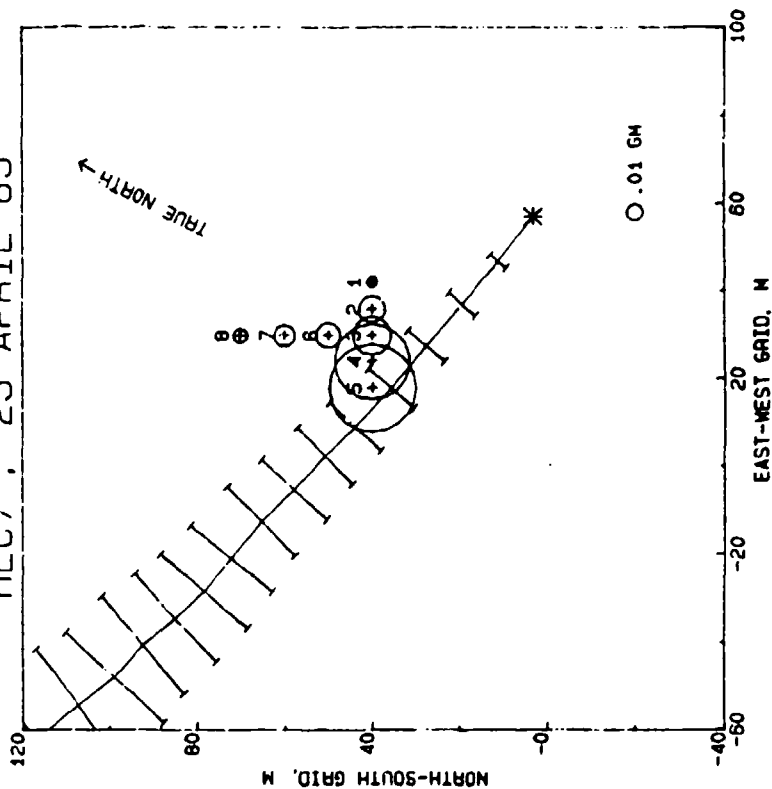
## GELMAN DOSAGE (G S/M<sup>3</sup>):

GELMAN A GELMAN B GELMAN C GELMAN D  
 0.000 0.000 0.000 0.000

C7 25LB 1237HR 23APR83 57.3



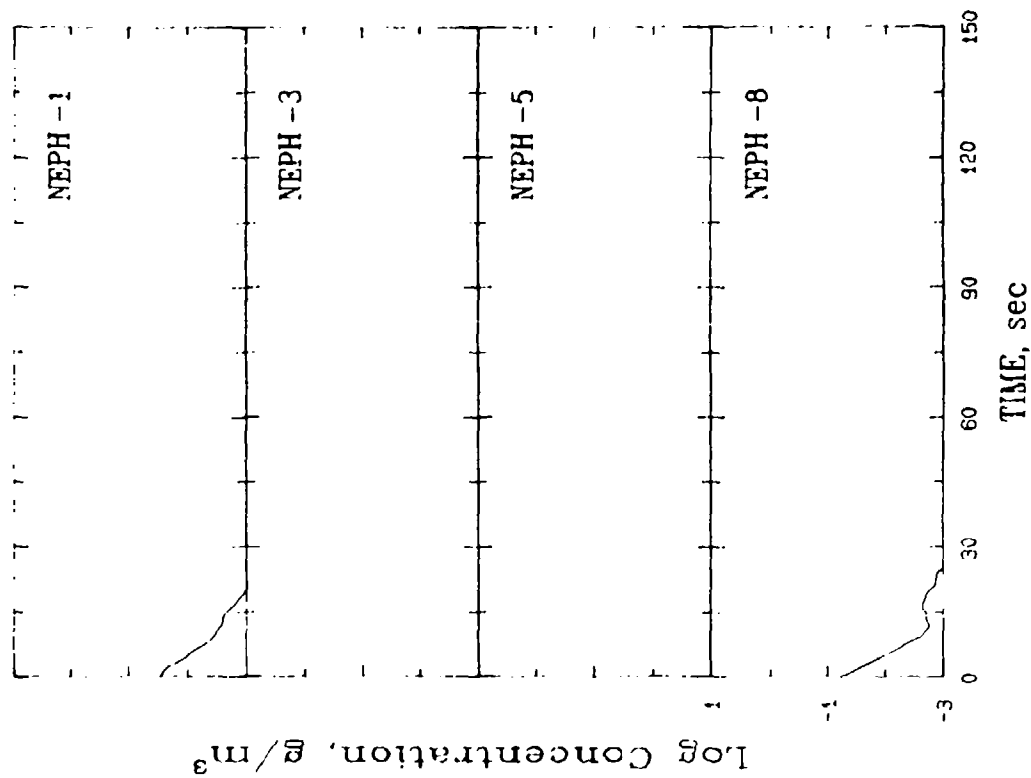
HEC7 . 23 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS

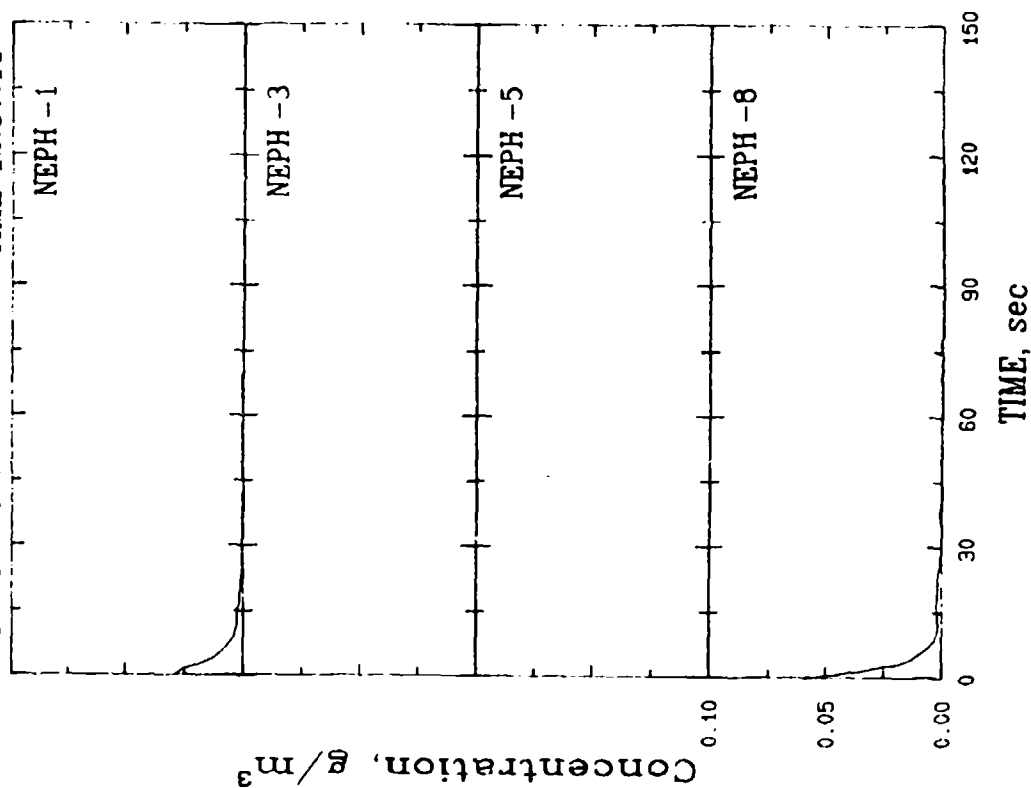
TRIAL HE-C 7

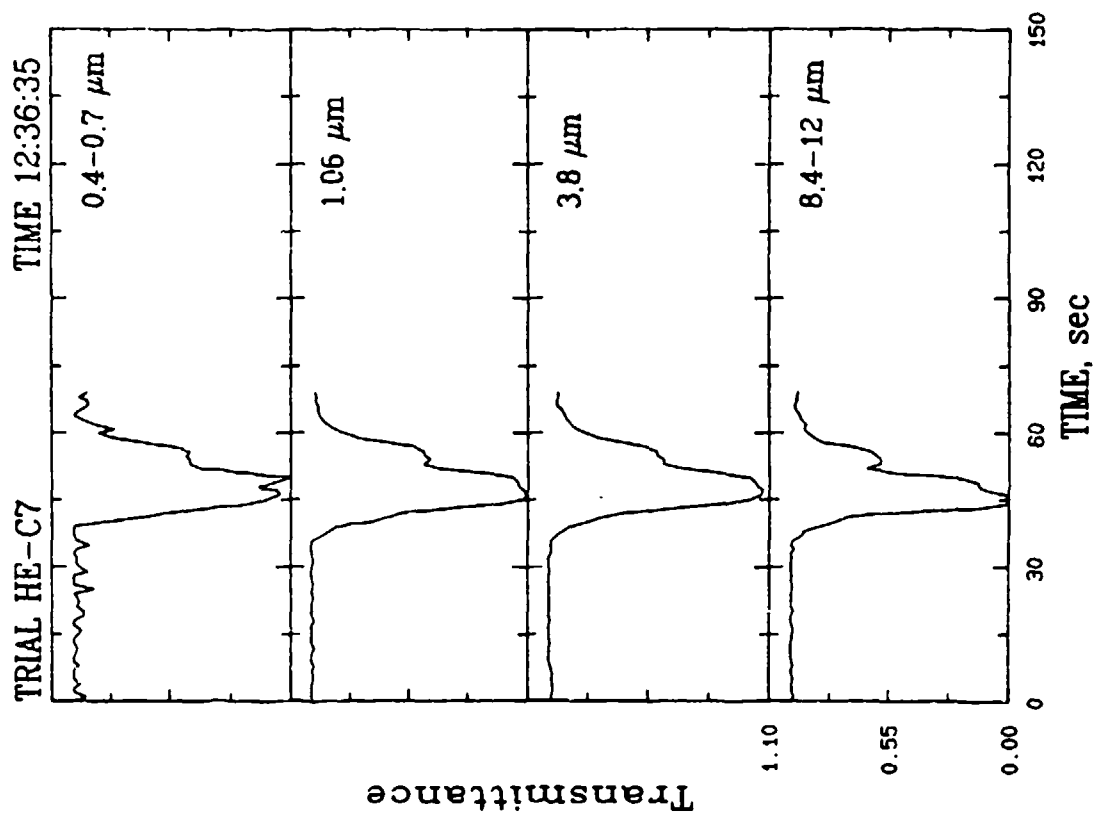
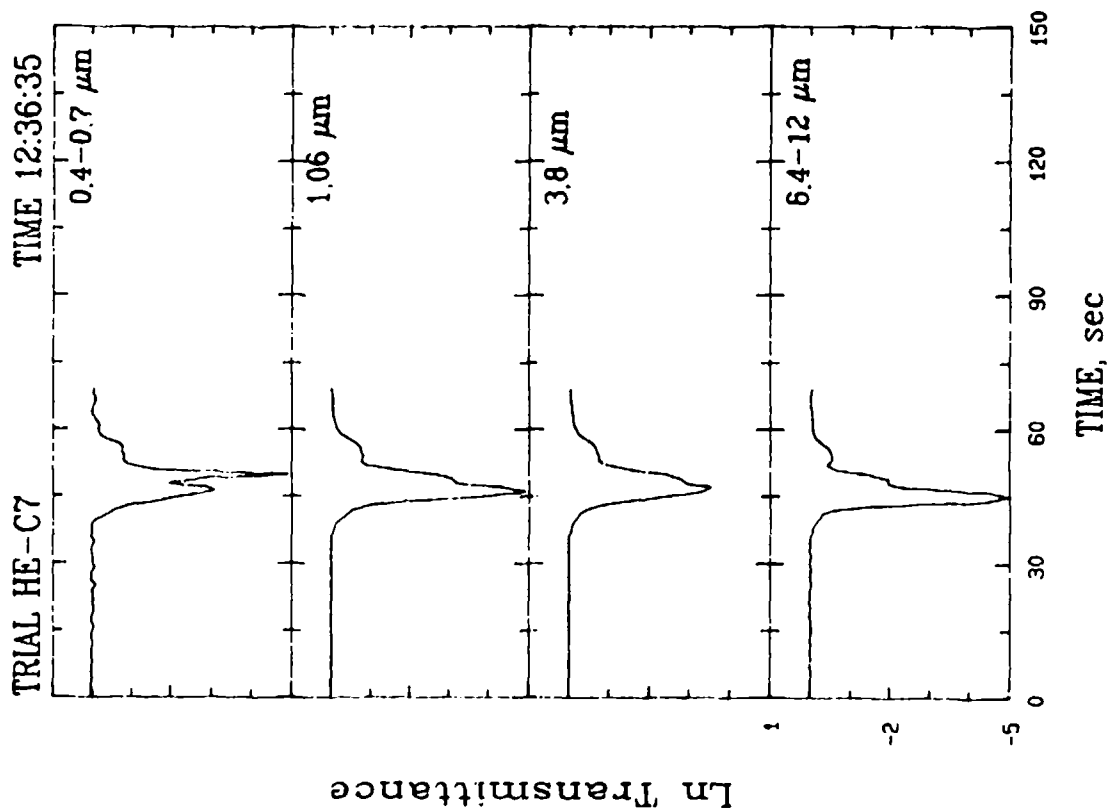
TIME 12:37:11



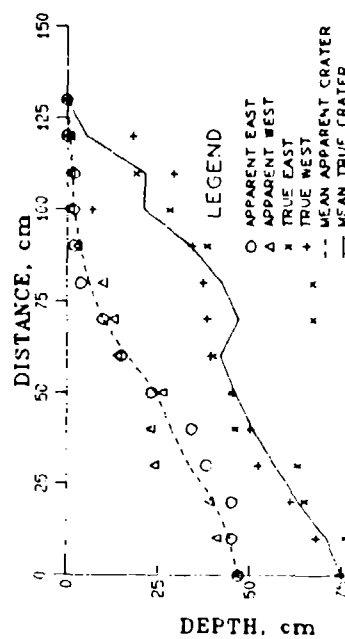
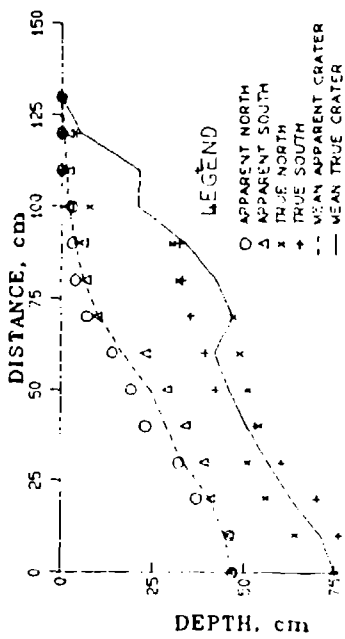
TRIAL HE-C 7

TIME 12:37:11

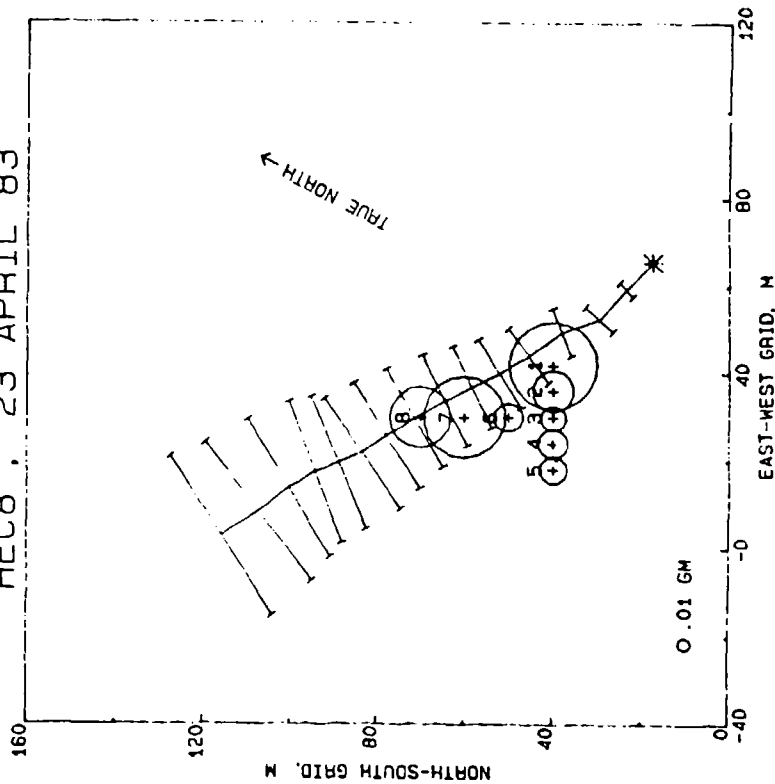




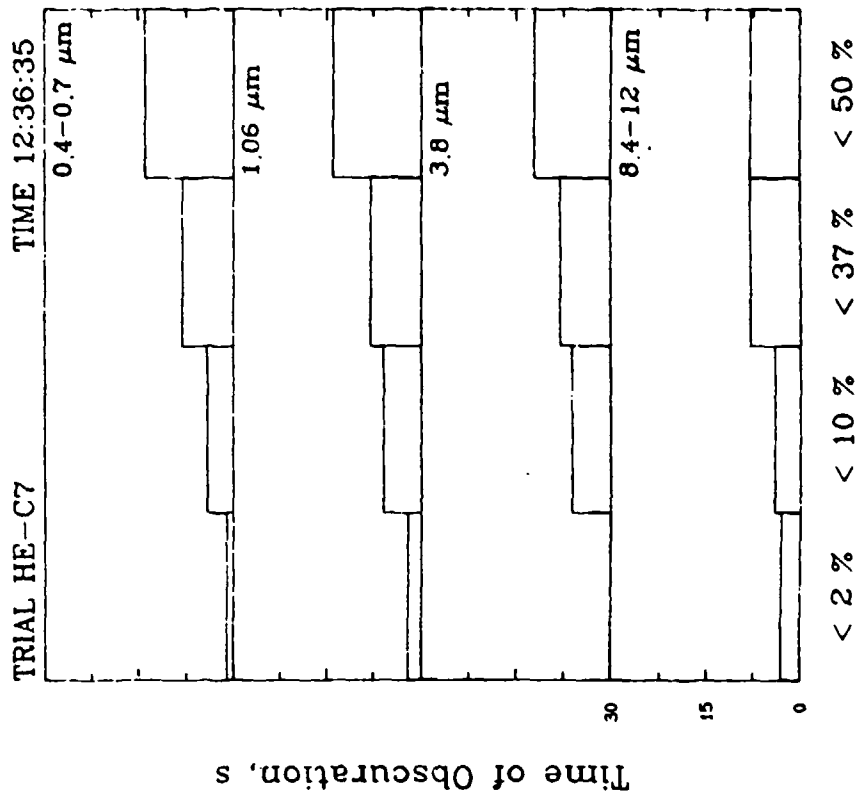
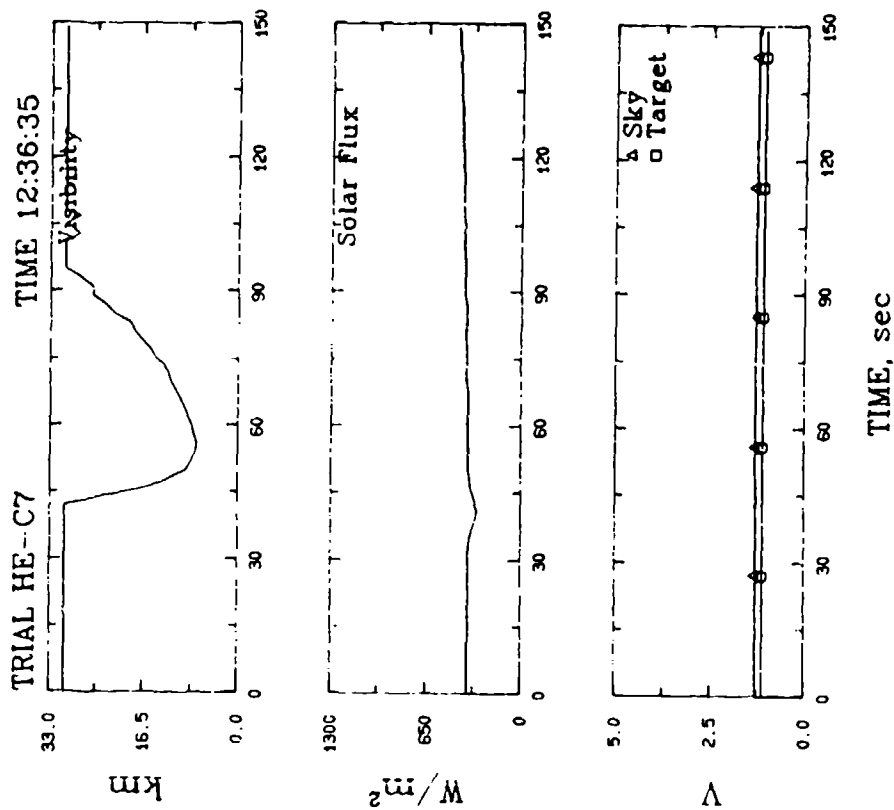
C8 25LB 1339HR 23APR83 65.17



HEC8, 23 APRIL 83



MASSES COLLECTED BY HI-VOL SAMPLERS  
 CLOUD PATH AND WIDTH BY 2-SEC INTERVALS



# EVENT SUMMARY DATA

Test Number: HEC8  
 Date: 23 APRIL 83  
 Detonation Coordinates (M):  
 X: 65.3  
 Y: 17.5  
 Surface Tangent  
 Charge Shape: BLOCK  
 Charge Wt: 25.0 LB  
 Event Time: 13:39:30

## METEOROLOGICAL DATA:

Pacquist Category: B  
 Richardson Number: -0.714

16 Meter Tower (Mean)  
 Start Time: 13:38:10 End Time: 13:41:39

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 4.60  | 4.84  | 5.17  | 5.65  |
| Wind Dir. (DEG)  | 117.9 | 118.2 | 118.9 | 119.2 |
| Sigma WSP        | 0.77  | 0.79  | 0.84  | 0.77  |
| Sigma WDIR       | 8.1   | 7.9   | 7.5   | 8.6   |
| UW Components    |       |       |       |       |
| U (N-S) (M/S)    | 2.09  | 2.22  | 2.43  | 2.70  |
| V (E-W) (M/S)    | -4.05 | -4.25 | -4.52 | -4.90 |
| W (Vert) (M/S)   | 0.28  | 0.35  | 0.31  | •     |
| Sigma U          | 0.53  | 0.52  | 0.48  | 0.67  |
| Sigma V          | 0.85  | 0.88  | 0.94  | 0.90  |
| Sigma W          | 0.25  | 0.31  | 0.34  | •     |
| Temperature (C)  | 16.7  | 15.7  | 15.1  | 14.7  |

Soil Temperature (C): 20.3 Solar Flux (W/M<sup>2</sup>): 1034.5  
 Dew Point (C): 2.5 Visual Range (M): 30480.0  
 Temperature (C): 15.6 Vista Ranger Voltages:  
 Rel. Hum. (%): 41.2 Sky: 1.40  
 Target: 1.24  
 Abs. Hum. (G/M<sup>3</sup>): 5.50 Sky-Target Contrast: -0.11  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 65.0 17.0     | 42  | 220 | 305 | 410 |
| Post-Shot | 65.0 17.0     | •   | •   | •   | •   |

# CRATER DATA

Moisture Content: 12.1  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 1.598  
 Apparent Crater: 0.481  
 Flow: 1.117  
 DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.480  
 Flow: 1.124  
 Bottom: 1.113  
 Side: 1.134

