HEAVY GAS DISPERSION TRIALS
THORNEY ISLAND 1982-3

DATA FOR TRIAL 012/1

Research and Laboratory Services Division
Red Hill, Sheffield S3 7HQ Tel: 0742 78141
8 Trials 24 to 29
The correct heights for the gas sensors on the mast at (372, 228) are 0.4, 2.4 and 4.4 metres, not 0.4, 1.4 and 2.4 as shown. In trials 26 and 27, where the mast was in the cloud, gas was detected at a height 2.4 m as shown on page G05. The height shown on page G05 is therefore correct.

9 Trial 23
Pages E05 and E17 have been inverted. Although the page numbers are incorrect, the positional information on the plots is correct.

10 Trials 26 to 28
The key to the instrument list shows
BE = Building east side i.e. to right of axis
BW = Building west side i.e. to left of axis
This should be
BE = Building east side i.e. to left of axis
BW = Building west side i.e. to right of axis
I shall be pleased to answer any queries arising from the above changes.

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HGDTC Project Manager
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Safety Engineering Laboratory
Broad Lane, Sheffield S3 7HQ

Tel 0742 78141
COMMERCIAL IN CONFIDENCE

This report is issued to sponsors of the trials on a commercial in confidence basis and must not be released before 1 January 1984.
SUMMARY INFORMATION AT THE TIME OF THE SPILL

Gas released at: 18:03:28 hrs

Freon 12/Nitrogen mixture: relative density 2.31

Number of smoke canisters discharged: 6

Mean Wind Speed at 10 m height:
   During main data collection period: 2.6 m/s
   From 5 minute cyclic data just before the release: 3.1 m/s

Mean Wind Heading ('A' station)
   (relative to the centre line of the array) 53.8°

NB Positive angles are to the right (clockwise) of the centre line when looking downwind of the gas bag.

Relative Humidity (at 10 m height) 66.2%

Insolation 4W/m²

Ambient Air Temperature (at 9 m height) 10.80°C

Treated Runway Surface Temperature 13.5°C

Grass Surface Temperature 12.0°C

Observed Cloud Cover 7/8

STABILITY CONDITION

E (From Observations)
E (From DT/DZ)
G (From Solarimeter)
G (From Heat Flux)
E (From Richardson No)
D (From Bulk Richardson No)
D/E (From Standard Deviation of Wind Heading)

Stability condition inferred from data during the release and just before the release: E.
HISTORY

About 2 hours before gas was released insolation was slight (about 170W/m²); the wind speed was about 3 m/s and its heading was 65°. These conditions gave an atmospheric stability of 'C/D' at that time. As time progressed, insolation gradually reduced but the wind speed remained more or less the same. The wind gradually swung round to the left so that the heading was about 45° while the bag was being filled; however about 15 minutes before the release the wind changed direction such that by the time gas was released the heading was about 54°. Under these conditions with almost total cloud cover the stability was judged to be 'E'.

1 ATMOSPHERIC STABILITY

The atmospheric stability during the period of the experiment was obtained from the following methods:

i) Visual Observation

This is based on the amount of cloud cover, or the judged level of incoming solar radiation and the value of the wind speed (see attached table provided by the Meteorological Office).

ii) Temperature Difference (DT/DZ)

This method is one of the two suggested by the US Nuclear Regulatory Commission and in the present exercise was calculated as:

\[
\frac{\Delta T}{\Delta Z} = \frac{T_{30} - T_9}{21} \times 100.0
\]

The NRC tables, see e.g. Sedefian and Bennett[1] or McQuaid[2] were then consulted to determine the appropriate stability.

iii) Solarimeter

The measured insolation, from the solarimeter, was used together with the wind speed to determine the stability based on the information presented in Pasquill[3] (Figure 6.13).

iv) Heat Flux

Heat flux (H) was calculated from the insolation (R) by the formula

\[ H = 0.4(R-100) \]

based on the suggestion by Smith[4]. Pasquill's[3], Figure 6.13 was then consulted to determine the stability. This method therefore agrees generally with the previous method.

v) Richardson Number

The Richardson number is calculated according to Sedefian and Bennett[1] as:

\[
R_i = \frac{g(\Delta \theta/\Delta Z)}{T(\Delta U/\Delta Z)^2}
\]

where \( \theta \) is the potential temperature and \( T \) is the actual temperature; in this case, the temperature at 16 m above the ground. \( \Delta \theta/\Delta Z \) was calculated as:

\[
\frac{T_{30} - T_9}{21} + 0.00986
\]