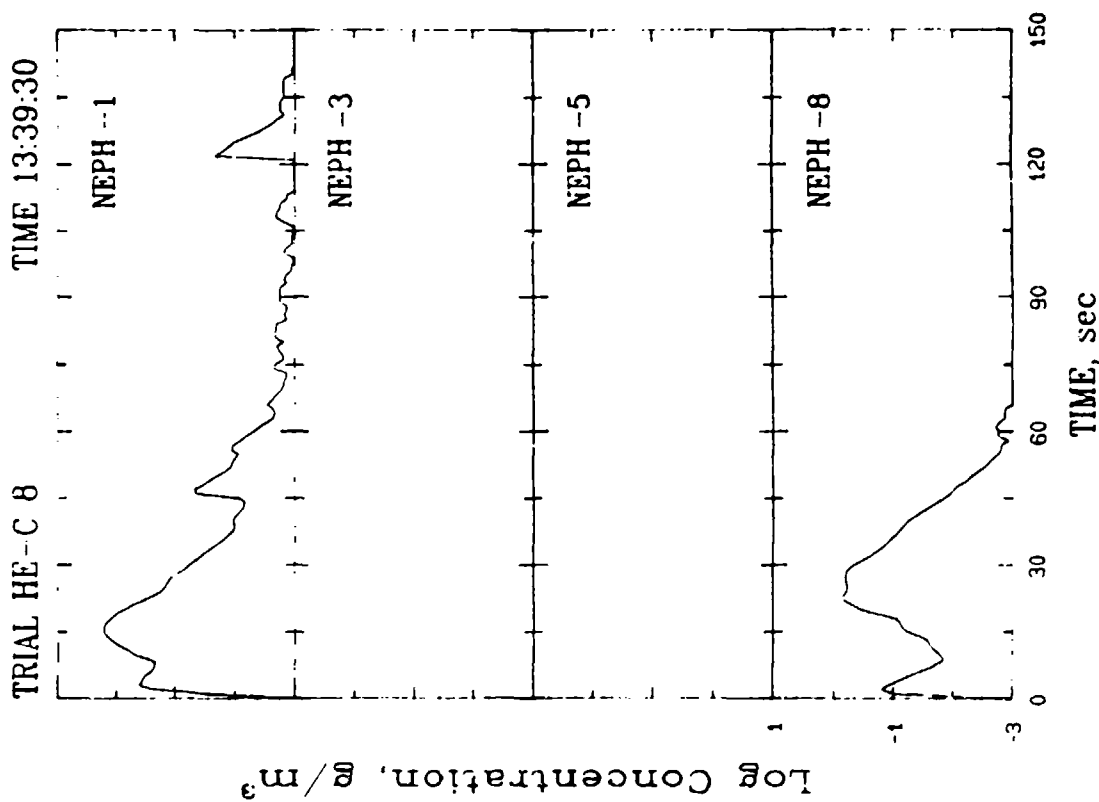
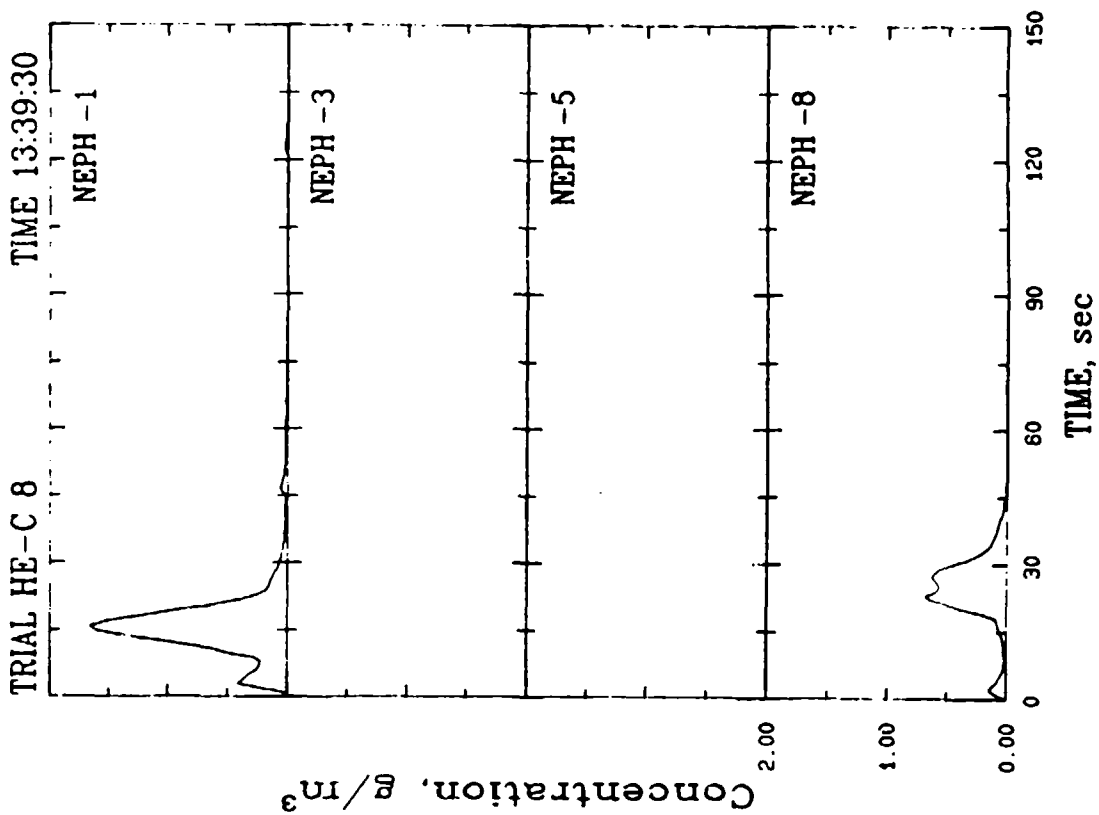
# HI VOL DATA (G):

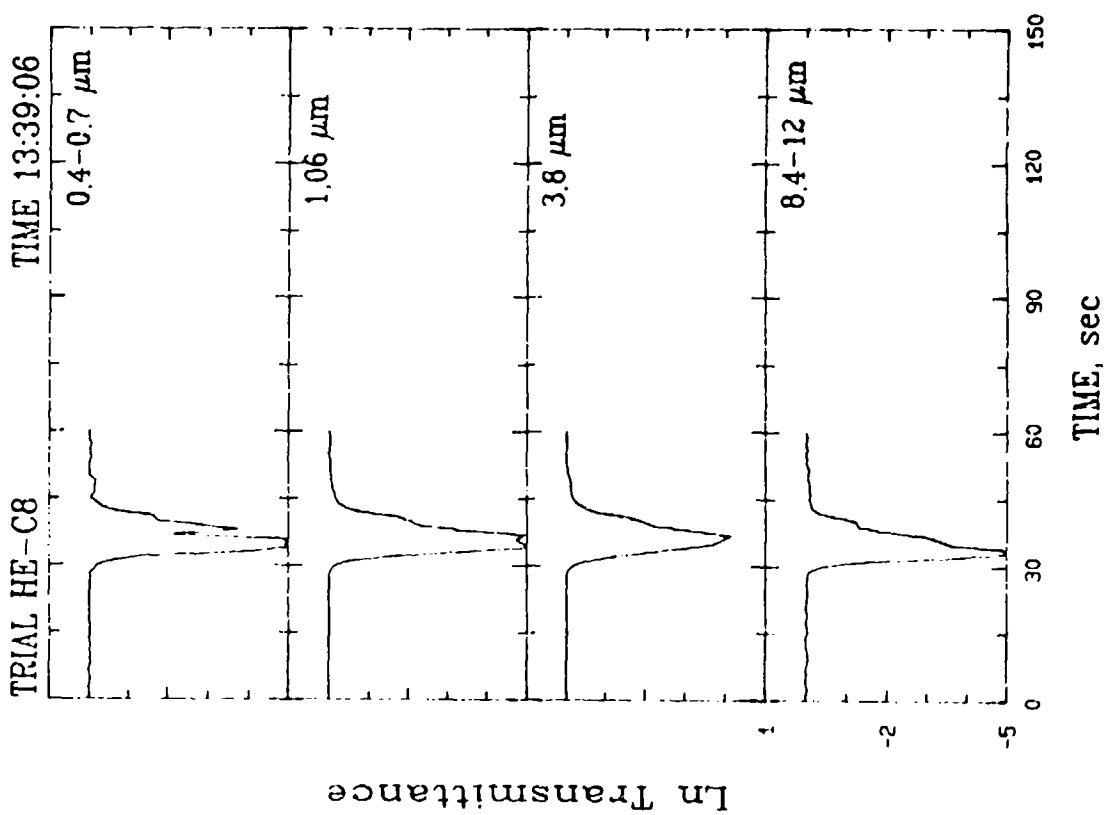
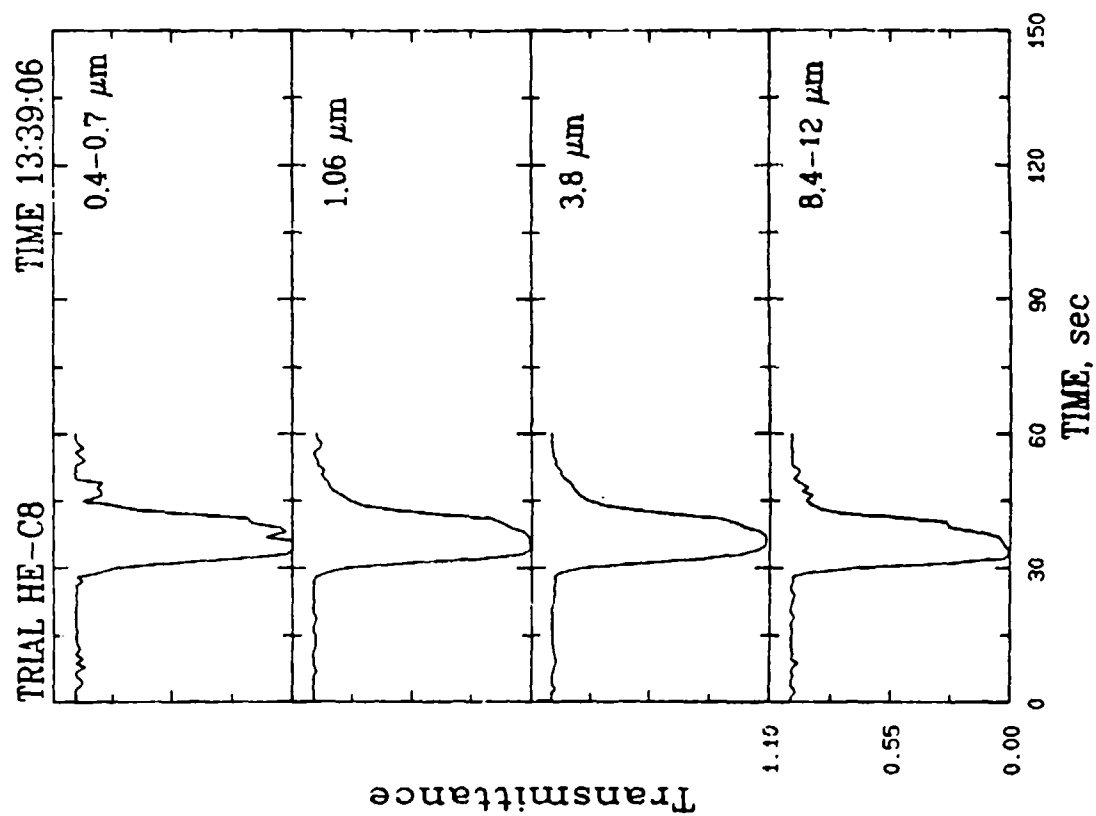
|  | HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--|--------|--------|--------|--------|--------|--------|--------|--------|
|  | 0.4490 | 0.0995 | 0.0359 | 0.0514 | 0.0439 | 0.0490 | 0.3887 | 0.2199 |

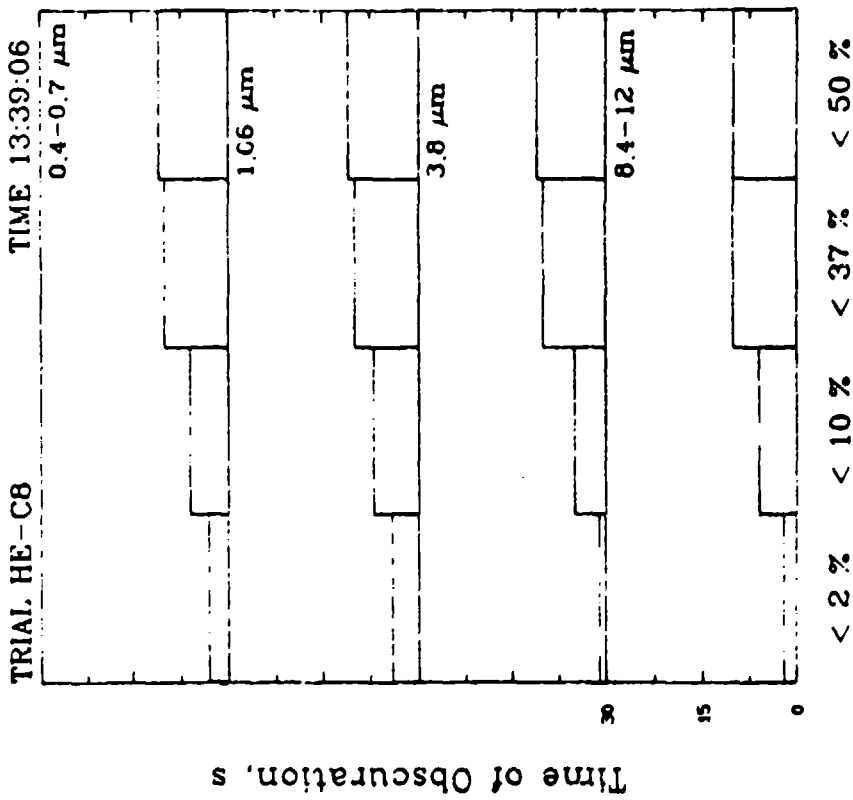
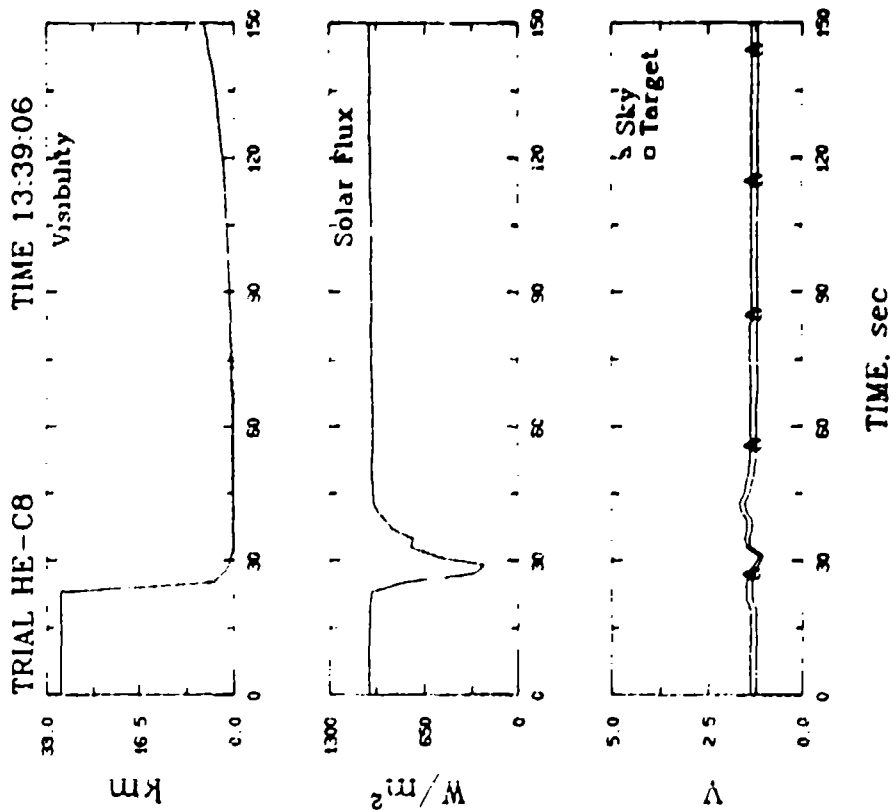
SUM: 1.3373

# GELMAN DOSAGE (G S/M<sup>3</sup>):

|  | GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|--|----------|----------|----------|----------|
|  | 58.768   | 223.200  | 444.583  | 77.297   |







# EVENT SUMMARY DATA

Test Number: REC9  
 Date: 23 APRIL 83  
 Detonation Coordinates (M):  
 X: 75.7  
 Y: -13.9  
 Surface Target  
 Charge Shape: BLOCK  
 Charge Wt: 25.0 LB  
 Event Time: 16:19:18

## METEOROLOGICAL DATA:

Pasquill Category: D  
 Richardson Number: -0.138  
 16 Meter Tower (Means)  
 Start Time: 16:16:48  
 End Time: 16:21:16

|                  | 2M    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 4.85  | 5.28  | 5.64  | 6.55  |
| Wind Dir. (DEG)  | 140.3 | 140.5 | 140.7 | 138.5 |
| Sigma WSP        | 0.80  | 0.80  | 0.83  | 0.79  |
| Sigma WDIR       | 12.5  | 12.5  | 11.8  | 11.0  |
| UTM Components   |       |       |       |       |
| U (N-S) (M/S)    | 3.61  | 3.96  | 4.23  | 4.79  |
| V (E-W) (M/S)    | -3.05 | -3.30 | -3.53 | -4.29 |
| W (Vert) (M/S)   | 0.28  | 0.49  | 0.32  | 0     |
| Sigma U          | 0.75  | 0.65  | 0.83  | 0.85  |
| Sigma V          | 1.11  | 1.13  | 1.18  | 1.24  |
| Sigma W          | 0.16  | 0.34  | 0.34  | 0     |
| Temperature (C)  | 16.0  | 15.6  | 15.2  | 14.8  |

Soil Temperature (C): 25.1  
 Solar Flux (W/M<sup>2</sup>): 186.5  
 Dew Point (C): 2.2  
 Visual Range (M): 30480.0  
 Temperature (C): 15.0  
 Vista Ranger Voltages:  
 Rel. Hum. (%): 41.9  
 Sky: 1.43  
 Target: 1.25  
 Abs. Hum. (G/M<sup>3</sup>): 5.40  
 Sky-Target Contrast: -0.12  
 Rain Accumulation (MM): 0.00

# COMB INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45   |
|-----------|---------------|-----|-----|-----|------|
| Pre-Shot  | 77.0 -14.0    | 50  | 335 | 685 | 750+ |
| Post-Shot | 77.0 -14.0    | 25  | 195 | 550 | 750+ |

## CRATER DATA

Moisture Content: 11.7

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 1.327  
 Apparent Crater: 0.694  
 Flow: 0.633

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.450  
 Flow: 1.093  
 Bottom: 1.124  
 Side: 1.061

## HI VOL DATA (G):

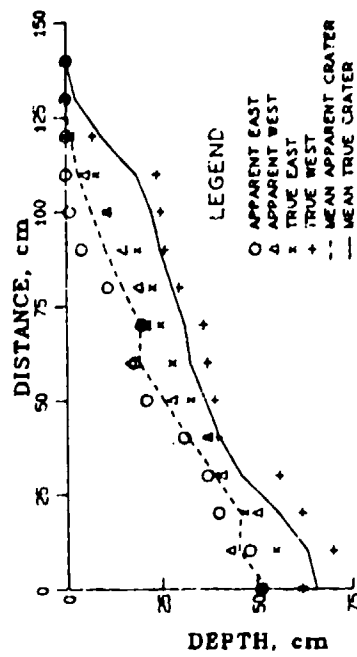
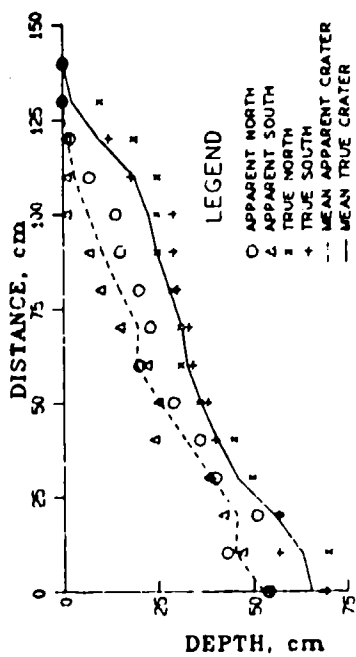
| HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.4746 | 0.1274 | 0.0000 | 0.0132 | 0.0203 | 0.0351 | 0.1326 | 0.2131 |

SUM: 1.0763

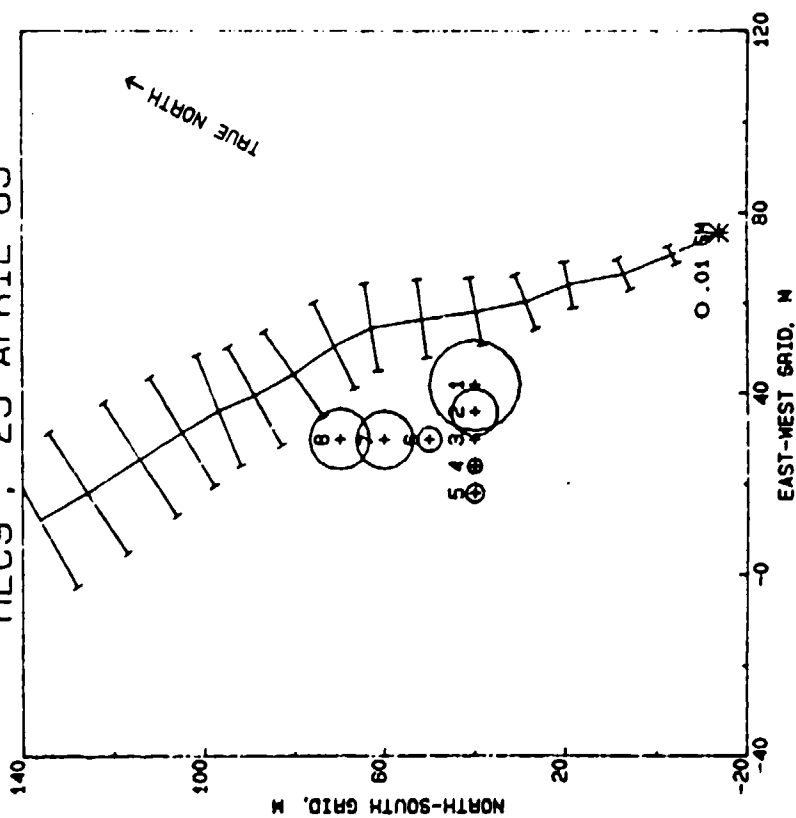
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 61.611   | 139.200  | 63.512   | 59.459   |

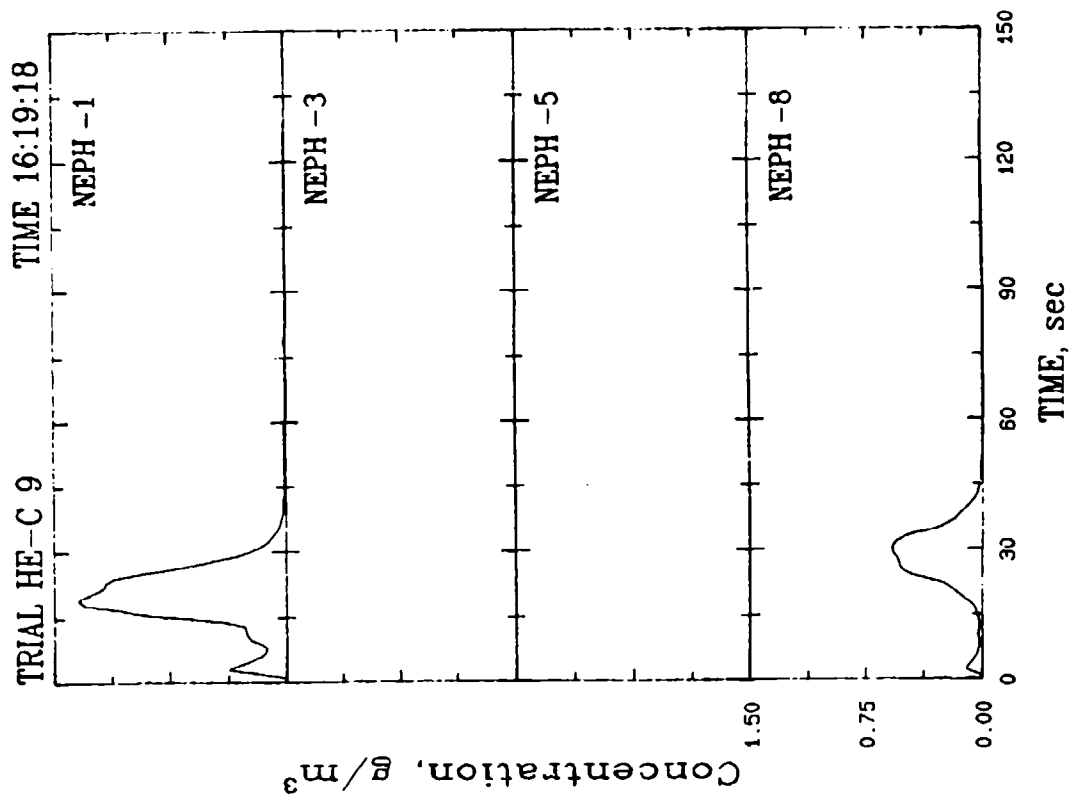
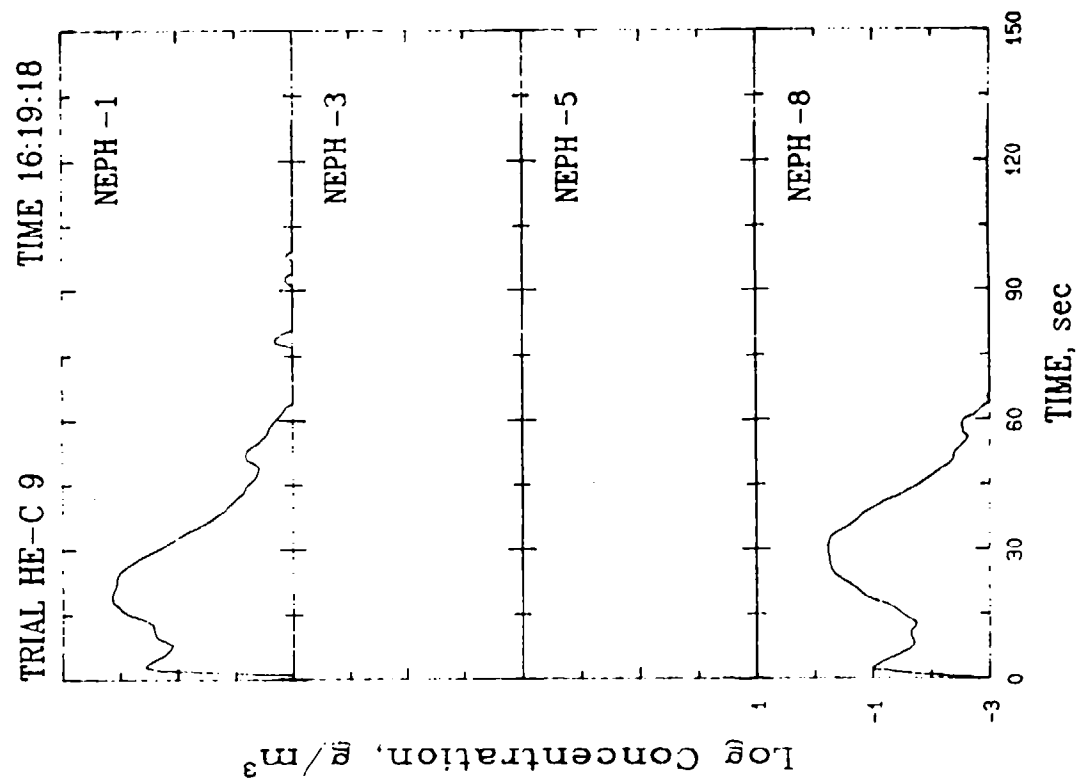
C9 25LB 1619HR 23APR83 76,-14

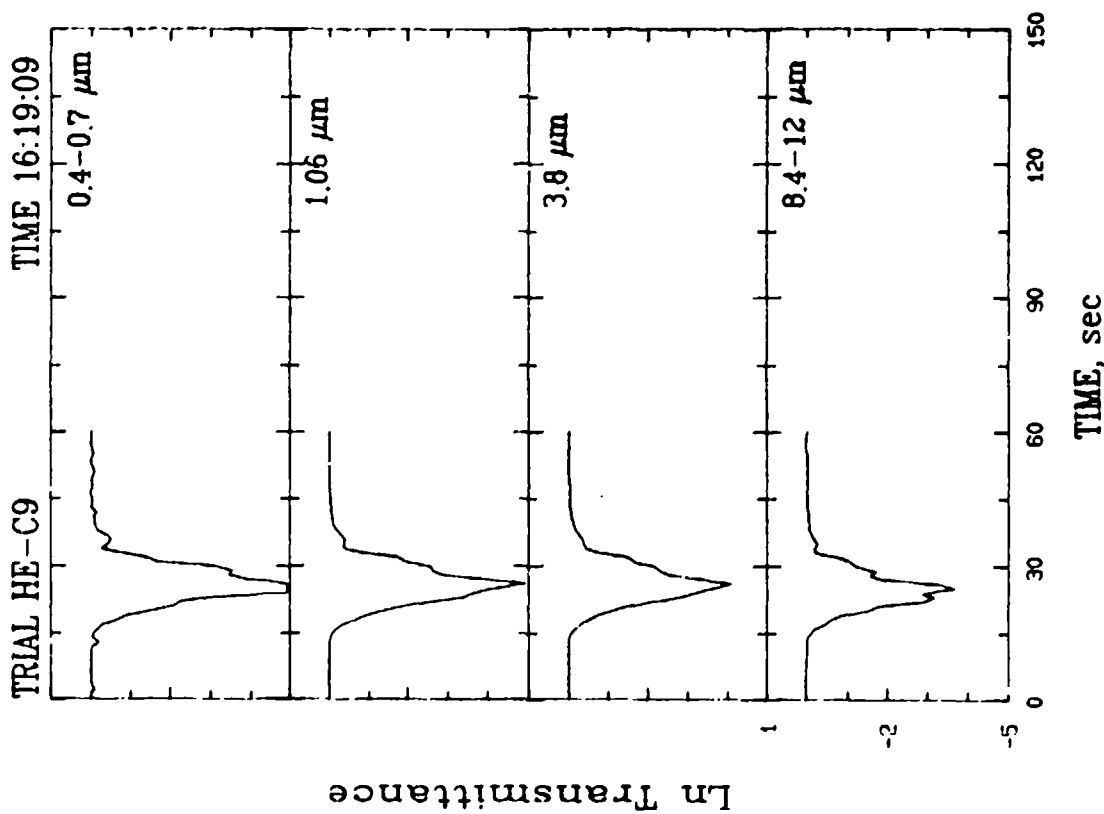
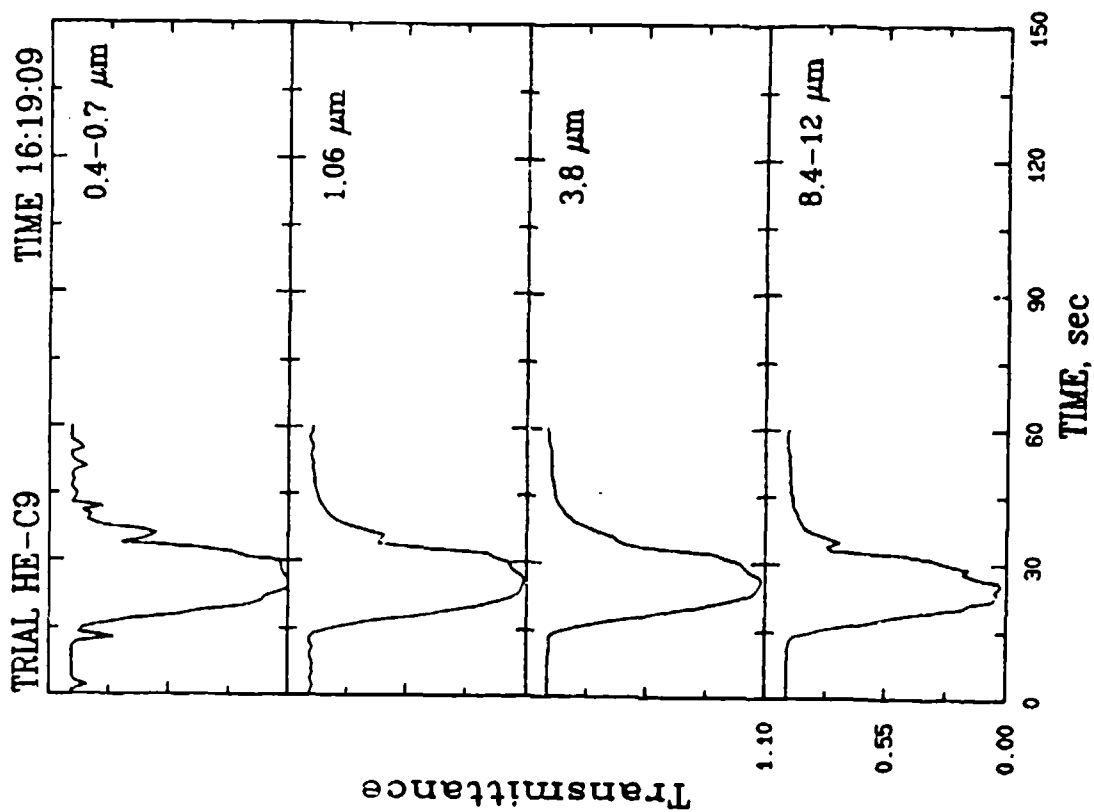


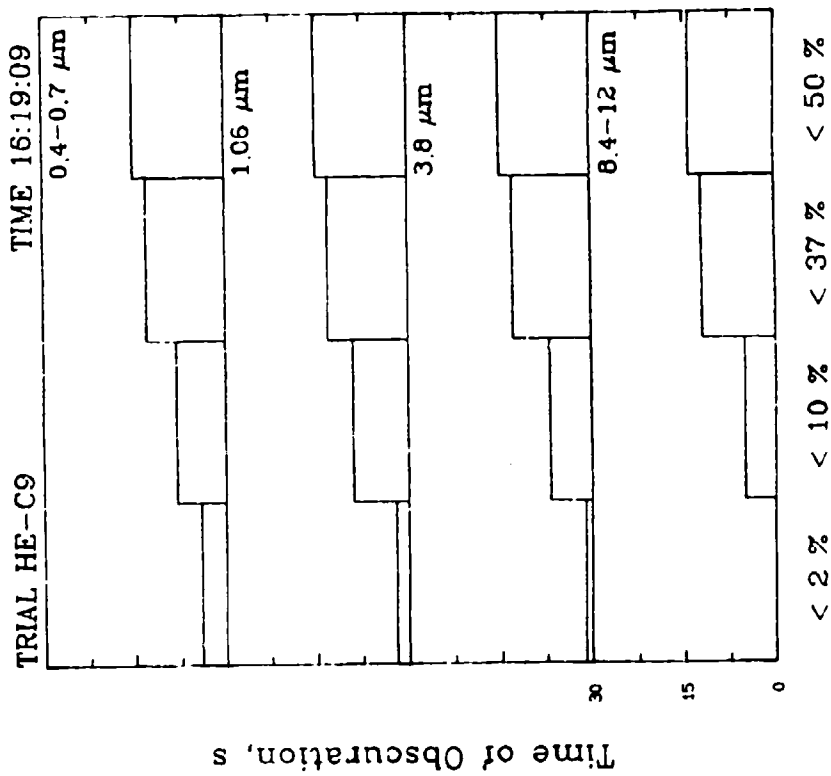
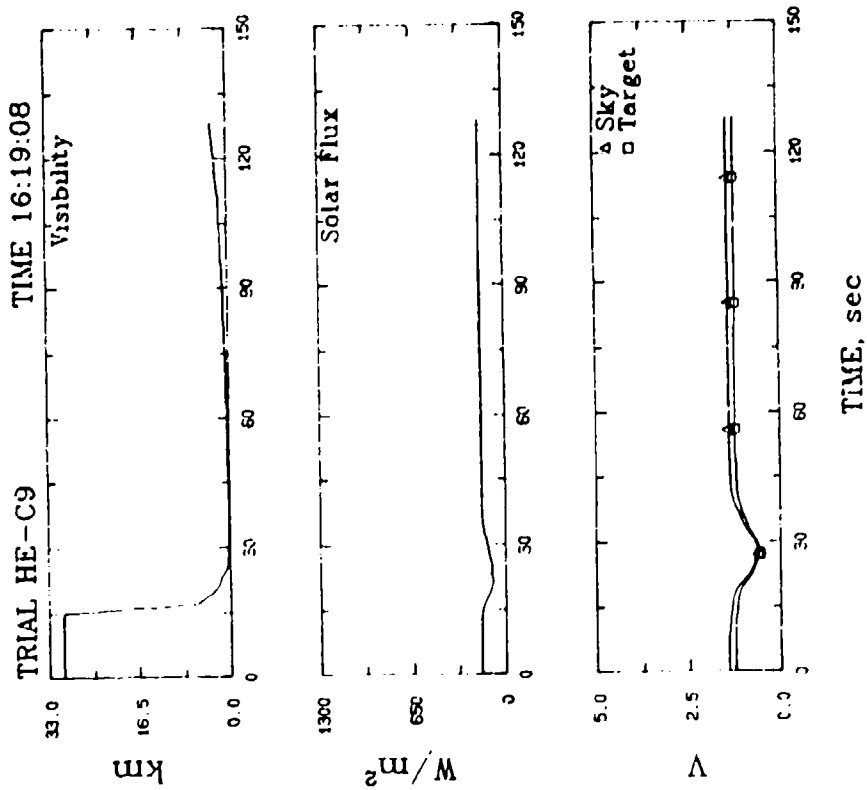
HEC9 . 23 APRIL 83



MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS







# EVENT SUMMARY DATA

Test Number: HEC10 Surface Tangent  
 Date: 25 APRIL 83 Charge Shape: BLOCK  
 Detonation Coordinates (M): Charge Wt: 25.0 LB  
 X: 10.2 Event Time: 14:09:22  
 Y: 23.5

## METEOROLOGICAL DATA:

Pasquill Category: C  
 Richardson Number: -0.122

16 Meter Tower (Means)  
 Start Time: 14: 8:27 End Time: 14:11:24

|                  | 2K    | 4M    | 6M    | 16M   |
|------------------|-------|-------|-------|-------|
| Wind Speed (M/S) | 8.07  | 8.94  | 9.21  | 10.30 |
| Wind Dir. (DEG)  | 212.3 | 211.2 | 212.4 | 208.6 |
| Sigma WSP        | 1.64  | 1.60  | 1.50  | 1.43  |
| Sigma WDIR       | 13.4  | 12.4  | 13.1  | 11.7  |
| UVW Components   |       |       |       |       |
| U (N-S)          | 6.64  | 7.45  | 7.54  | 8.85  |
| V (E-W)          | 4.23  | 4.59  | 4.89  | 4.85  |
| W (Vert)         | 0.08  | 0.59  | -0.02 | *     |
| Sigma U          | 1.68  | 1.56  | 1.47  | 1.54  |
| Sigma V          | 1.76  | 1.89  | 2.06  | 1.99  |
| Sigma W          | 0.28  | 0.33  | 0.33  | *     |
| Temperature (C)  | 24.9  | 24.0  | 23.6  | 22.9  |

Soil Temperature (C): 39.2 Solar Flux (W/M<sup>2</sup>): 970.6  
 Dew Point (C): -11.4 Visual Range (M): 30480.0  
 Temperature (C): 24.0 Vista Ranger Voltages:  
 Rel. Hum. (%): 7.7 Sky: 1.84  
 Target: 0.88  
 Abs. Hum. (G/M<sup>3</sup>): 1.67 Sky-Target Contrast: -0.52  
 Rain Accumulation (MM): 0.00

# CONE INDEX:

|           | X,Y Coord (M) | SFC | 15  | 30  | 45  |
|-----------|---------------|-----|-----|-----|-----|
| Pre-Shot  | 10.0 23.0     | 100 | 213 | 250 | 235 |
| Post-Shot | 10.0 23.0     | 25  | 135 | 250 | 465 |

## CRATER DATA

Moisture Content: 12.4

CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 1.335  
 Apparent Crater: 0.443  
 Flow: 0.892

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.310  
 Flow: \*  
 Bottom: 1.137  
 Side: 1.113

## RI VOL DATA (G):

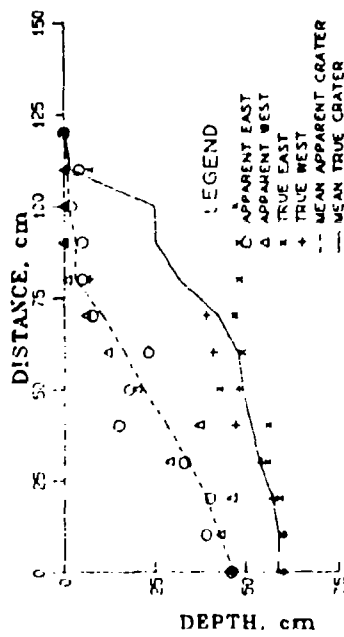
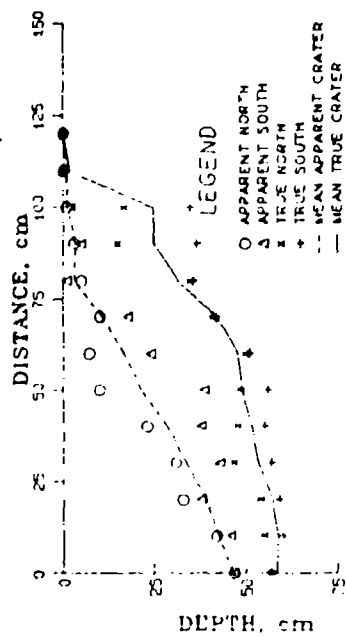
|  | HV1    | HV2    | HV3    | HV4    | HV5    | HV6    | HV7    | HV8    |
|--|--------|--------|--------|--------|--------|--------|--------|--------|
|  | 0.0540 | 0.1145 | 0.6082 | 0.4340 | 0.5880 | 0.3617 | 0.3948 | 0.1246 |

SUM: 2.6798

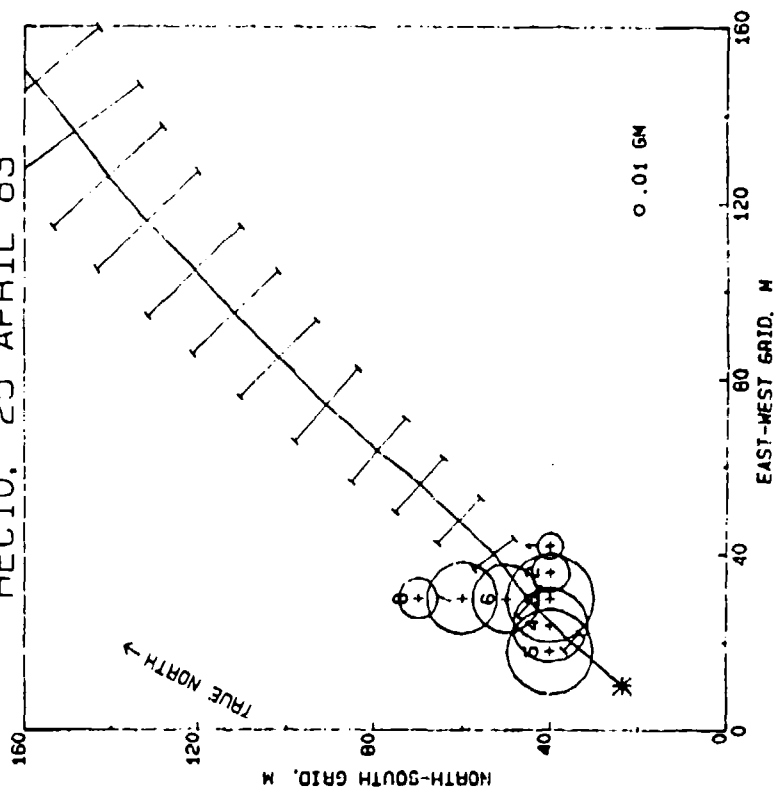
## GELMAN DOSAGE (G S/M<sup>3</sup>):

| GELMAN A | GELMAN B | GELMAN C | GELMAN D |
|----------|----------|----------|----------|
| 11.374   | 12.000   | 6.725    | 76.757   |

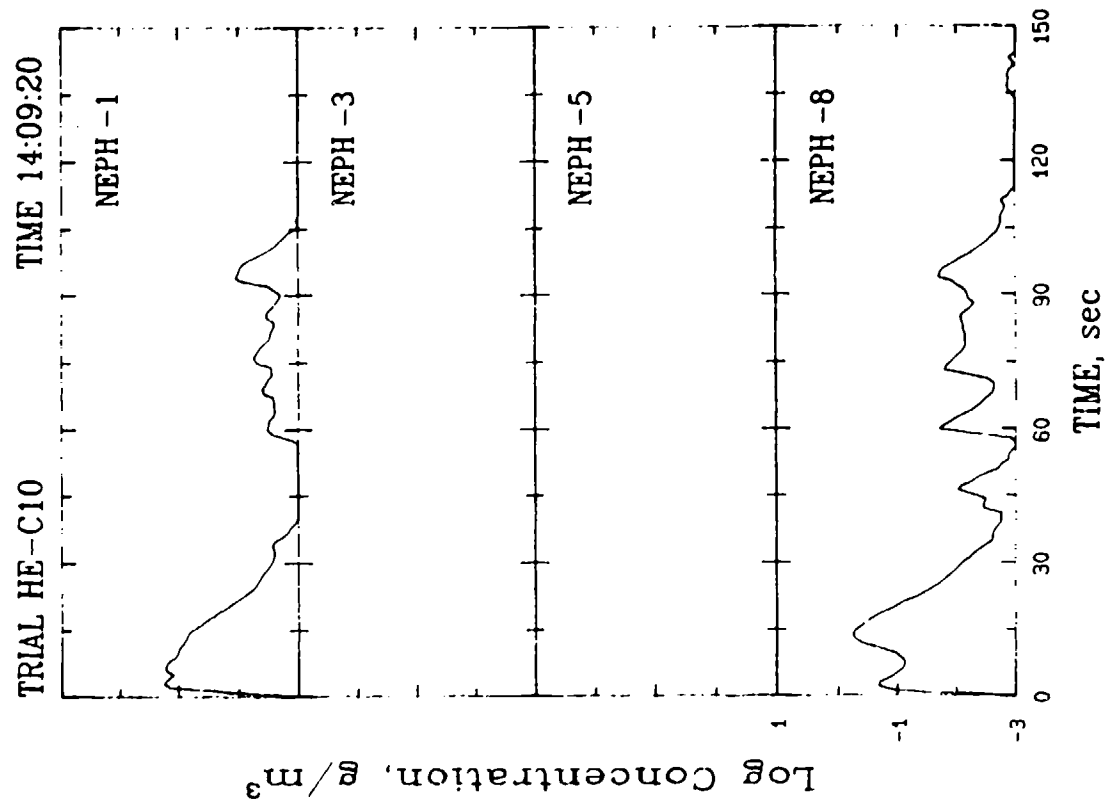
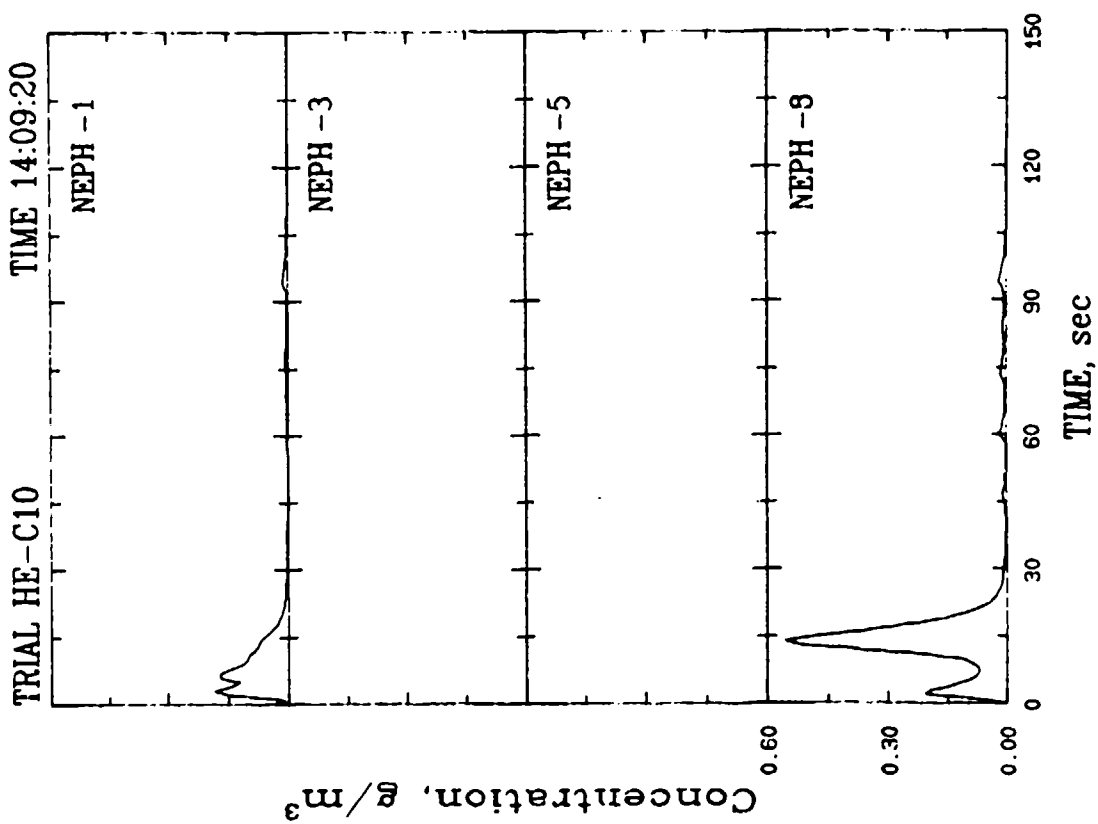
C10 25LB 1400HR 25APR83 10,23