\( DU \) was calculated as \( \frac{U_{30} - U_{10}}{20} \)
Sedefian and Bennett calculate the limits of Richardson number for the various stability categories, however the limits they presented were valid for measurements at heights whose geometric mean was 22 m. Since the measurement stations were at 30 m, 9 m and 16 m the limits of Richardson number for the various stability categories were recalculated to correspond to a geometric mean height of 16 m.

vi) Bulk Richardson Number

The bulk Richardson number was also calculated according to Sedefian and Bennett[1] as:

$$R_{i\infty} = \frac{g(D\theta/DZ)Z^2}{T \bar{U}^2}$$

where $\bar{Z}$ is the geometric mean height = $\sqrt{9 \times 30}$

$T$ is the temperature at 16 m above the ground

and $\bar{U}$ is the mean wind speed at 30 m.

Here again the limits of $R_{i\infty}$ were recalculated to correspond to a geometric mean height of 16 m.

vii) Standard Deviation of Wind Heading

The standard deviation of wind heading was calculated from the Porton wind vane, which has a resolution bandwidth of 11°. The resulting accuracy is predicted to be around ±2° or so, assuming a Gaussian distribution of wind direction. These estimates were compared with the simple assumption that the standard deviation is approximately 1/6 (maximum—minimum angle).

The NRC limits for $\sigma_{dB}$ are then used to determine the appropriate stability category.

2 WIND SPEED

Two values of wind speed are presented. The first is the mean value at the 10 m height for the first 10 minutes of the data collection period, which generally began about one minute before the gas bag was dropped.

The second wind speed is also a mean value obtained at the 10 m height, but corresponds to data taken over a five minute period just before main data collection began; data during this period is termed the 'cyclic' data.

REFERENCES


3 Pasquill F (1974) "Atmospheric Diffusion". 2nd Ed. Published by Ellis Horwood Ltd, Chichester.

### MODIFIED PASQUILL STABILITY CATEGORIES

<table>
<thead>
<tr>
<th>Wind Speed (kt)</th>
<th>DAYTIME (excluding 1 hour after sunrise and 1 hour before sunset)</th>
<th>Within 1 hour before sunset or after sunrise</th>
<th>NIGHT-TIME</th>
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<td>Incoming Solar Radiation (W m⁻²)</td>
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<td>Cloud Amount (oktas)</td>
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<td>Strong (&gt;600)</td>
<td>Mod (300-600)</td>
<td>Slt (&lt;300)</td>
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<tr>
<td>&gt;12</td>
<td>C</td>
<td>D</td>
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</table>

**Notes**

1. Night was originally defined to include periods of one hour before sunset and after sunrise. These two hours are always categorised here as D.

2. Pasquill said that in light winds on clear nights the vertical spread may be less than for category F but excluded such cases because the surface plume is unlikely to have any definable travel. However, they are important from the point of view of the build up of pollution and category G (night-time, 0 or 1 okta of cloud, wind speed 0 or < : kt) has been added.

3. 1 kt = 0.52 m/s.
KEY TO GRAPHS

1 AVERAGING TIME

Length of the time window over which mean values have been calculated for the purpose of the plots. Since the full record contains 20 samples per second, an averaging time of 0.6 seconds gives the arithmetic mean of 12 samples of the original signal. Note that it is not a running average but a 'box' window which is moved through the data in increments of the averaging time.

2 X:Y:Z

The location in metres of the sensor on the trials site. The (X,Y) axes are defined by the grid of fixed masts, the release point is at X = 400 metres, Y = 200 metres. The Z axis defines the height of the sensor on the mast at location (X, Y) – see mast array. Note that the axis is defined by measurement from the mast base and is not absolute in the sense that it takes no account of any slope of the trials site.

3 TYPE

Defines the type of sensor which generated the data shown in the plots.

GAS: Standard oxygen deficiency sensor
     Frequency response 1 Hz (at -3 dB point)

HGAS: High speed oxygen deficiency sensor
      Frequency response 10 Hz (at -3 dB point)

SMOK: High speed light scattering smoke sensor
       Frequency response 10 Hz (at -3 dB point)

WSPD: Wind heading as indicated by wind vanes in degrees relative to the site axis. Positive values are to the right of the site axis (looking 'downwind' for the source) and negative values to the left.