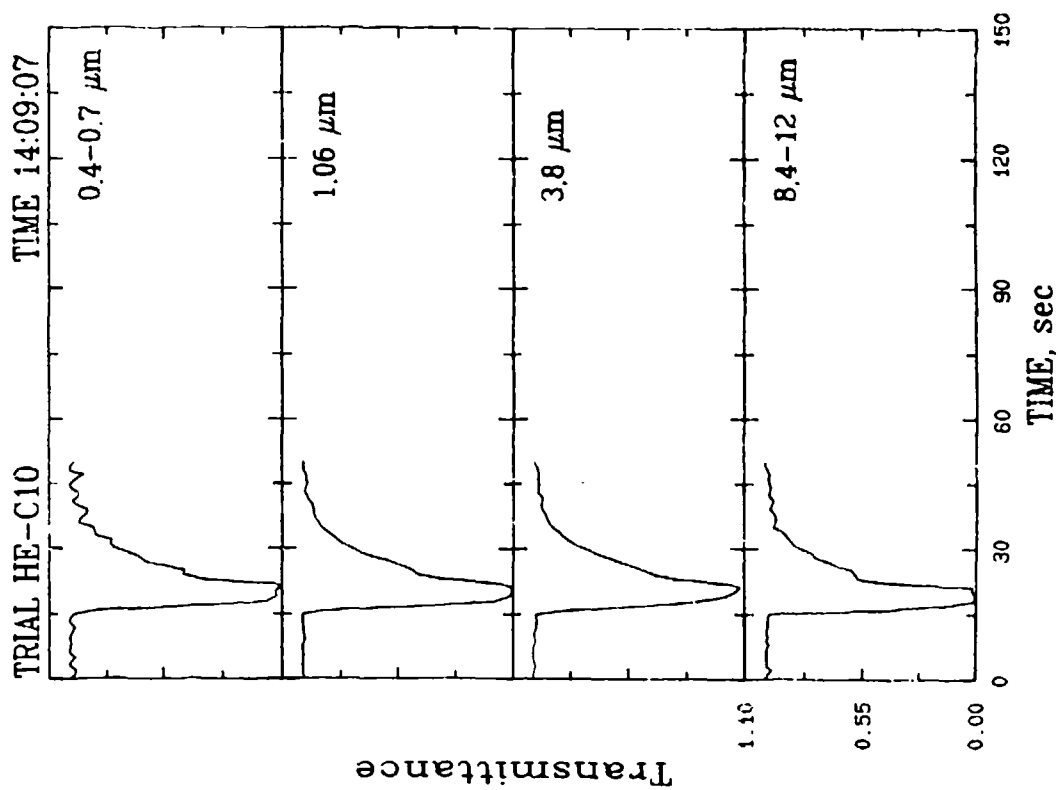
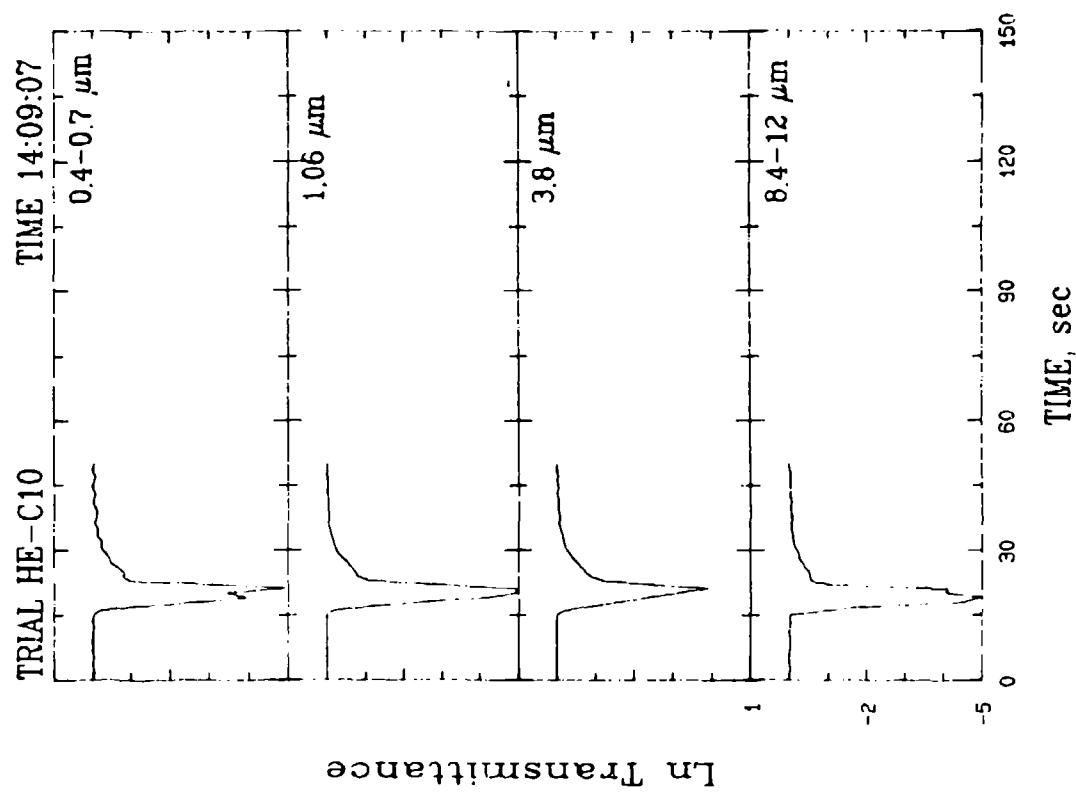


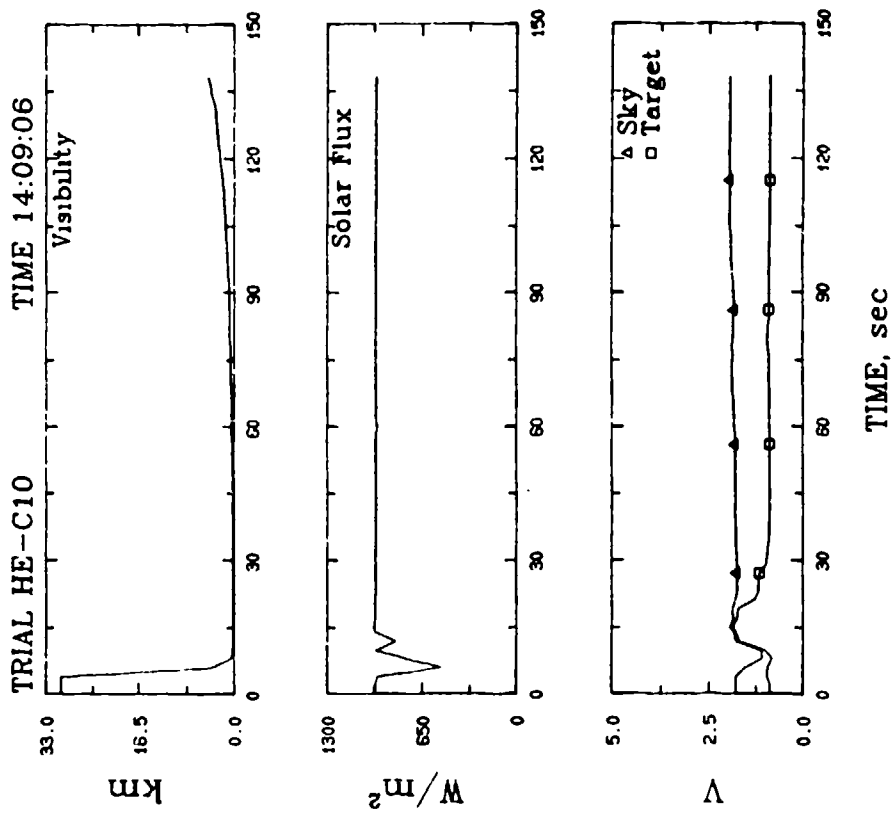
HEC10, 25 APRIL 83

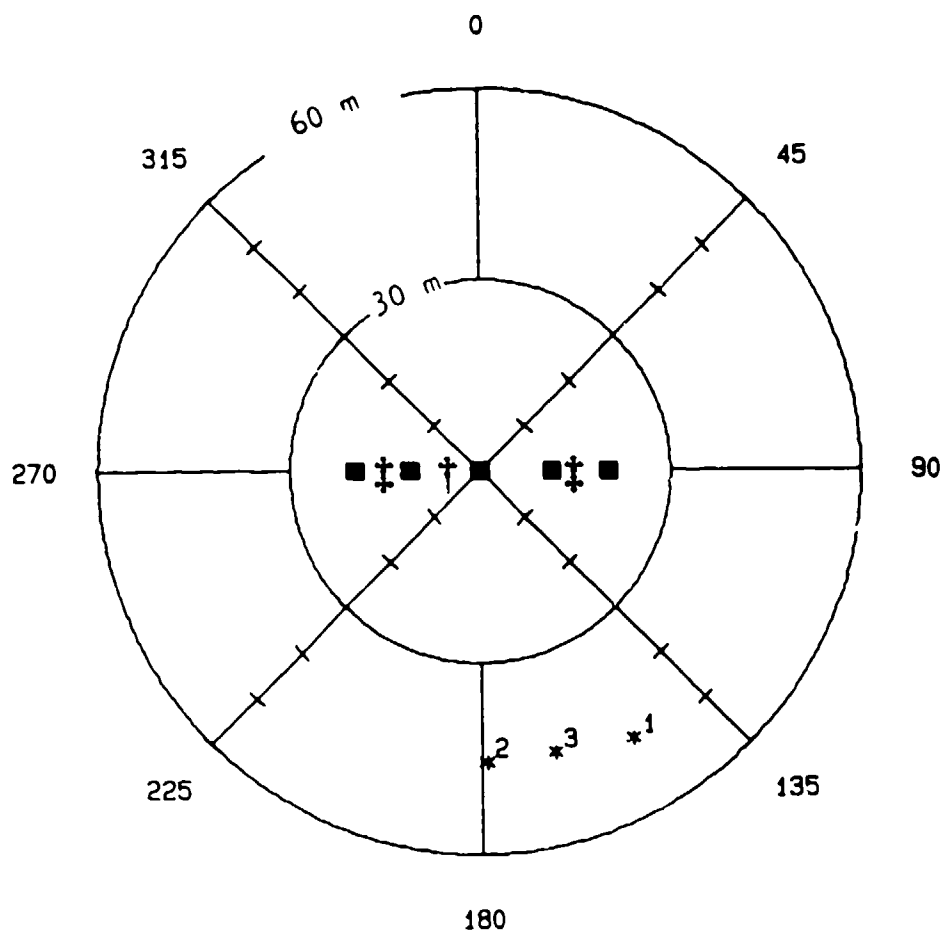


MASSSES COLLECTED BY HI-VOL SAMPLERS  
CLOUD PATH AND WIDTH BY 2-SEC INTERVALS









- † — MET TOWER
- † — TETHERED BALLOONS
- — HI-VOL SAMPLERS
- \* — DETONATION LOCATIONS  
FOR SHOTS 1B, 2B, AND 3C

# EVENT SUMMARY DATA

Test Number: HE1B (TEST 8) Surface Target  
 Date 04 AUGUST 83 Charge Shape: SPHERICAL  
 Detonation Coordinates : Charge Wt: 15.0 LB  
 AZIMUTH (DEG): 150 Event Time: 12:11  
 RANGE (M): 50

## METEOROLOGICAL DATA:

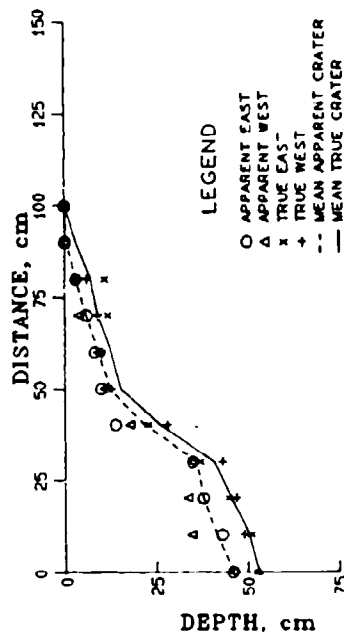
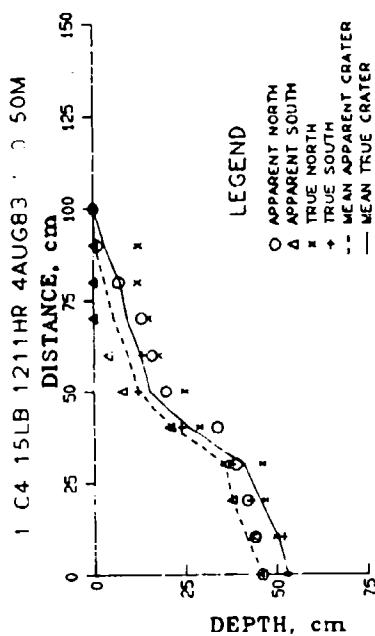
Start Time: 11:45 End Time: 12:07  
 Wind Speed (M/S): 2.5  
 Wind Direction (DEG): 170  
 Temperature (C): 16.7  
 Relative Humidity (%): 46

## CONE INDEX:

|           | Range | Azimuth | SFC | 15  | 30  | 45  |
|-----------|-------|---------|-----|-----|-----|-----|
| Pre-Shot  | 50.0  | 150.0   | •   | 333 | 583 | 711 |
| Post-Shot | 50.0  | 150.0   | •   | 358 | 628 | 733 |

## CRATER DATA

Moisture Content: 11.6  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.480  
 Apparent Crater: 0.320  
 Flow: 0.160  
 DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.71  
 Post Shot: 1.85



# EVENT SUMMARY DATA

Test Number: H22B (TEST 9) Surface Tangent  
 Date: 04 AUGUST 83 Charge Shape: SPHERICAL  
 Detonation Coordinates: Charge Wt: 15.0 LB  
 AZIMUTH (DEG): 179 Event Time: 13:19  
 RANGE (M): 46

## METEOROLOGICAL DATA:

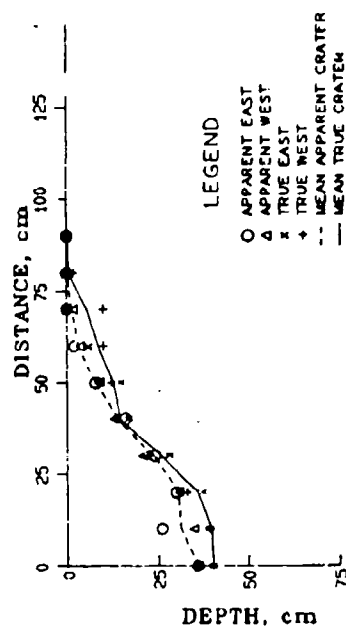
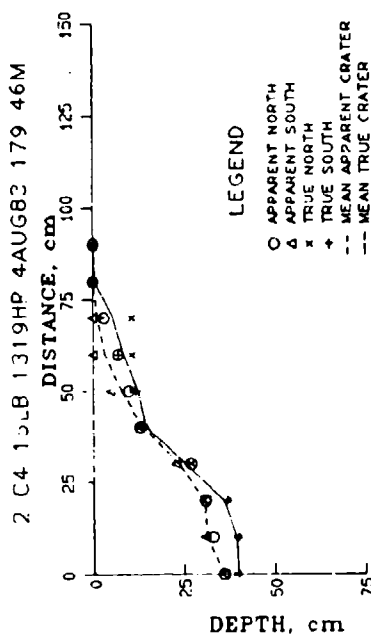
Start Time: 12:45 End Time: 13:01  
 Wind Speed (M/S): 2.7  
 Wind Direction (DEG): 155  
 Temperature (C): 29.4  
 Relative Humidity (%): 40

## JCNE INDEX:

| Range, Azimuth       | SFC | 15  | 30  | 45   |
|----------------------|-----|-----|-----|------|
| Pre-Shot 46.0 179.0  | •   | 315 | 700 | 730+ |
| Post-Shot 46.0 179.0 | •   | 336 | 722 | 730+ |

## CRATER DATA

Moisture Content: 17.5  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.254  
 Apparent Crater: 0.188  
 FLOW: 0.066  
 DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.94  
 Post Shot: 1.91



# EVENT SUMMARY DATA

Test Number: HESC (TEST 10) Surface Tangent  
 Date 04 AUGUST 83 Charge Shape: SPHERICAL  
 Detonation Coordinates: Charge Wt: 25.0 LB  
 AZIMUTH (DEG): 165 Event Time: 14:00  
 RANGE (M): 45

## METEOROLOGICAL DATA

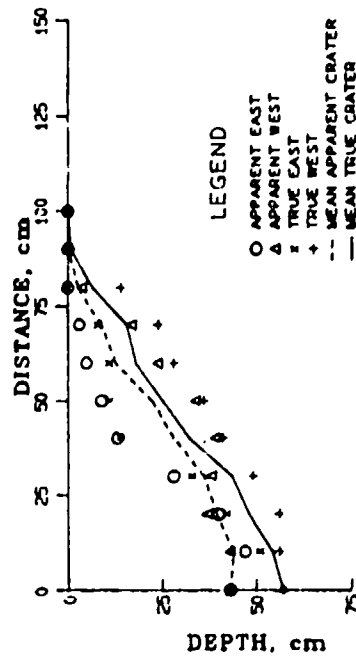
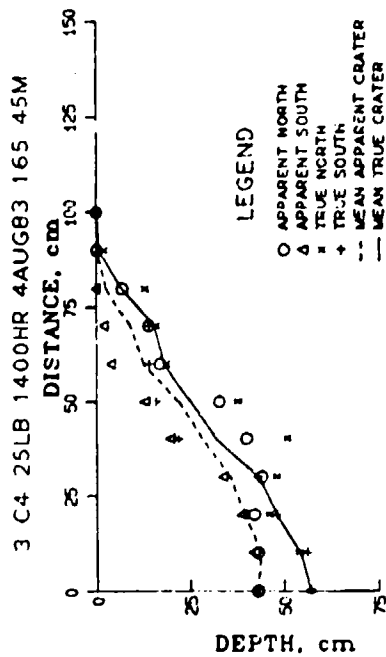
Start Time: 13:44 End Time: 14:00  
 Wind Speed (M/S): 2.5  
 Wind Direction (DEG): 110  
 Temperature (C): 22.2  
 Relative Humidity (%): 44

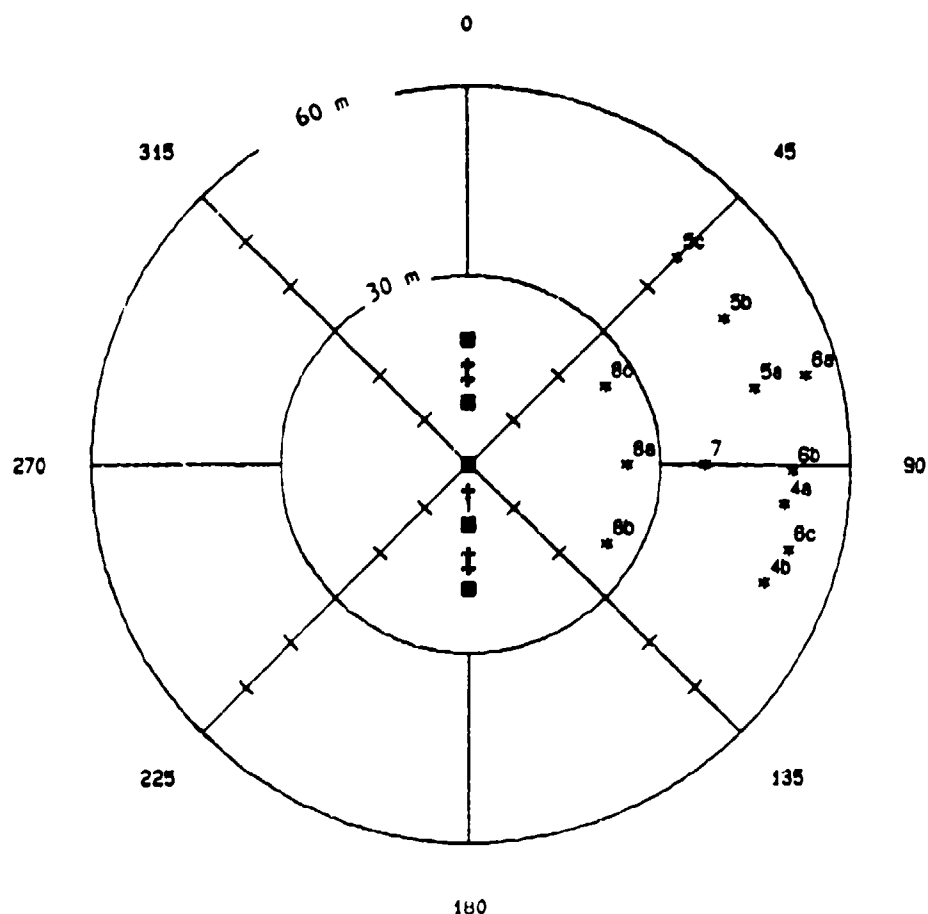
## CONE INDEX:

|           | Range, Azimuth | SFC | 15  | 30  | 45   |
|-----------|----------------|-----|-----|-----|------|
| Pre-Shot  | 45.0 165.0     | •   | 317 | 633 | 750+ |
| Post-Shot | 45.0 165.0     | •   | 255 | 590 | 667  |

## CRATER DATA

Moisture Content: 13.2  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.517  
 Apparent Crater: 0.393  
 Flow: 0.124  
 DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.93  
 Post Shot: 1.78





- † — MET TOWER
- ⊕ — TETHERED BALLOONS
- — HI-VOL SAMPLERS
- \* — DETONATION LOCATIONS  
FOR SHOTS

# EVENT SUMMARY DATA

Test Number: 4E4B-a (TEST 11) Surface Tangent  
 Date: 04 AUGUST 83 Charge Shape: SPHERICAL  
 Detonation Coordinates: Charge Wt: 15.0 LB  
 AZIMUTH (DEG): 112 Event Time: 15:30  
 RANGE (M): 50

## METEOROLOGICAL DATA:

Start Time: 14:34 End Time: 15:10  
 Wind Speed (M/S): 3.4  
 Wind Direction (DEG): 115  
 Temperature (C): 30.0  
 Relative Humidity (%): 40