AIRT: Air temperature in degrees centigrade

SOLA: Solar radiation as measured by solarimeter in watts/square metre.

BROM: Barometric pressure measured in millibars.

UANA: Velocity component A of tri-axial anemometers in the horizontal (X Y) plane.

UANB: Velocity component B of tri-axial anemometer in the horizontal (X Y) plane.

UANW: Velocity component W of tri-axial anemometer in the vertical (Z) direction.
UANT: Temperature, as measured by tri-axial anemometer with this facility.

RUN UP MEAN: The mean value of the appropriate sensor output averaged over the run up period i.e. in the period 1471 to 1171 seconds before the gas container release.

RUN DOWN MEAN: The mean value of the appropriate sensor output averaged over the run down period i.e. in the period 2896 to 3196 seconds after the gas container release.

4 GAS SENSORS

The readings of the GAS and HGAS sensors are in terms of the % concentration of the released gas mixture with an associated error band of either 10% of reading or as determined by calibration checks with a standard gas mixture. An estimate of the accuracy of each sensor for each test will be sent out separately. Note that the SMOK sensors have no absolute calibration in terms of gas concentration but have been included because of the potential high frequency information their outputs contain. An approximate calibration may be obtained by comparing their output to that of the nearest oxygen deficiency sensor.

5 SONIC ANEMOMETERS

Prints of the sonic anemometer outputs are included for completeness but it will be appreciated that analysis of records can only be performed using the data tapes. The three wind velocity components A, B and W can be transposed into components corresponding with the X, Y and Z coordinates of the mast array as follows:

\[ X = \frac{1}{\sqrt{3}} (A - B) \]

\[ Y = A + B \]

\[ Z = W \]

RMS turbulence values measured at 10 m height on 'A' mast are given below. The values are non-dimensionalised i.e. original values have been divided by \( U_{10} \), the mean wind speed at 10 m height during the main data collection period which was 2.555 m/s.

\[ U' \text{ RMS} = 0.113 \quad \text{(component in the wind direction)} \]

\[ V' \text{ RMS} = 0.143 \quad \text{(crosswind component)} \]

\[ W' \text{ RMS} = 0.056 \quad \text{(vertical component)} \]

6 RUNNING MEANS

In order to assist analysis, a three minute running mean has been superimposed on all environmental records except the sonic anemometers. The points plotted represent the mean of 300 values (0.6 second averages) and are plotted at 0.6 second intervals.
NOTES ON VALIDATION OF GAS SENSOR DATA FOR TRIAL G12

1 The gas cloud kept low to the ground over much of the site and consequently many of the upper gas sensors on the masts within the cloud did not respond. Except where stated, these sensors were functioning correctly implying a gas concentration of much less than 1% at their respective positions.

2 The first 'spike' on the trace shown on page G02 should be ignored.

3 The trace shown on page G24 probably depicts sensor drift rather than gas. The sensor immediately below, at 4.4 m at (600,300), was functioning correctly but did not detect any gas.

4 Please ignore the traces shown in pages G25 and G26.

5 The hump shown on page G35 is probably due to sensor drift. The gas signal occurs at about 500 seconds.

6 The standard gas sensor at 6.4 metres on the M2(a) mast (500,350) had a noise level of about 1% peak-to-peak (equivalent gas concentration). No signal due to gas could be discerned above the noise level.

7 The smoke sensor at 2.0 metres on the M2(a) mast at (500,350) was apparently functioning correctly but no signal due to smoke could be discerned above the noise level.

M J LECK
Special Instruments and Techniques Section
Safety Engineering Laboratory
12 May 1983
Note: The Location Coordinates are the X, Y coordinates in metres at 1/100 scale. The source is at (4.0, 2.0).
The table scans the layout by successive rows (i.e., at constant Y) of masts.