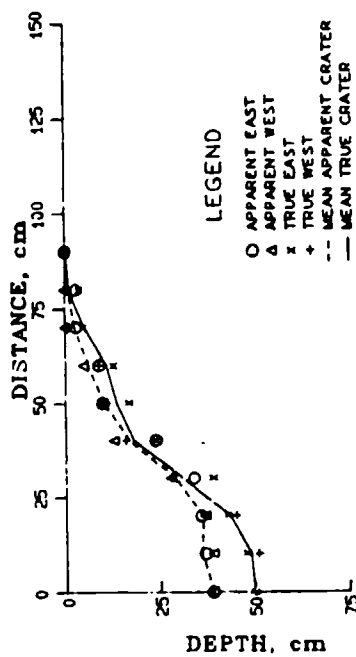
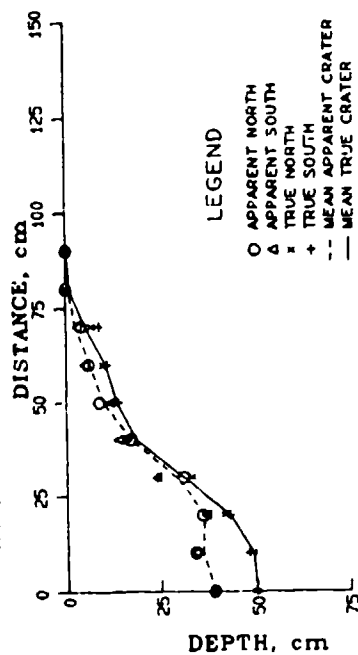
## CONE INDEX:

|           | Range | Azimuth | SFC | 15  | 30  | 45  |
|-----------|-------|---------|-----|-----|-----|-----|
| Pre-Shot  | 50.0  | 112.0   | •   | 317 | 617 | 745 |
| Post-Shot | 50.0  | 112.0   | •   | 328 | 472 | 505 |

## CRATER DATA

Moisture Content: 11.6  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.309  
 Apparent Crater: 0.243  
 Flow: 0.066  
 DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.78  
 Post Shot: 1.76

4A C4 15LB 1530HR 4AUG83 112 50M



# EVENT SUMMARY DATA

Test Number: HE4B-b (TEST 11) Surface Tangent  
 Date: 04 AUGUST 83 Charge Shape: SPHERICAL  
 Detonation Coordinates: Charge Wt: 15.0 LB  
 AZIMUTH (DEG): 097 Event Time: 15:40  
 RANGE (M): 50

## METEOROLOGICAL DATA:

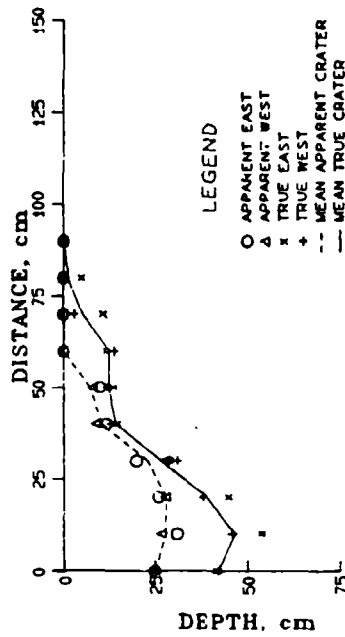
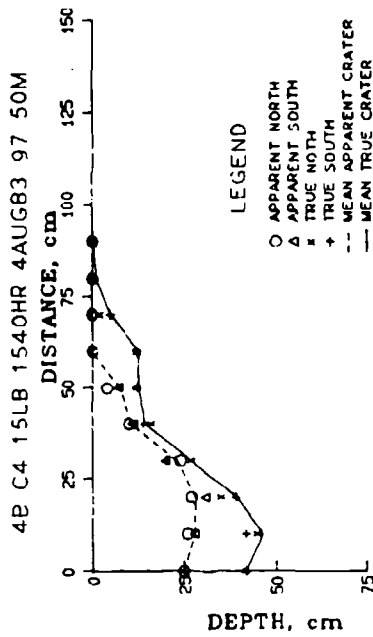
Start Time: 14:34 End Time: 15:10  
 Wind Speed (M/S): 3.4  
 Wind Direction (DEG): 115  
 Temperature (C): 30.0  
 Relative Humidity (%): 40

## CONE INDEX:

|           | Range, Azimuth | SFC | 15  | 30  | 45   |
|-----------|----------------|-----|-----|-----|------|
| Pre-Shot  | 50.0 097.0     | •   | •   | •   | •    |
| Post-Shot | 50.0 097.0     | •   | 322 | 695 | 750+ |

## CRATER DATA

Moisture Content: 10.5  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.288  
 Apparent Crater: 0.151  
 Flow: 0.137  
 DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.70  
 Post Shot: 1.70



# EVENT SUMMARY DATA

Test Number: HESB-a (TEST 14) Surface Tangent  
 Date: 05 AUGUST 83 Charge Shape: SPHERICAL  
 Detonation Coordinates: Charge Wt: 15.0 LB  
 AZIMUTH (DEG): 075 Event Time: 11:50  
 RANGE (M): 46

## METEOROLOGICAL DATA:

Start Time: 11:10 End Time: 11:44  
 Wind Speed (M/S): 3.4  
 Wind Direction (DEG): 080  
 Temperature (C): NO DATA  
 Relative Humidity (%): NO DATA

## CONE INDEX:

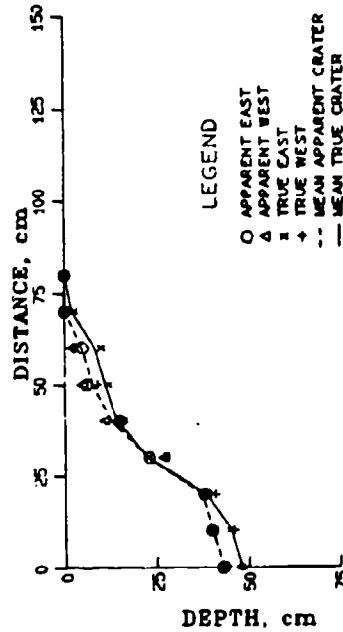
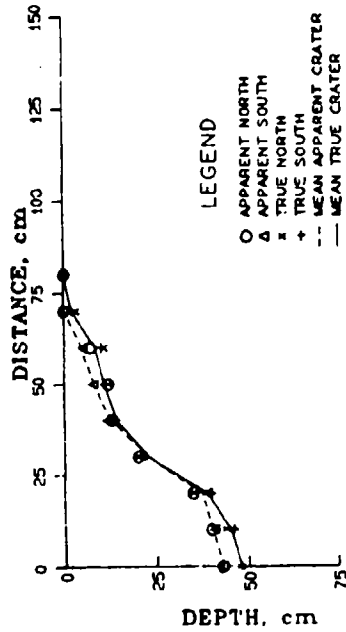
|           | Range, Azimuth | SFC | 15  | 30   | 45   |
|-----------|----------------|-----|-----|------|------|
| Pre-Shot  | 47.0 061.0     | •   | 578 | 750+ | 750+ |
| Post-Shot | 46.0 075.0     | •   | 330 | 703  | 750+ |

## CRATER DATA

Moisture Content: 7.9  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.238  
 Apparent Crater: 0.196  
 Flow: 0.042

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.69  
 Post Shot: 1.71

5A C4 15LB 1150HR SAUG83 75 46M



# EVENT SUMMARY DATA

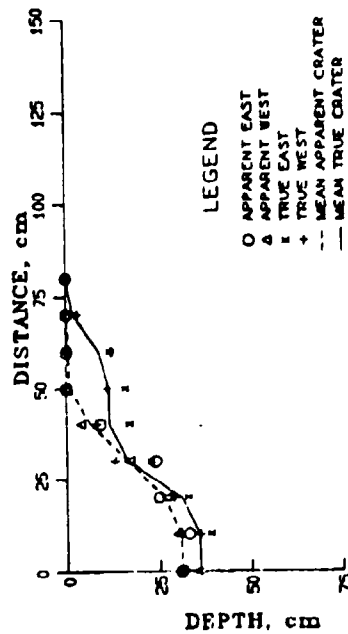
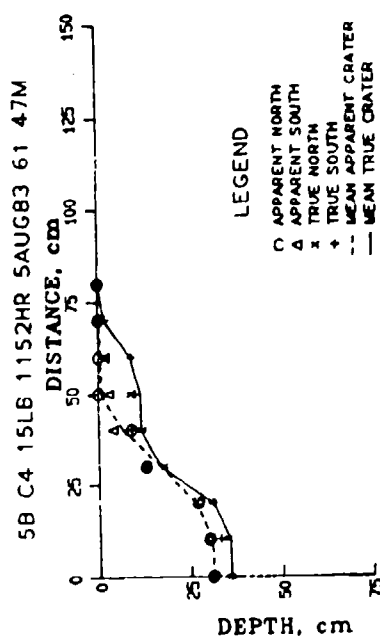
Test Number: HESB-b (TEST 14) Surface Tangent  
 Date: 05 AUGUST 83 Charge Shape: SPHERICAL  
 Detonation Coordinates: Charge Wt: 15.0 LB  
 AZIMUTH (DEG): 061 Even: Time: 11:32  
 RANGE (M): 47

METEOROLOGICAL DATA:  
 Start Time: 11:10 End Time: 11:44  
 Wind Speed (M/S): 3.4  
 Wind Direction (DEG): 080  
 Temperature (C): NO DATA  
 Relative Humidity (%): NO DATA

| CONE INDEX: |      | Range | Azimuth | SFC | 15  | 30   | 45 |
|-------------|------|-------|---------|-----|-----|------|----|
| Pre-Shot    | 47.0 | 061.0 | •       | •   | •   | •    | •  |
| Post-Shot   | 47.0 | 061.0 | •       | 439 | 728 | 750+ |    |

## CRATER DATA

Moisture Content: 8.2  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.228  
 Apparent Crater: 0.110  
 Flow: 0.086  
 DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.50  
 Post Shot: 1.50



# EVENT SUMMARY DATA

Test Number: HEIB-c (TEST 14) Surface Tangent  
 Date: 05 AUGUST 83 Charge Shape: SPHERICAL  
 Detonation Coordinates: Charge Wt: 15.0 LB  
 AZIMUTH (DEG): 045 Event Time: 11:44  
 RANGE (M): 46

## METEOROLOGICAL DATA:

Start Time: 11:10 End Time: 11:44

Wind Speed (M/S): 3.4

Wind Direction (DEG): 080

Temperature (C): NO DATA

Relative Humidity (%): NO DATA

## CONE INDEX:

|           | Range, Azimuth | SFC | 15  | 30  | 45   |
|-----------|----------------|-----|-----|-----|------|
| Pre-Shot  | 46.0 045.0     | •   | •   | •   | 75 • |
| Post-Shot | 47.0 045.0     | •   | 354 | 670 | 750+ |

## CRATER DATA

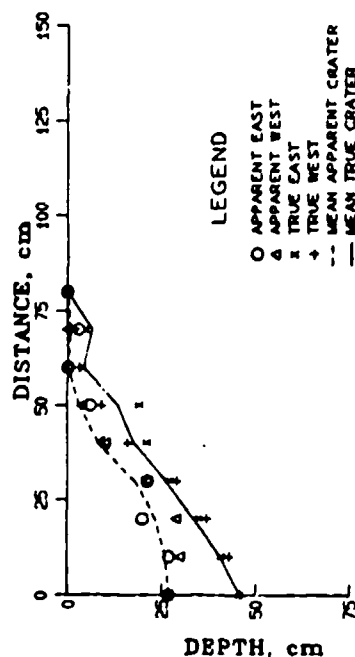
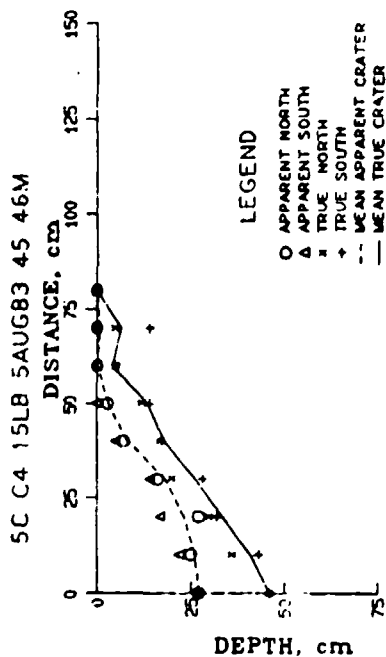
Moisture Content: 5.0

## CRATER VOLUMES (M<sup>3</sup>):

True Crater: 0.256  
 Apparent Crater: 0.118  
 Flow: 0.138

## DENSITIES (G/CM<sup>3</sup>):

Pre-Shot: 1.71  
 Post Shot: 1.71



# EVENT SUMMARY DATA

Test Number: HE6C-a (TEST 15) Surface Target  
 Date: 05 AUGUST 83 Charge Shape: SPHERICAL  
 Detonation Coordinates: Charge Wt: 25.0 LB  
 AZIMUTH (DEG): 075 Event Time: 13:35  
 RANGE (M): 55

## METEOROLOGICAL DATA:

Start Time: 12:22 End Time: 12:45

Wind Speed (M/S): 2.9

Wind Direction (DEG): 075

Temperature (C): 33.3

Relative Humidity (%): 35

## CONE INDEX:

|           | Range, Azimuth | SFC | 15  | 30  | 45   |
|-----------|----------------|-----|-----|-----|------|
| Pre-Shot  | 55.0 075.0     | •   | 372 | 678 | 750+ |
| Post-Shot | 55.0 075.0     | •   | •   | •   | •    |

## CRATER DATA

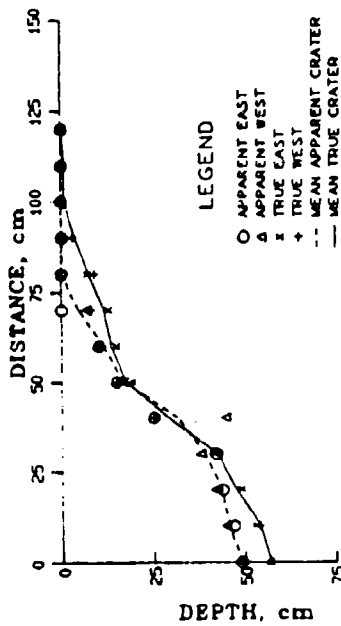
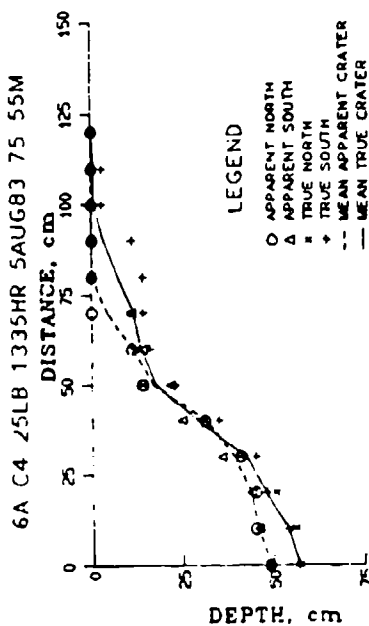
Moisture Content: 8.1

CRATER VOLUMES (M<sup>3</sup>):

True Crater: 0.481  
 Apparent Crater: 0.360  
 Flow: 0.121

DENSITIES (G/CM<sup>3</sup>):

Pre-Shot: 1.79  
 Post Shot: •



# EVENT SUMMARY DATA

Test Number: HE6C-b (TEST 15) Surface Tangent  
 Date: 05 AUGUST 83 Charge Shape: SPHERICAL  
 Detonation Coordinates: Charge Wt: 25.0 LB  
 AZIMUTH (DEG): 09; Event Time: 13:35  
 RANGE (M): 51

## METEOROLOGICAL DATA:

Start Time: 12:22 End Time: 12:45

Wind Speed (M/S): 2.9

Wind Direction (DEG): 075

Temperature (C): 33.3

Relative Humidity (%): 35

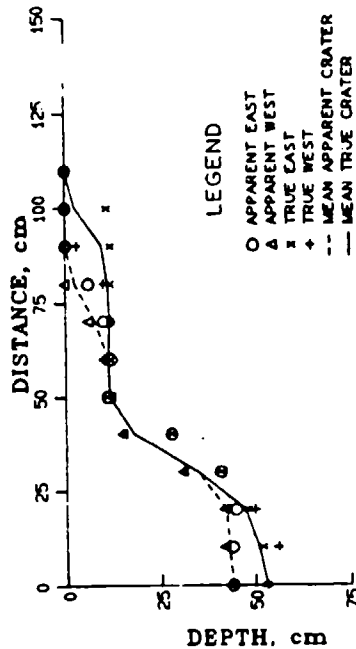
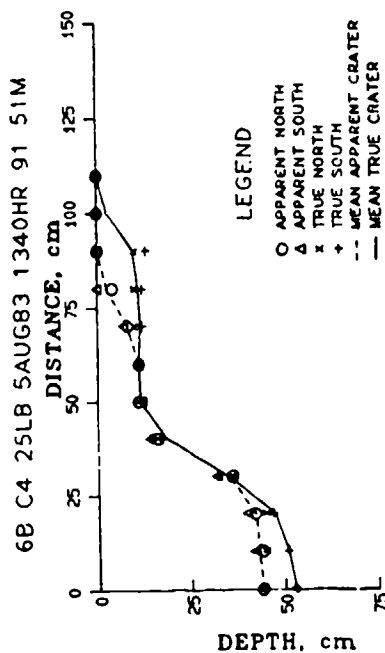
## CONE INDEX:

|           | Range, Azimuth | SFC | 15  | 30  | 45   |
|-----------|----------------|-----|-----|-----|------|
| Pre-Shot  | 55.0 075.0     | •   | 372 | 678 | 750+ |
| Post-Shot | 55.0 075.0     | •   | •   | •   | •    |

## CRATER DATA

Moisture Content: 8.3  
 CRATER VOLUMES (M<sup>3</sup>):  
 True Crater: 0.467  
 Apparent Crater: 0.323  
 Flow: 0.144

DENSITIES (G/CM<sup>3</sup>):  
 Pre-Shot: 1.62  
 Post Shot: •



# EVENT SUMMARY DATA

Test Number: HEGC-c (TEST 15) Surface Tangent

Date: 05 AUGUST 83 Charge Shape: SPHERICAL

Detonation Coordinates: Charge Wt: 25.0 LB

AZIMUTH (DEG): 090 Event Time: 00:00

RANGE (M): 37

## METEOROLOGICAL DATA:

Start Time: 12:22 End Time: 12:45

Wind Speed (M/S): 2.5

Wind Direction (DEG): 075

Temperature (C): 33.3

Relative Humidity (%): 35

## CONE INDEX:

|           | Range | Azimuth | SFC | 15  | 30  | 45   |
|-----------|-------|---------|-----|-----|-----|------|
| Pre-Shot  | 55.0  | 075.0   | •   | 372 | 678 | 750+ |
| Post-Shot | 55.0  | 075.0   | •   | •   | •   | •    |

## CRATER DATA

Moisture Content: •

CRATER VOLUMES (M<sup>3</sup>):

True Crater: •

Apparent Crater: •

Flow: •

DENSITIES (G/CM<sup>3</sup>):

Pre-Shot: •

Post Shot: •

# EVENT SUMMARY DATA

Test Number: HETC (TEST 16) Surface Tangent

Date: 05 AUGUST 83 Charge Shape: SPHERICAL

Detonation Coordinates: Charge Wt: 25.0 LB

AZIMUTH (DEG): 090 Event Time: 00:00

RANGE (M): 37

## METEOROLOGICAL DATA:

Start Time: 13:15 End Time: 13:30

Wind Speed (M/S): 4.0

Wind Direction (DEG): 075

Temperature (C): NO DATA

Relative Humidity (%): NO DATA

## CONE INDEX:

|           | Range | Azimuth | SFC | 15  | 30  | 45  |
|-----------|-------|---------|-----|-----|-----|-----|
| Pre-Shot  | 37.0  | 090.0   | •   | 258 | 583 | 745 |
| Post-Shot | 37.0  | 090.0   | •   | 113 | 433 | 595 |

## CRATER DATA

Moisture Content: 11.8

CRATER VOLUMES (M<sup>3</sup>):

True Crater: •

Apparent Crater: •

Flow: •

DENSITIES (G/CM<sup>3</sup>):

Pre-Shot: •

Post Shot: 1.64

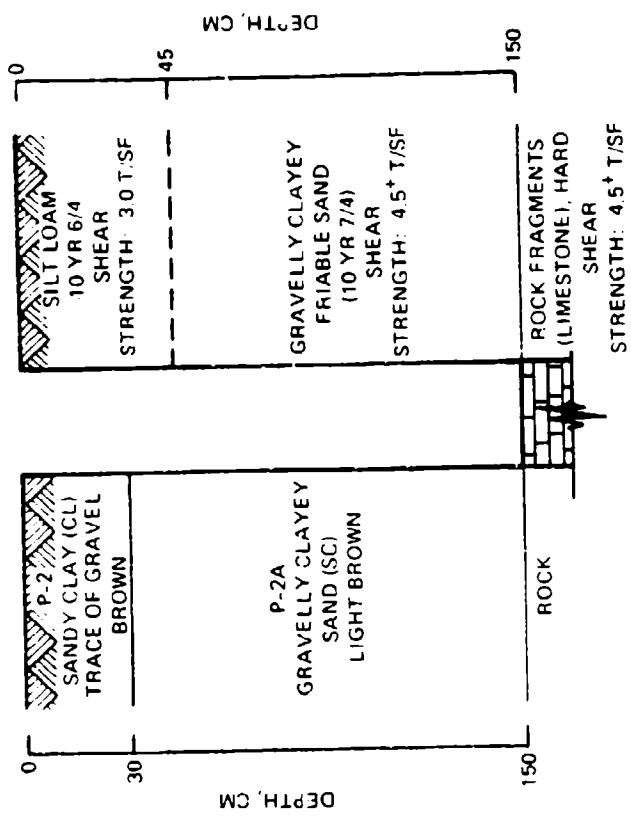
APPENDIX B: SOILS DATA FROM DOT I  
AND DOT II EXERCISES

PIT SOIL DATA: DOT I

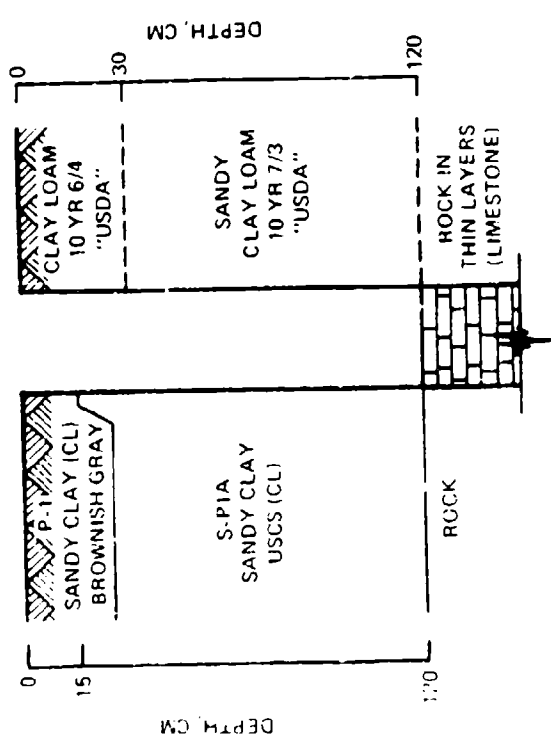
| Pit<br>Sample | Date<br>1983 | Locale<br>(m) |    | Depth<br>cm | Soil<br>Type<br>USCS | Finer<br>0.074um | Density*<br>gm/cc | Organic<br>Matter% | Moisture<br>Content% | Specific<br>Gravity |
|---------------|--------------|---------------|----|-------------|----------------------|------------------|-------------------|--------------------|----------------------|---------------------|
|               |              | X             | Y  |             |                      |                  |                   |                    |                      |                     |
| P1            | 4-15         | 0             | 80 | 10          | CL                   | 71               | 1.44/1.26         | 3.6                | 11.5                 | 2.68                |
| P1A           | 4-15         | 0             | 80 | 150         | CL                   | 64               | 1.45/1.35         | 2.2                | 2.0                  | 2.73                |
| P2            | 4-15         | 40            | 80 | 10          | CL                   | 72               | 1.69/1.48         | 2.9                | 14.1                 | 2.68                |
| P2A           | 4-15         | 40            | 80 | 150         | SC                   | 30               | 1.57/1.50         | 1.4                | 4.9                  | 2.76                |
| P3            | 4-16         | 80            | 80 | 10          | CL                   | -                | 1.62/1.45         | -                  | 10.3                 | 2.65                |
| P4            | 4-18         | 80            | 0  | 10          | CL                   | -                | 1.52/1.34         | -                  | 13.4                 | 2.69                |
| P4A           | 4-18         | 80            | 0  | 145         | CL                   | 78               | 1.51/1.38         | 2.2                | 9.4                  | 2.72                |
| P4B           | 4-18         | 80            | 0  | 60          | CL                   | 76               | 1.49/1.36         | 2.5                | 10.8                 | 2.71                |
| P5            | 4-18         | 40            | 0  | 10          | CL                   | -                | 1.55/1.40         | -                  | 13.8                 | 2.67                |
| P5A           | 4-18         | 40            | 0  | 40          | CL                   | 79               | -                 | 2.8                | -                    | 2.72                |
| P5B           | 4-18         | 40            | 0  | 180         | CL                   | 81               | 1.51/1.38         | 1.7                | 9.2                  | 2.76                |
| P5C           | 4-18         | 40            | 0  | 40          | CL                   | -                | 1.53/1.38         | -                  | 10.5                 | 2.69                |
| P6            | 4-18         | 0             | 0  | 10          | CL                   | -                | 1.57/1.46         | -                  | 7.9                  | 2.68                |
| P6A           | 4-18         | 0             | 0  | 65          | CL                   | 62               | 1.67/1.53         | 2.5                | 8.9                  | -                   |

\* Density wet/density dry.

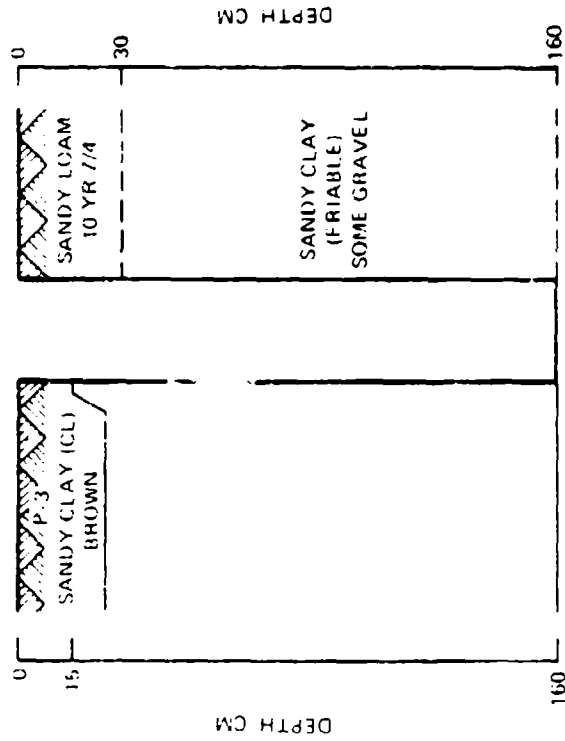
PIT NO. 2  
X40, Y80



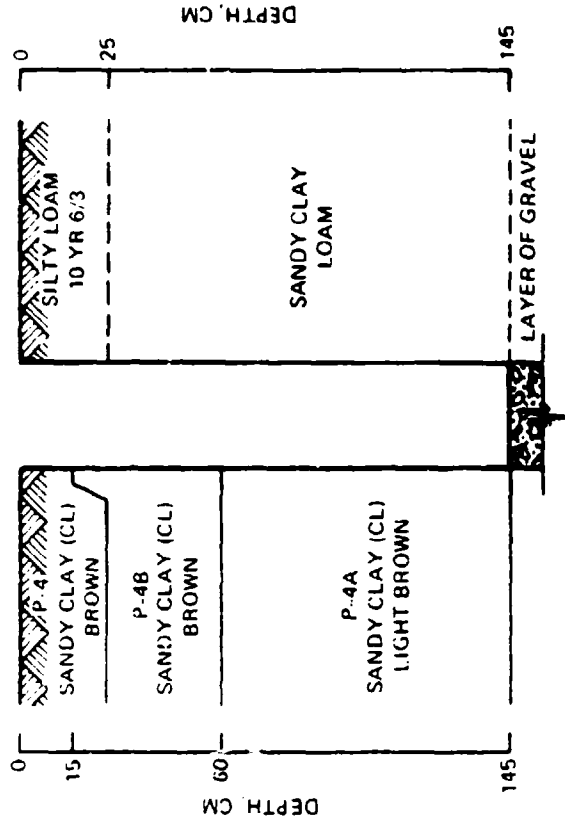
PIT NO. 1  
X0, Y80



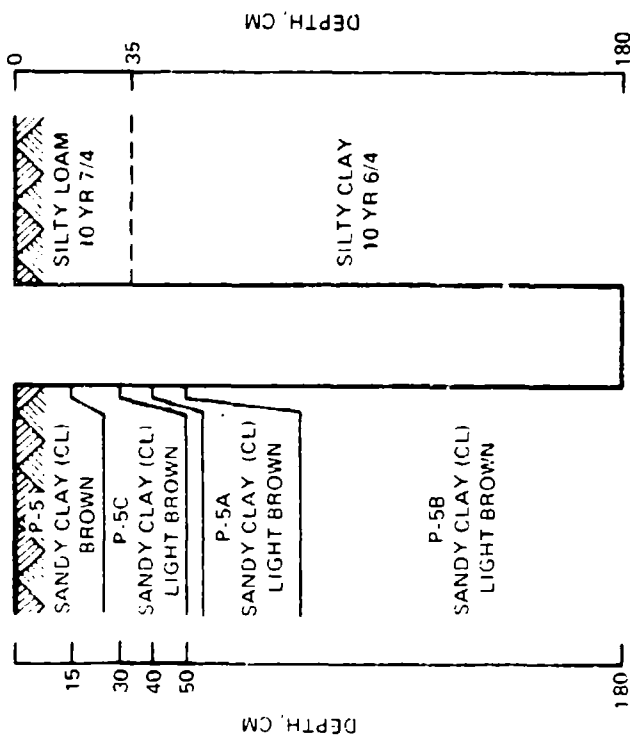
PIT NO. 3  
X80, Y80



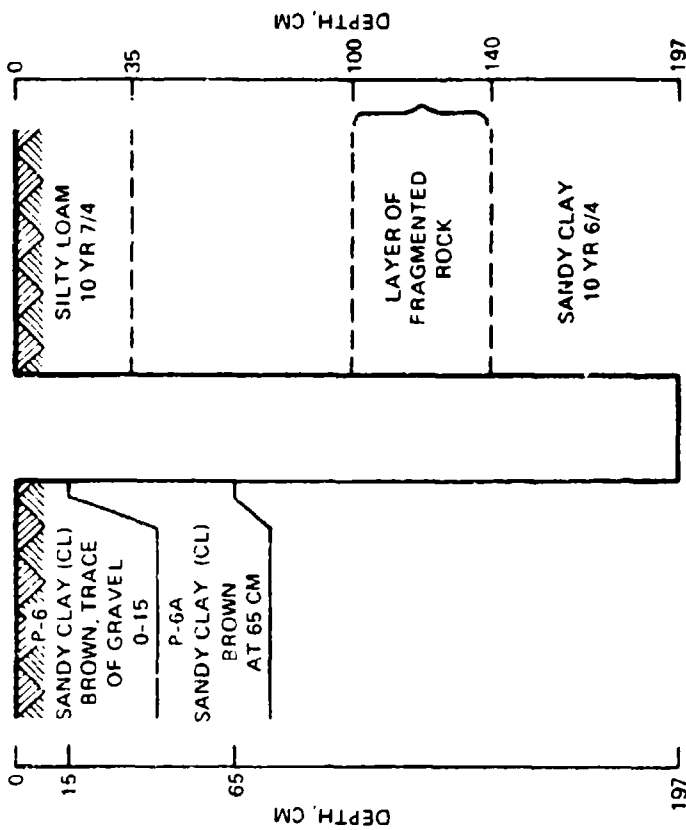
PIT NO. 4  
X80, Y0

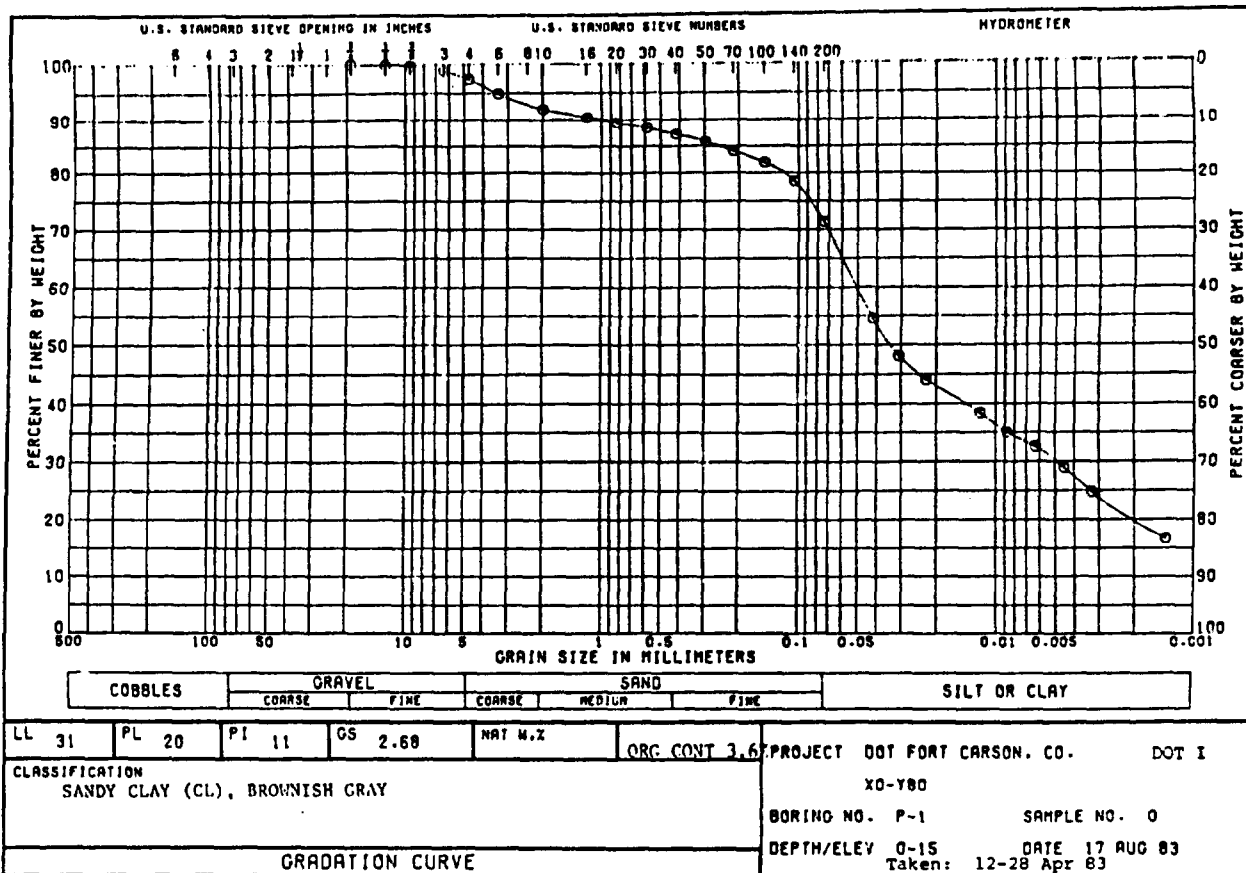


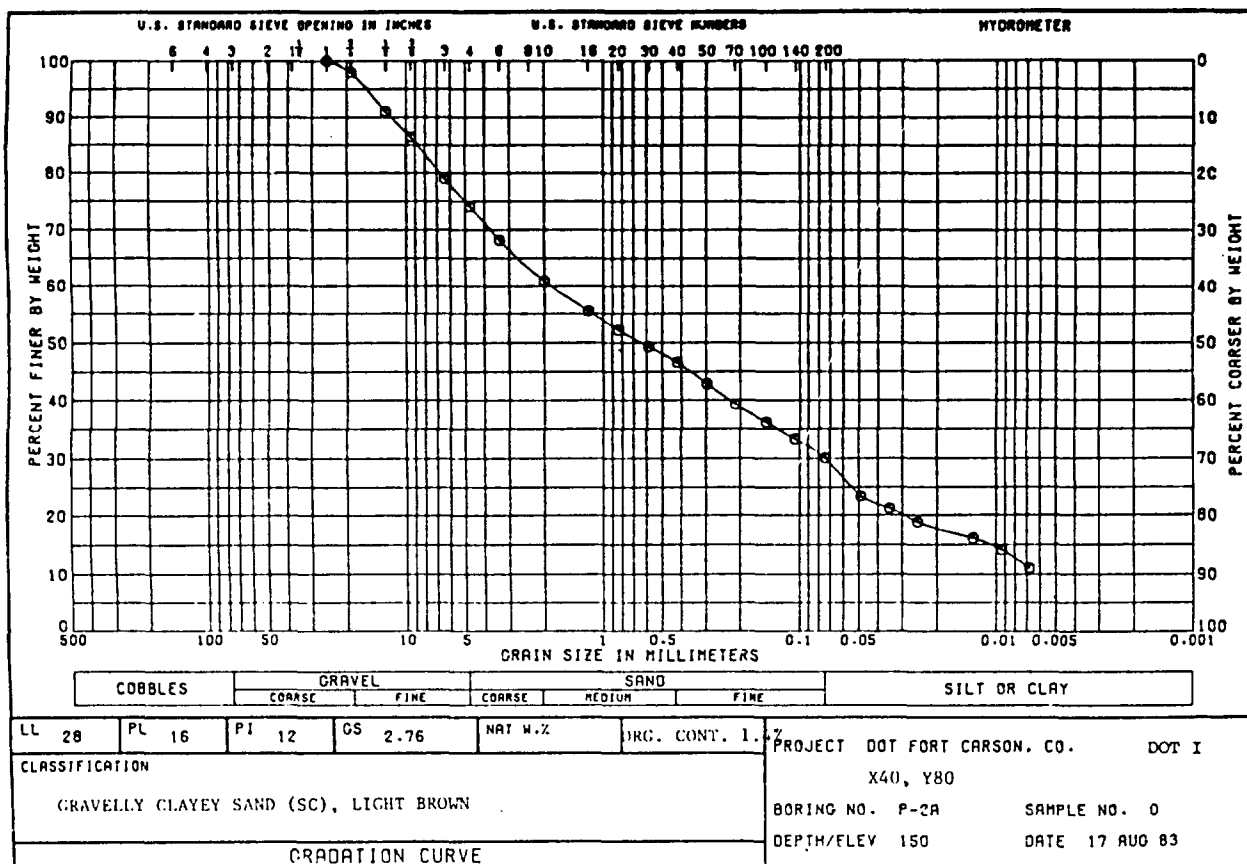
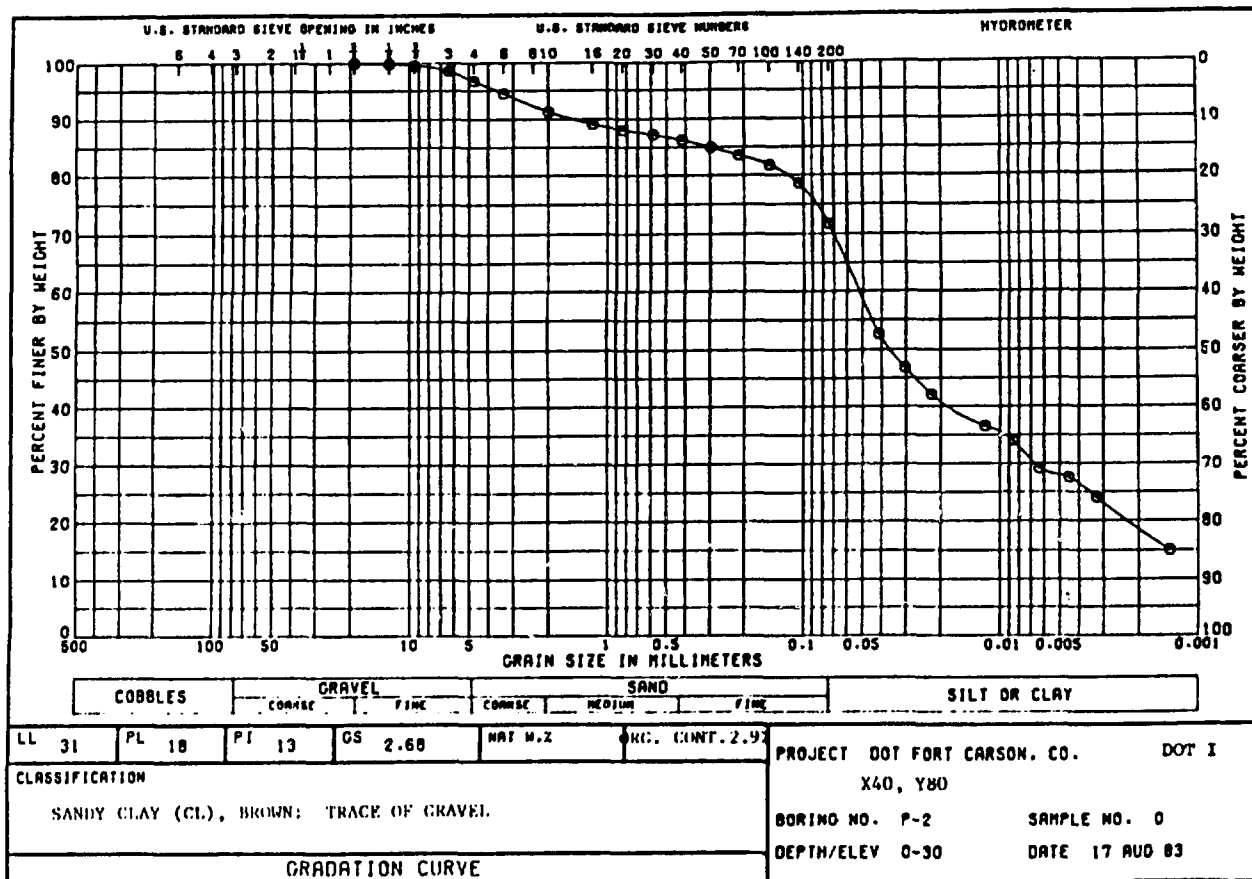
PIT NO. 5  
X40, Y0

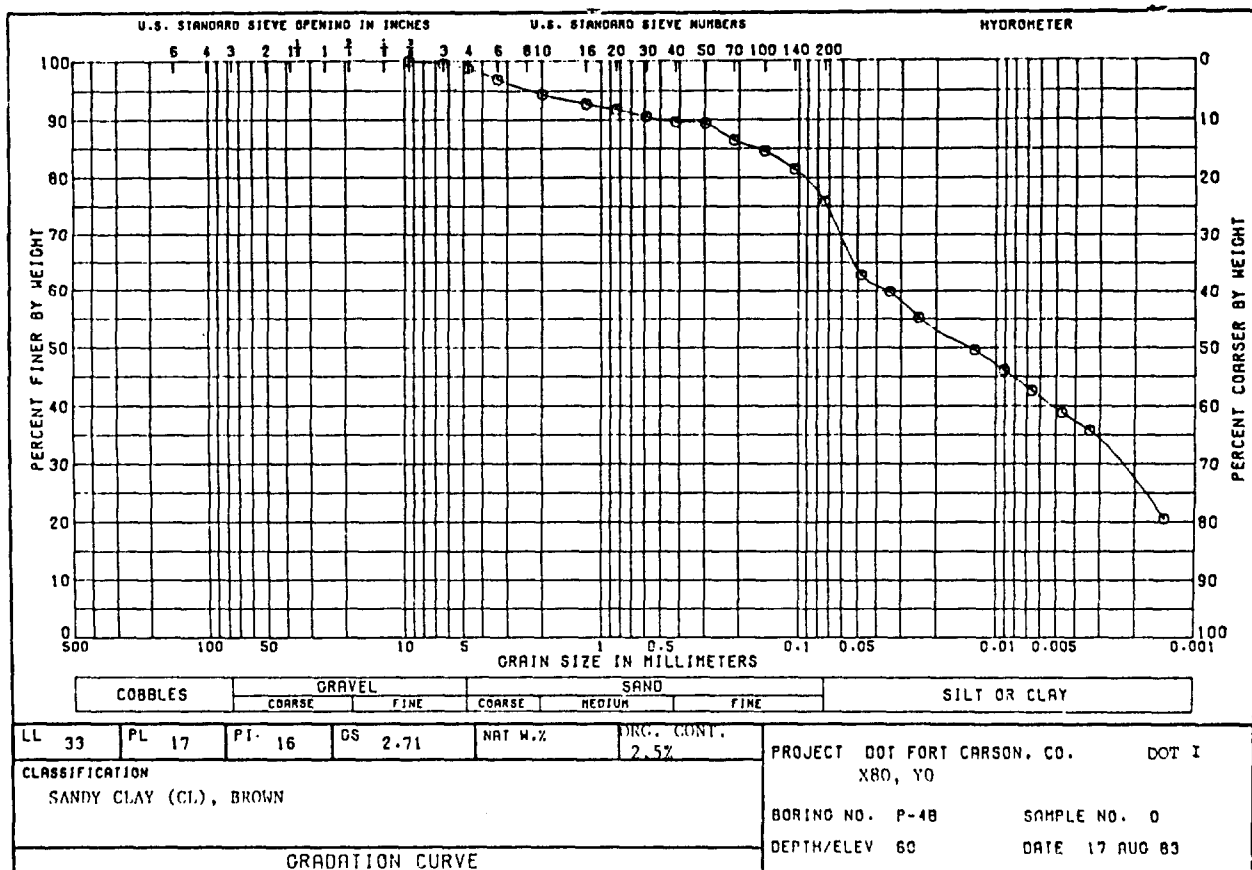
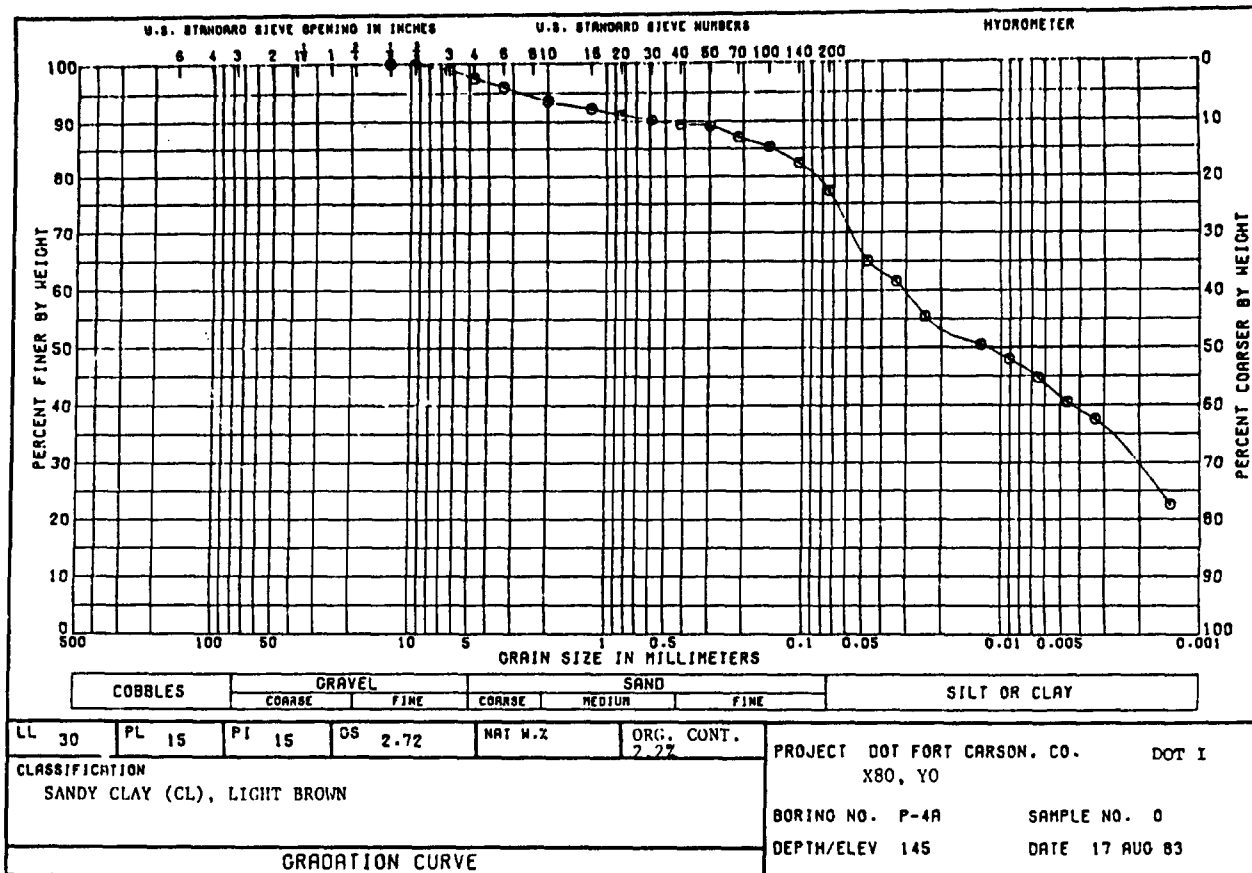