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<th>LOCATION COORDINATES</th>
<th>TYPE OF MAST</th>
<th>DATA TERMINAL NUMBER</th>
<th>CHANNEL NUMBER</th>
<th>HEIGHT ABOVE GROUND m</th>
<th>TYPE OF SENSOR</th>
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<td>LOCATION COORDINATES</td>
<td>TYPE OF MAST</td>
<td>DATA TERMINAL NUMBER</td>
<td>CHANNEL NUMBER</td>
<td>HEIGHT ABOVE GROUND (m)</td>
<td>TYPE OF SENSOR</td>
<td>REMARKS</td>
<td>PAGE NUMBER</td>
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<tr>
<td>6.0, 5.0 F</td>
<td>F</td>
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<td>Gas Sensor</td>
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<td>7.0, 5.0 F</td>
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<td>20</td>
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<td>Solarimeter</td>
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<td>7.0, 5.0 F</td>
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<tr>
<td>3.0, 3.5 M2(b)</td>
<td>F</td>
<td>31</td>
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<td>Gas Sensor</td>
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<td>3.0, 3.5 M2(b)</td>
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<td>1.0, 6.0 F</td>
<td>F</td>
<td>21</td>
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<td>0.4</td>
<td>Gas Sensor</td>
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<td>E55</td>
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<td>2.0, 6.0 F</td>
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<td>22</td>
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<td>0.4</td>
<td>Gas Sensor</td>
<td></td>
<td>E56</td>
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<td>Gas Sensor</td>
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<td>F</td>
<td>14</td>
<td>4</td>
<td>0.4</td>
<td>Gas Sensor</td>
<td></td>
<td>G55</td>
</tr>
<tr>
<td>6.0, 6.0 F</td>
<td>F</td>
<td>27</td>
<td>4</td>
<td>0.4</td>
<td>Gas Sensor</td>
<td></td>
<td>G56</td>
</tr>
<tr>
<td>7.0, 6.0 F</td>
<td>F</td>
<td>27</td>
<td>4</td>
<td>0.4</td>
<td>Gas Sensor</td>
<td></td>
<td>G59</td>
</tr>
<tr>
<td>1.0, 7.0 F</td>
<td>F</td>
<td>21</td>
<td>4</td>
<td>0.4</td>
<td>Gas Sensor</td>
<td></td>
<td>G60</td>
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<td>2.2, 6.7 F</td>
<td>F</td>
<td>22</td>
<td>4</td>
<td>0.4</td>
<td>Gas Sensor</td>
<td></td>
<td>G61</td>
</tr>
<tr>
<td>3.0, 7.0 F</td>
<td>F</td>
<td>23</td>
<td>4</td>
<td>0.4</td>
<td>Gas Sensor</td>
<td></td>
<td>G62</td>
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<td>4.0, 7.0 F</td>
<td>F</td>
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<td>0.4</td>
<td>Gas Sensor</td>
<td></td>
<td>G63</td>
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<td>5.0, 7.0 F</td>
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<td>15</td>
<td>0</td>
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<td>Gas Sensor</td>
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<td>G64</td>
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<td>6.0, 7.0 F</td>
<td>F</td>
<td>28</td>
<td>0</td>
<td>0.4</td>
<td>Gas Sensor</td>
<td></td>
<td>G65</td>
</tr>
<tr>
<td>7.0, 7.0 F</td>
<td>F</td>
<td>28</td>
<td>4</td>
<td>0.4</td>
<td>Gas Sensor</td>
<td></td>
<td>G66</td>
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<tr>
<td>4.0, 9.5 D</td>
<td>D</td>
<td>29</td>
<td>0</td>
<td>0.4</td>
<td>Gas Sensor</td>
<td>Not connected</td>
<td>E59</td>
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</table>
21 = \frac{\text{DATA TERMINAL}}{4} = \frac{\text{CHANNEL NUMBER}}{4} \text{ OF GAS SENSORS AT 0.4m HEIGHT}

\bigcirc = \text{SENSORS AT 0.4m HEIGHT VERIFIED TO HAVE SEEN GAS}
CONCENTRATION

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 350 M  Y: 150 M  Z: 0.4 M

G01
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 450 M  Y: 150 M  Z: 1.4 M
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS
X: 450 M  Y: 150 M  Z: 2.4 M
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS
X: 500 M  Y: 200 M  Z: 1.4 M
TRIAL: 012  TYPE: GAS   AVERAGING TIME: 0.6 SECS
X: 500 M   Y: 200 M   Z: 2.4 M
Trial: 012  Type: Gas  Averaging Time: 0.6 secs

X: 450 m  Y: 250 m  Z: 0.4 m
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 450 M  Y: 250 M  Z: 2.4 M
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS
X: 450 M   Y: 250 M   Z: 4.4 M
TRIAL: 012  TYPE:  GAS  AVERAGING TIME:  0.6 SECS