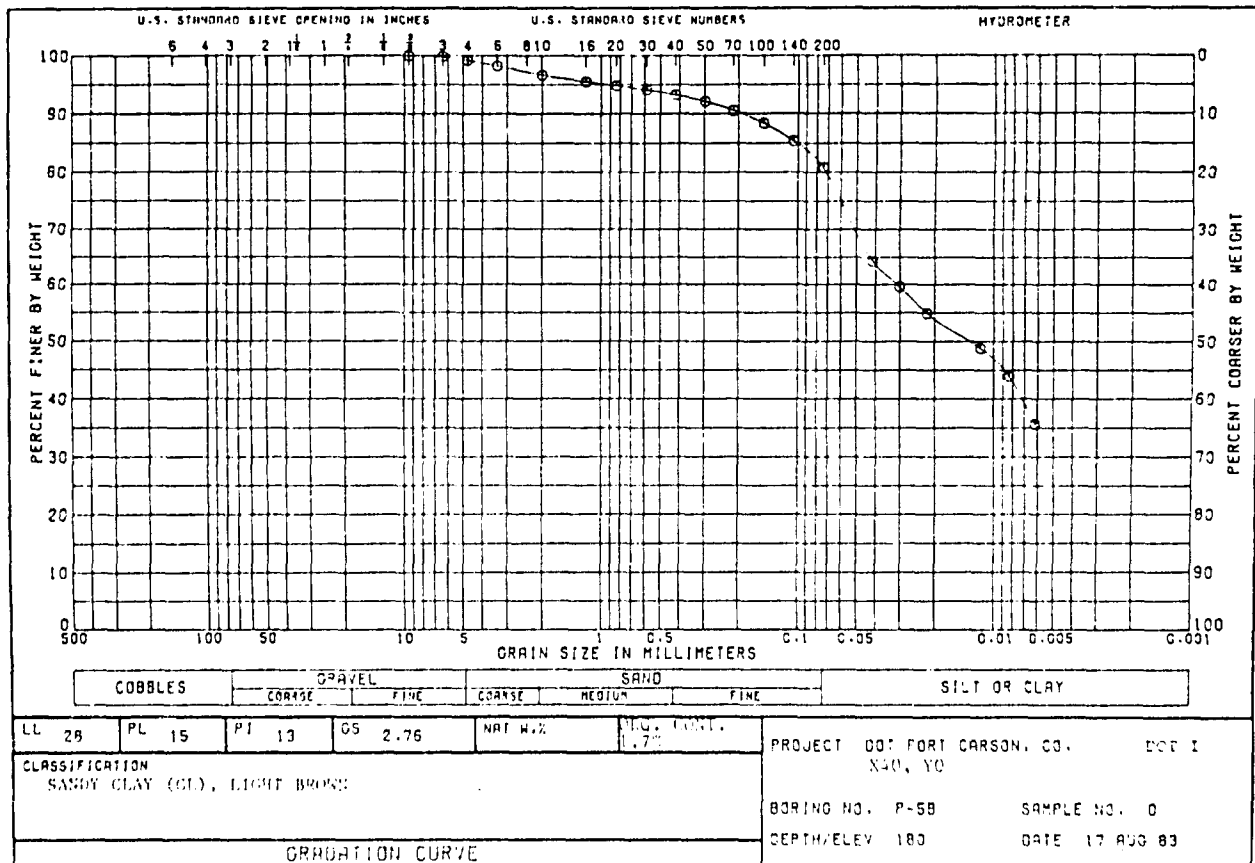
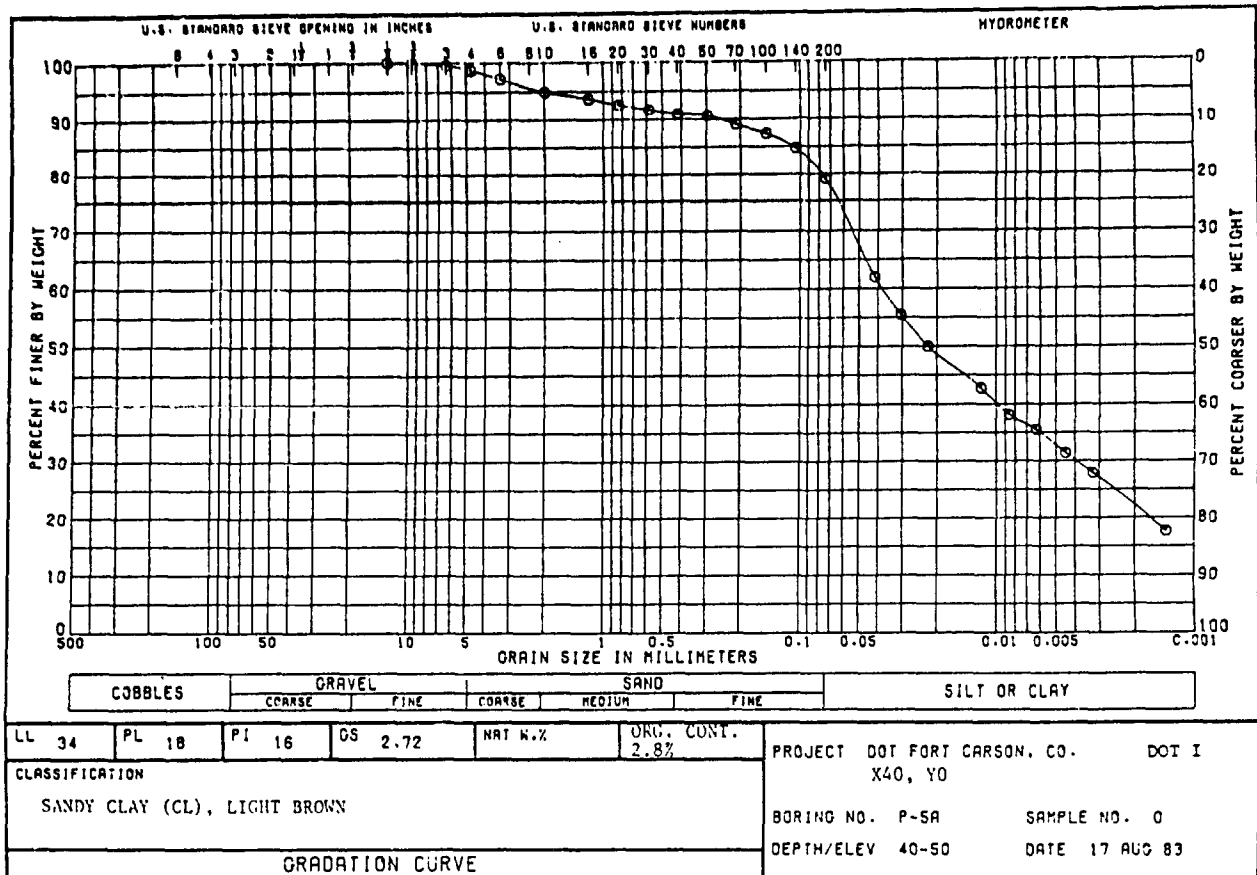
PIT NO. 6  
X0, Y0

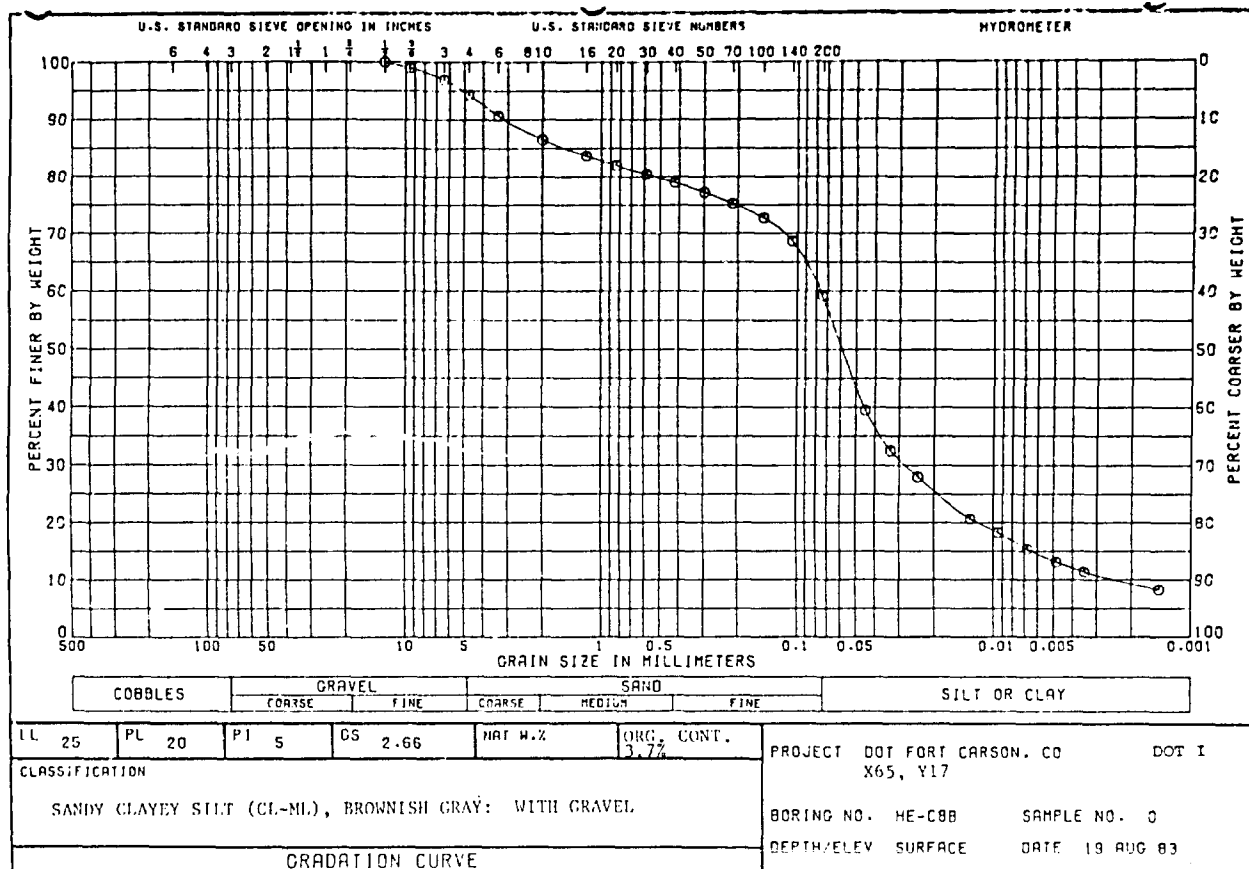
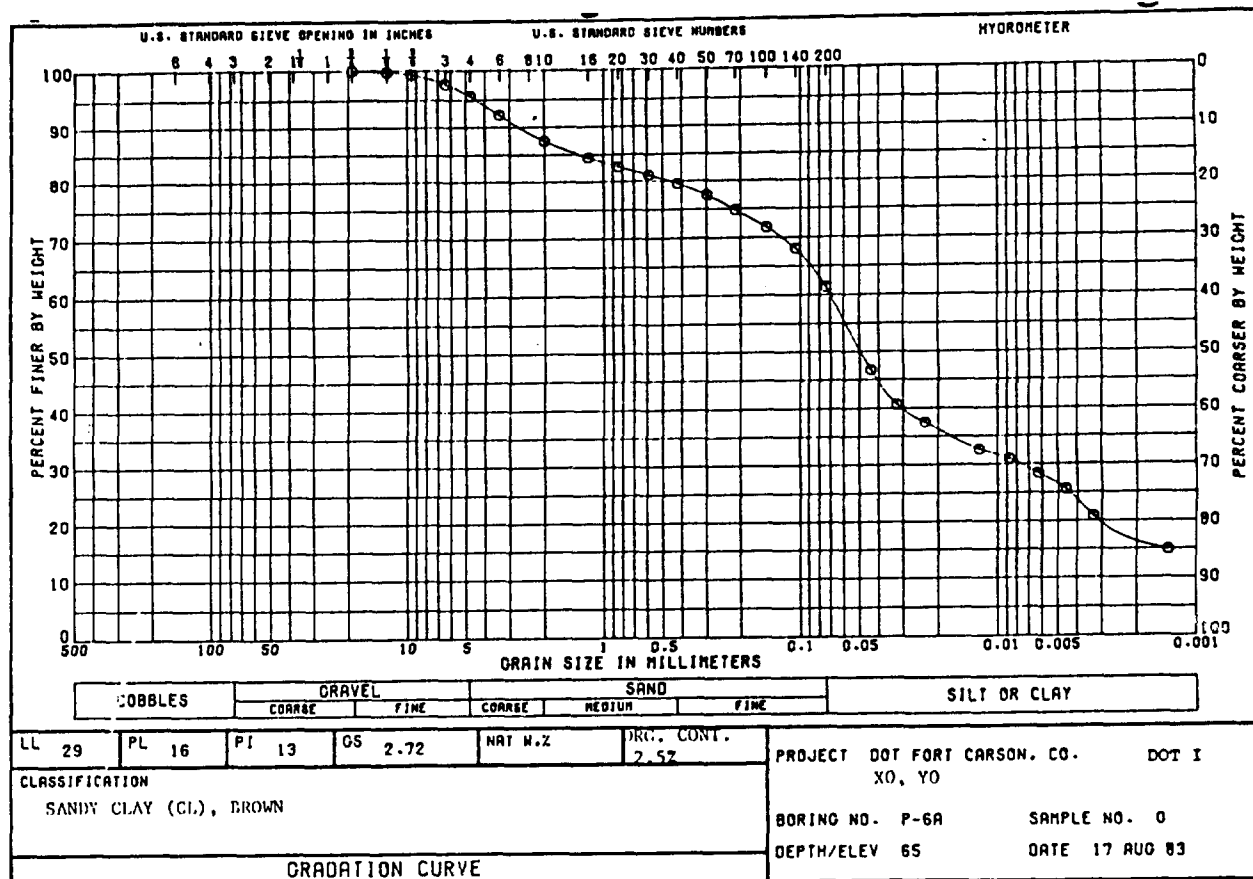


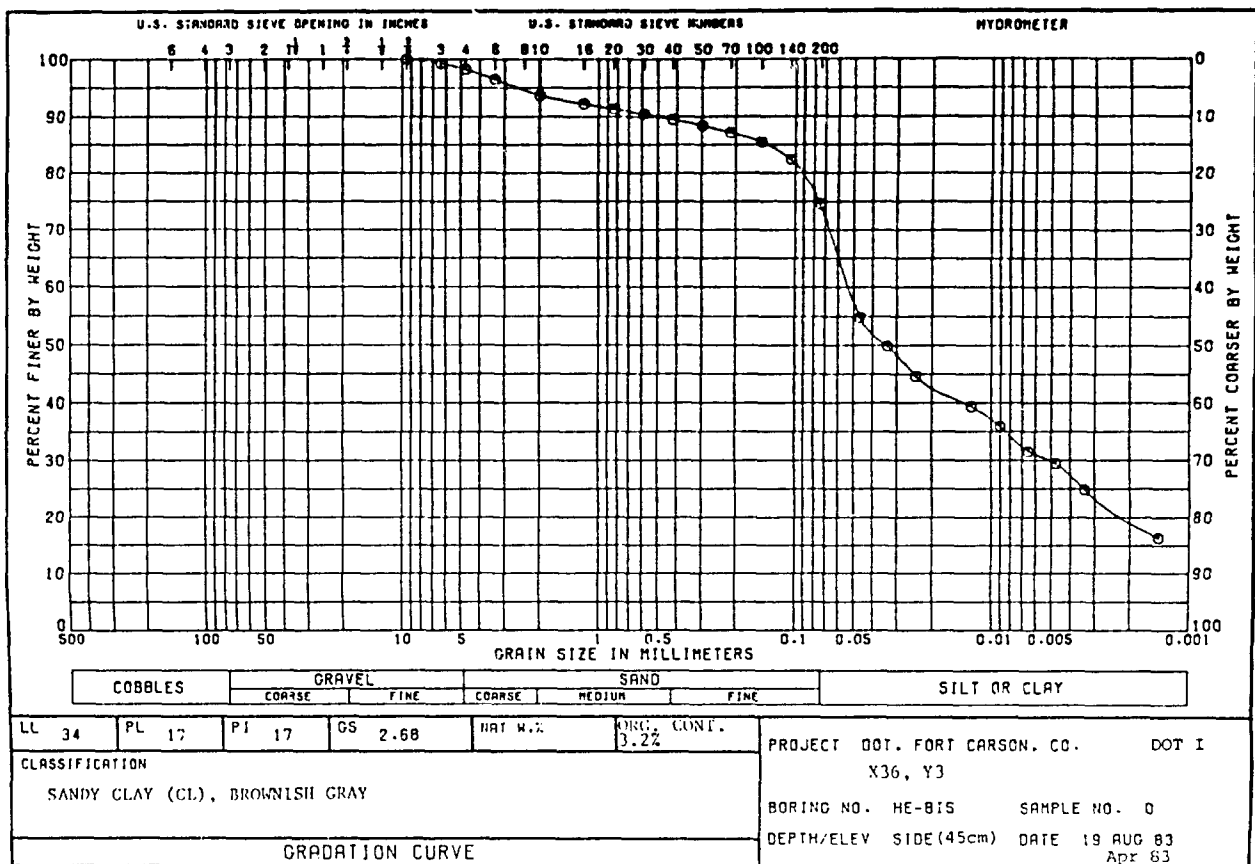
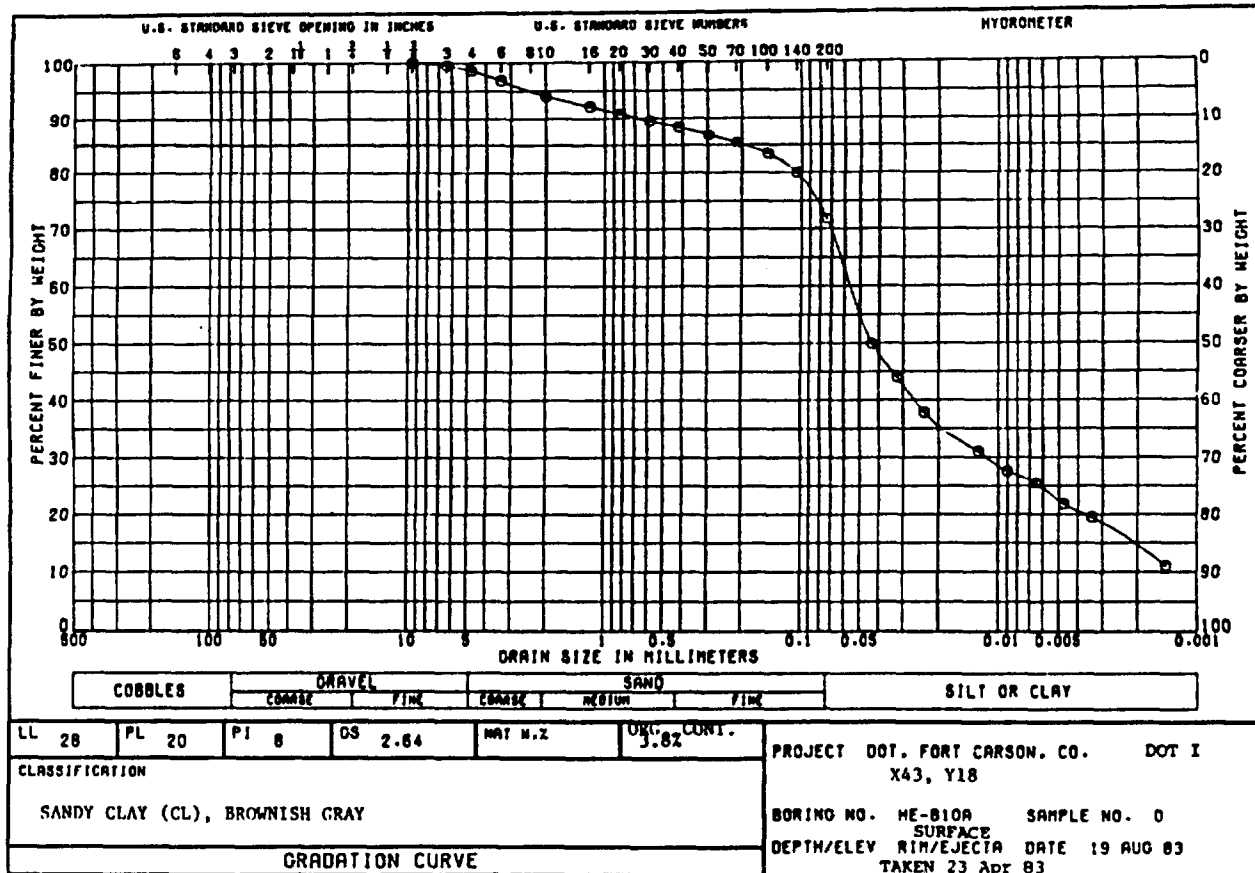


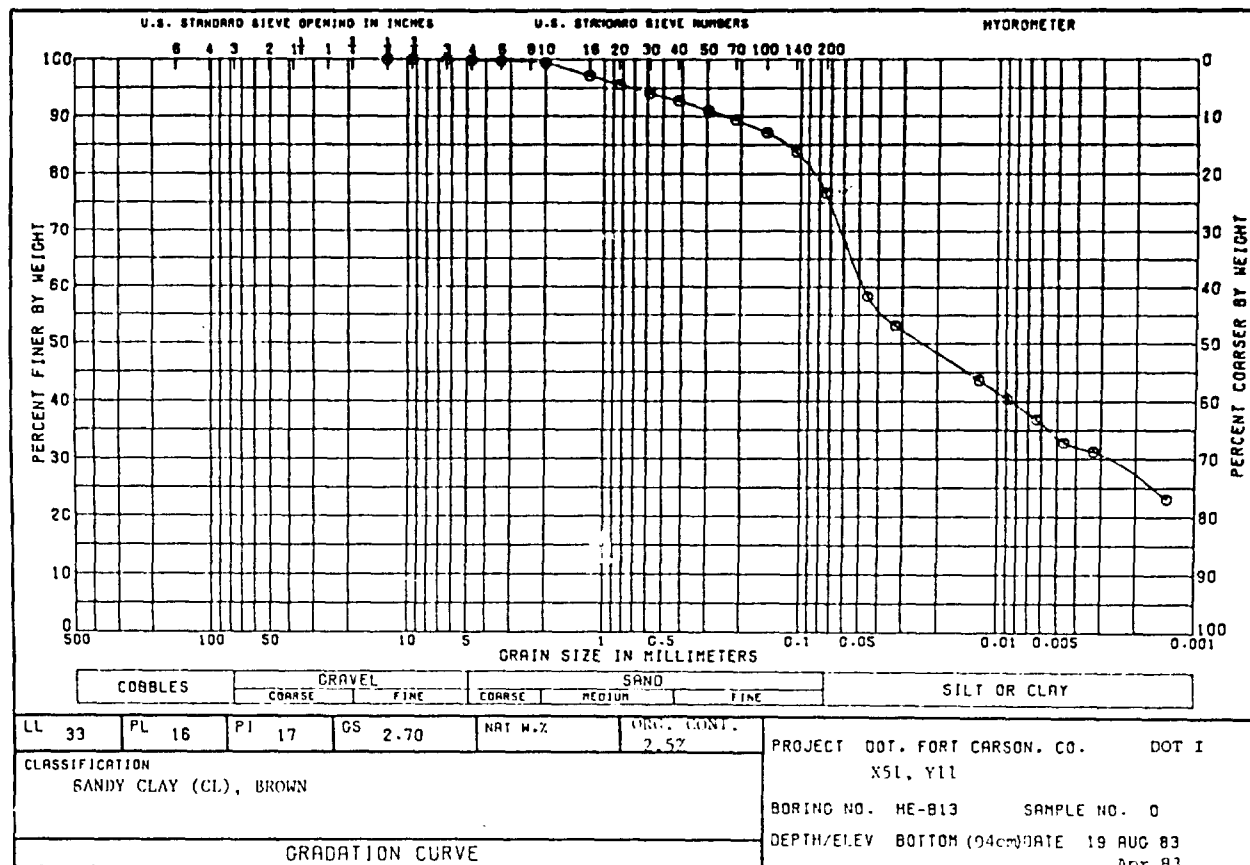
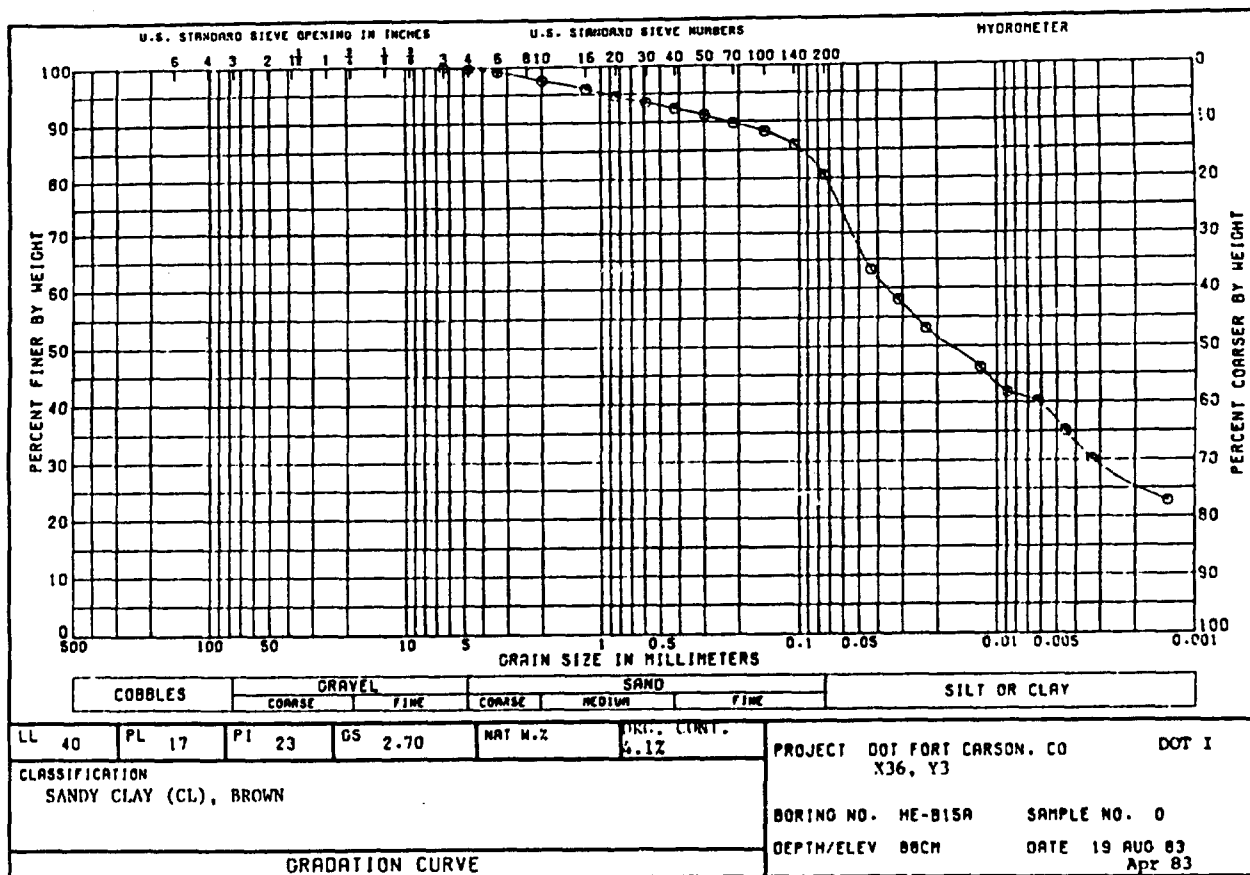




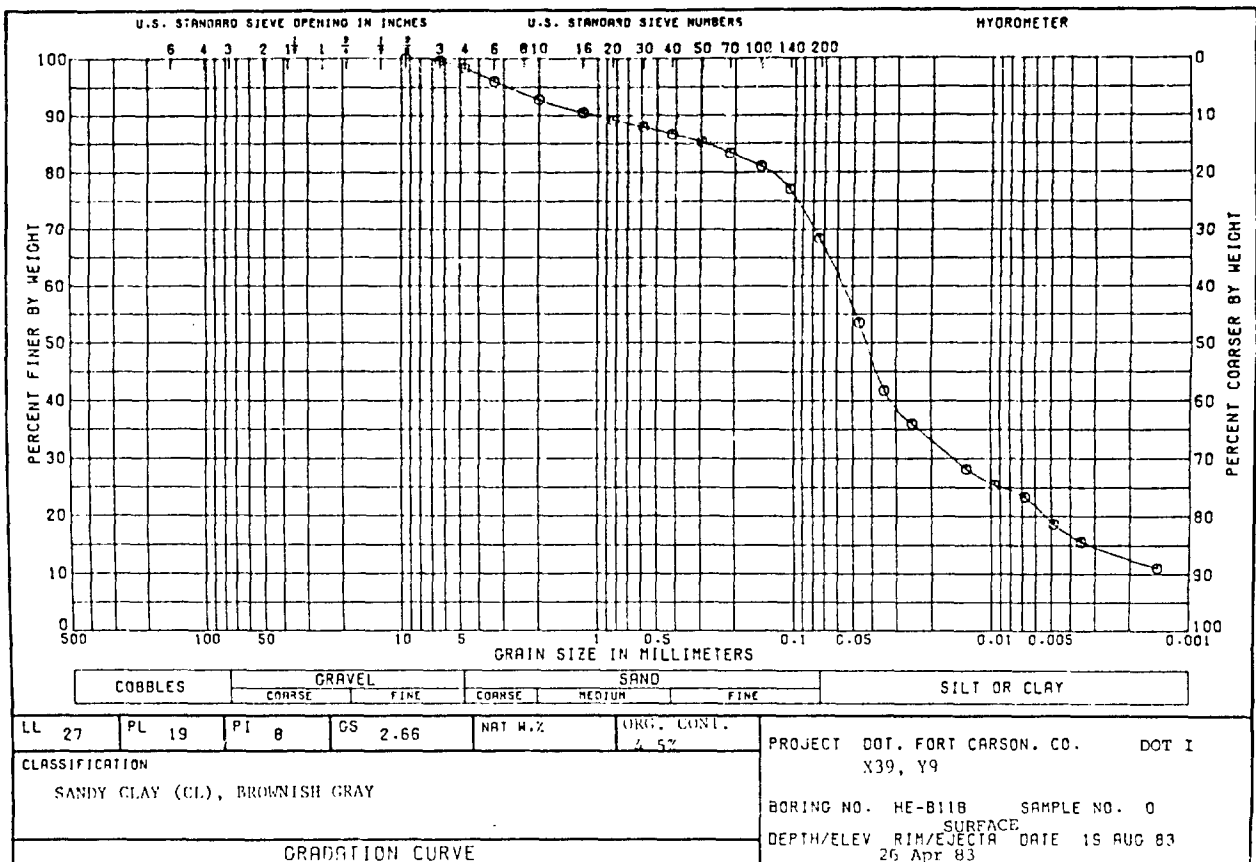
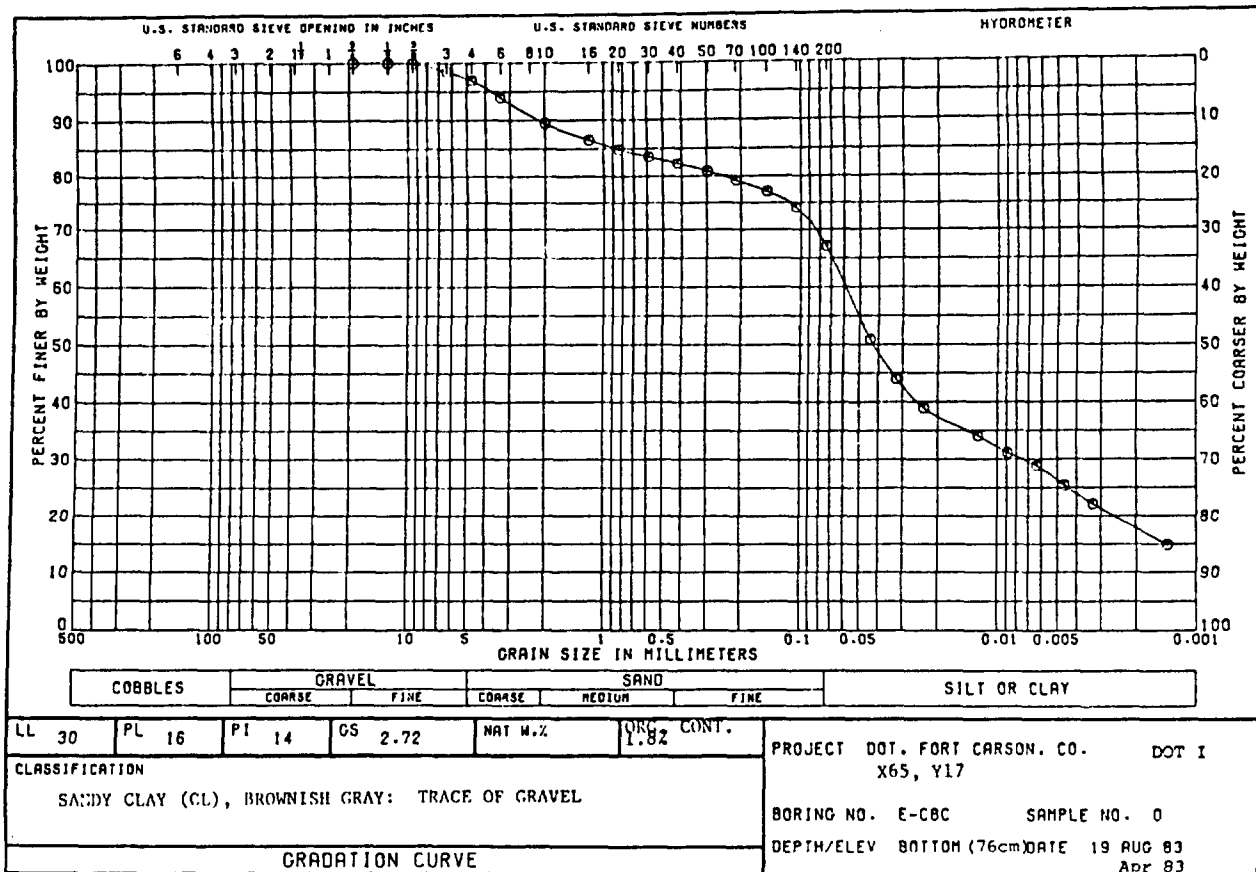


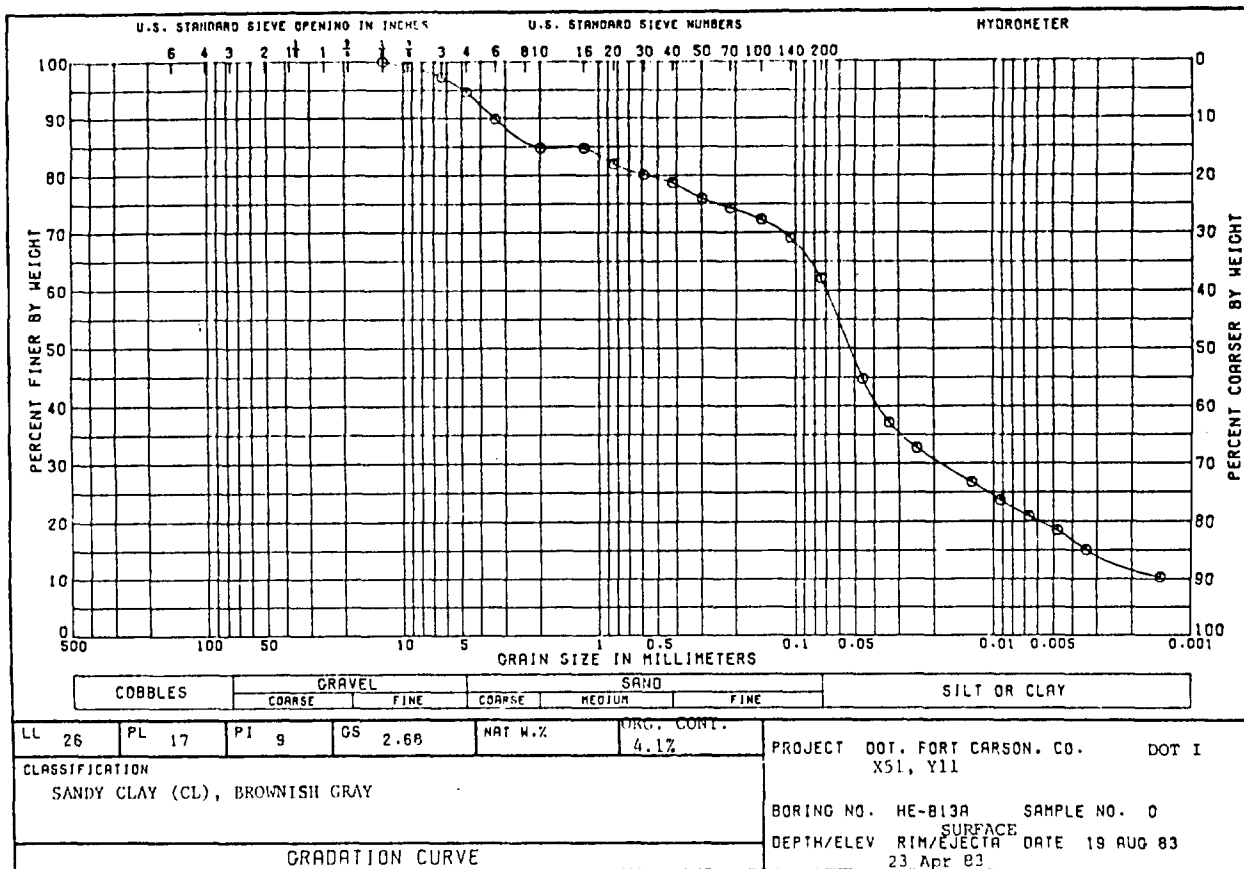
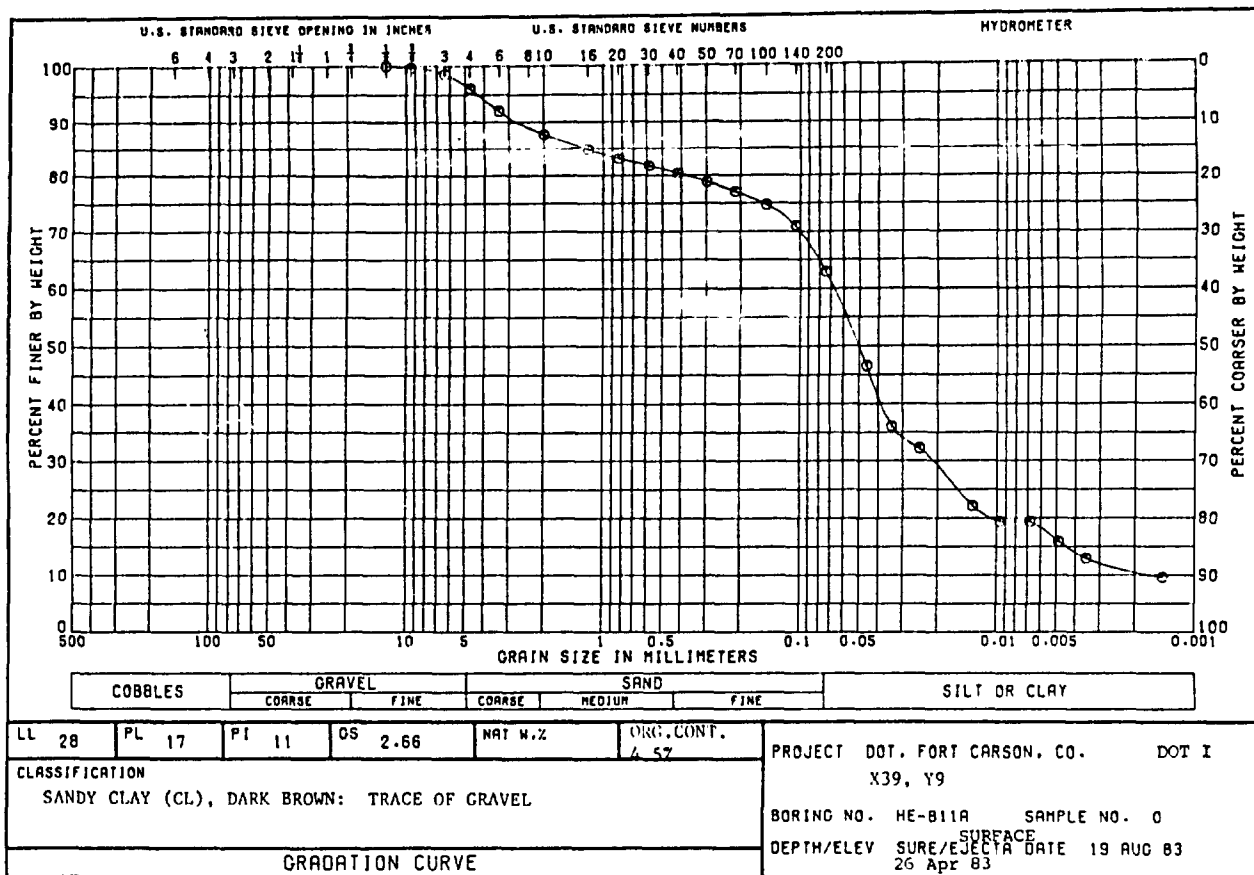


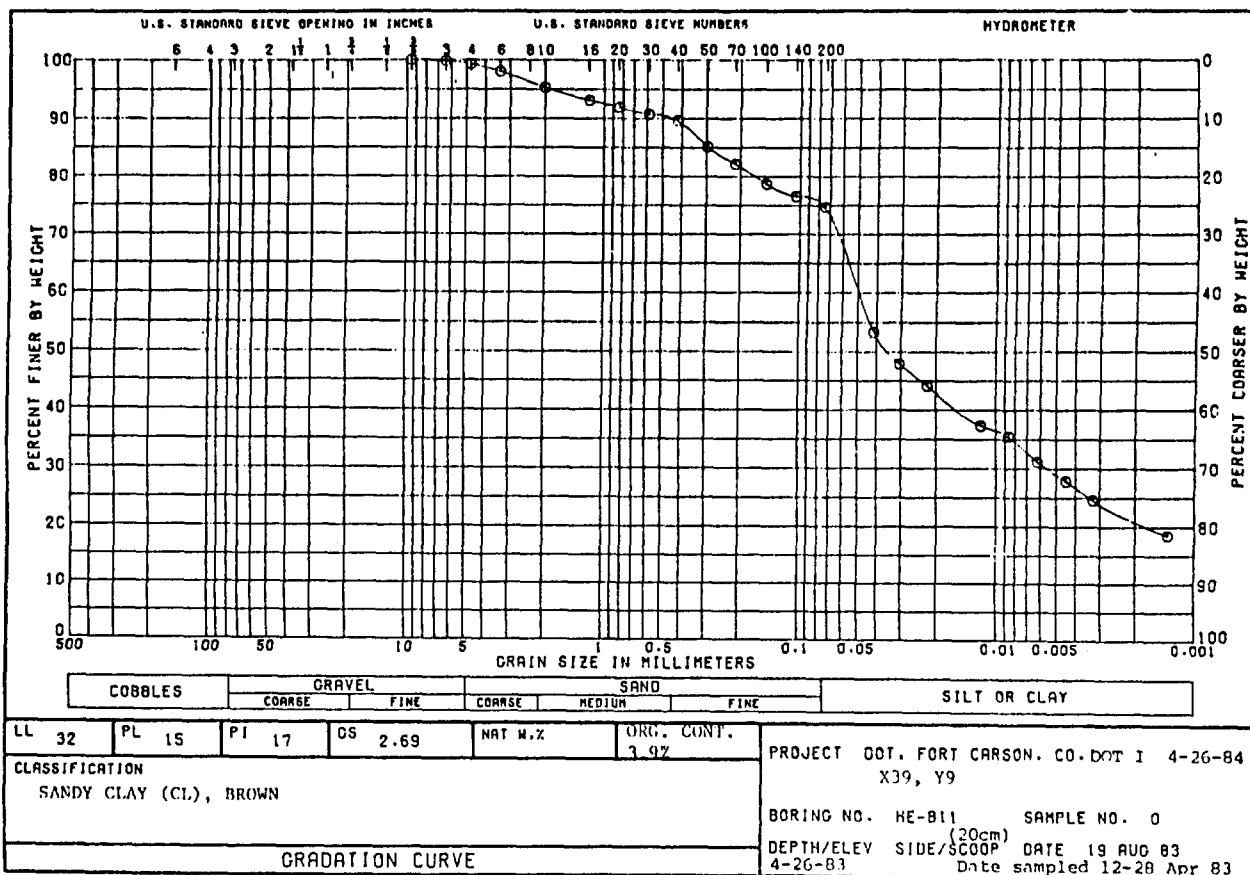












## PIT SOIL DATA: DOT II

| Pit Sample | Date 1983 | Locale (m) |    | Depth om | Soil Type USCS | % Finer 0.074um | Density* gm/cc | Organic Matter% | Moisture Content% | Specific Gravity |
|------------|-----------|------------|----|----------|----------------|-----------------|----------------|-----------------|-------------------|------------------|
|            |           | X          | Y  |          |                |                 |                |                 |                   |                  |
| P1         | 7-29      | 0          | 45 | 50       | SC             | 40              | 1.63/1.53      | 1.2             | 6.6               | 2.68             |
| P1A        | 7-29      | 0          | 45 | 175      | SC             | 44              | 1.70/1.56      | 1.4             | 9.0               | 2.70             |
| P2         | 7-29      | 270        | 46 | 70       | CL             | 52              | 1.73/1.60      | 1.1             | 8.4               | 2.71             |
| P2A        | 7-29      | 270        | 46 | 170      | CL             | 57              | 1.58/1.45      | 1.8             | 9.3               | 2.70             |
| P3         | 7-29      | 180        | 45 | 60       | CL             | 85              | -              | 3.1             | 7.5               | 2.70             |
| P3A        | 7-29      | 180        | 45 | 170      | SC             | 20              | -              | 0.8             | 3.2               | 2.67             |
| P4         | 7-29      | 90         | 45 | 75       | CL             | 65              | 1.65/1.55      | 2.1             | 6.5               | 2.70             |
| P4A        | 7-29      | 90         | 45 | 175      | CL             | 57              | 1.75/1.63      | 1.5             | 7.5               | 2.70             |

\* Density wet/density dry.