X:  300 M  Y:  300 M  Z:  0.4 M
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 400 M  Y: 300 M  Z: 0.4 M
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS
X: 400 M  Y: 300 M  Z: 2.4 M
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 500 M  Y: 300 M  Z: 2.4 M
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS
X: 500 M  Y: 300 M  Z: 4.4 M
CONCENTRATION

(%)

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 600 M  Y: 300 M  Z: 2.4 M
CONCENTRATION

TIME FROM RELEASE (SECS*10**2)

TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 600 M  Y: 300 M  Z: 6.4 M

G24
CONCENTRATION

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: HGAS  AVERAGING TIME: 0.6 SECS
X: 300 M  Y: 350 M  Z: 2.0 M

G26
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS
X: 500 M  Y: 350 M  Z: 0.4 M
CONCENTRATION (%)

TIME FROM RELEASE (SECS x 10**-2)

TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS
X: 500 M  Y: 350 M  Z: 2.4 M

G33
CONCENTRATION (%)

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 400 M  Y: 400 M  Z: 0.4 M
TRIAL: 012    TYPE: GAS    AVERAGING TIME: 0.6 SECS

X: 500 M    Y: 400 M    Z: 2.4 M

G39
CONCENTRATION

TIME FROM RELEASE (SECS*10**2)

TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS
X: 600 M  Y: 400 M  Z: 4.4 M

G43
Trial: 012  Type: Gas  Averaging Time: 0.6 secs

X: 400 M  Y: 500 M  Z: 0.4 M
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS
X: 500 M  Y: 500 M  Z: 0.4 M
TRIAL: 012   TYPE: GAS   AVERAGING TIME: 0.6 SECS

X: 500 M   Y: 500 M   Z: 2.4 M
TRIAL: 012    TYPE: GAS    AVERAGING TIME: 0.6 SECS

X: 500 M    Y: 500 M    Z: 4.4 M
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 600 M  Y: 500 M  Z: 2.4 M
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 600 M  Y: 500 M  Z: 4.4 M
CONCENTRATION

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS
X: 700 M  Y: 600 M  Z: 2.4 M
CONCENTRATION

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 600 M  Y: 700 M  Z: 0.4 M
CONCENTRATION (%)

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS

X: 600 M  Y: 700 M  Z: 2.4 M
Trial: 012  Type: Gas  Averaging Time: 0.6 secs

X: 600 M  Y: 700 M  Z: 4.4 M
TRIAL: 012  TYPE: GAS  AVERAGING TIME: 0.6 SECS
X: 700 M  Y: 700 M  Z: 2.4 M
TRIAL: 012  TYPE: BROM  UNITS: MBAR
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 50 M  Z: 0.4 M
MEAN OF RUN UP: 1013  MEAN OF RUN DOWN: 1014
TRIAL: 012  TYPE: WSPD  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 50 M  Z: 2.0 M
MEAN OF RUN UP: 1.78  MEAN OF RUN DOWN: 1.31
TEMPERATURE

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: AIRT  UNITS: DEGREES C
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 50 M  Z: 2.0 M
MEAN OF RUN UP: 10.77  MEAN OF RUN DOWN: 10.18
TRIAL: 012    TYPE: UANA    UNITS: M/S
AVERRAGING TIME: 0.6 SEC    X: 400 M    Y: 50 M    Z: 2.0 M
MEAN OF RUN UP: 1.68    MEAN OF RUN DOWN: 1.33
TRIAL: 012  TYPE: UANW  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 50 M  Z: 2.0 M
MEAN OF RUN UP: 0.35  MEAN OF RUN DOWN: 0.31
TRIAL: 012   TYPE: UANT   UNITS: DEGREES C
AVERAGING TIME: 0.6 SEC   X: 400 M   Y: 50 M   Z: 2.0 M
MEAN OF RUN UP: 19.98   MEAN OF RUN DOWN: 19.49

EG8
TRIAL: 012  TYPE: WSPD  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 50 M  Z: 4.5 M
MEAN OF RUN UP: 2.47  MEAN OF RUN DOWN: 2.03
TEMPERATURE

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012    TYPE: AIRT    UNITS: DEGREES C
AVERAGING TIME: 0.6 SEC    X: 400 M    Y: 50 M    Z: 9.0 M
MEAN OF RUN UP: 11.24    MEAN OF RUN DOWN: 10.80
WIND SPEED

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: WSPD  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 50 M  Z: 10.0 M
MEAN OF RUN UP: 3.07  MEAN OF RUN DOWN: 2.47
TRIAL: 012  TYPE: UANA  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 50 M  Z: 10.0 M
MEAN OF RUN UP:  2.90  MEAN OF RUN DOWN:  2.24
TRIAL: 012   TYPE: UANB   UNITS: M/S
AVERAGING TIME: 0.6 SEC   X: 400 M   Y: 50 M   Z: 10.0 M
MEAN OF RUN UP:  -0.72   MEAN OF RUN DOWN:  -0.34
TRIAL: 012  TYPE: UANW  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 50 M  Z: 10.0 M
MEAN OF RUN UP: 0.04  MEAN OF RUN DOWN: 0.05
TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: WHDG  UNITS: DEGREES
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 50 M  Z: 10.0 M
MEAN OF RUN UP: 45.27  MEAN OF RUN DOWN: 34.97
TRIAL: 012  TYPE: AIRT  UNITS: DEGREES C

AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 50 M  Z: 16.0 M

MEAN OF RUN UP: 11.50  MEAN OF RUN DOWN: 11.04
WIND SPEED

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: WSPD  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 50 M  Z: 30.0 M
MEAN OF RUN UP: 4.18  MEAN OF RUN DOWN: 3.52

E21
TRIAL: 012  TYPE: AIRT  UNITS: DEGREES C
AVERAGING TIME: 0.8 SEC  X: 400 M  Y: 50 M  Z: 30.0 M
MEAN OF RUN UP: 11.41  MEAN OF RUN DOWN: 10.98
Temperature vs. time from release (sec x 10^-2)

Trial: 012  Type: AirT.  Units: Degrees C
Averaging time: 0.6 sec  X: 400 m  Y: 200 m  Z: 0.4 m
Mean of run up: 10.13  Mean of run down: 3.36
TEMPERATURE

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: AIRT  UNITS: DEGREES C
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 200 M  Z: 12.0 M
MEAN OF RUN UP: 12.42  MEAN OF RUN DOWN: 10.84
TRIAL: 012  TYPE: UANB  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 300 M  Y: 350 M  Z: 2.0 M
MEAN OF RUN UP: -0.03  MEAN OF RUN DOWN: 0.05

TIME FROM RELEASE (SECS*10**-2)

NORTH

SOUTH

EAST

WEST

0.0  1.0  2.0  3.0  4.0  5.0

-5.0 -4.0 -3.0 -2.0 -1.0  0.0  1.0  2.0  3.0  4.0  5.0

-2 -1  0  1  2  3  4  5  6  7  8  9  10  11  12  13  14
TRIAL: 012   TYPE: UANA   UNITS: M/S
AVERAGING TIME: 0.6 SEC   X: 300 M   Y: 350 M   Z: 2.0 M
MEAN OF RUN UP: 1.28   MEAN OF RUN DOWN: 0.88
TRIAL: 012  TYPE: UAHW  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 300 M  Y: 350 M  Z: 2.0 M
MEAN OF RUN UP: 0.00  MEAN OF RUN DOWN: 0.00
TRIAL: 012   TYPE: UANT   UNITS: DEGREES C

AVERAGING TIME: 0.6 SEC   X: 300 M   Y: 350 M   Z: 2.0 M

MEAN OF RUN UP: 12.68   MEAN OF RUN DOWN: 12.19
TRIAL: 012  TYPE: UANB  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 350 M  Z: 2.0 M
MEAN OF RUN UP: -0.13  MEAN OF RUN DOWN: 0.07
TRIAL: 012  TYPE: UANA  UNITS: M/S

AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 350 M  Z: 2.0 M

MEAN OF RUN UP: 2.12  MEAN OF RUN DOWN: 1.63
TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: UANW  UNITS: M/S

AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 350 M  Z: 2.0 M

MEAN OF RUN UP: 0.05  MEAN OF RUN DOWN: 0.05
WIND VELOCITY

TIME FROM RELEASE (SECS * 10**-2)

TRIAL: 012 TYPE: UANA UNITS: M/S
AVERAGING TIME: 0.6 SEC X: 400 M Y: 350 M Z: 5.0 M
MEAN OF RUN UP: 1.86 MEAN OF RUN DOWN: 1.34
WIND VELOCITY

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012 TYPE: UAVW UNITS: M/S
AVERAGING TIME: 0.6 SEC X: 400 M Y: 350 M Z: 5.0 M
MEAN OF RUN UP: 0.07 MEAN OF RUN DOWN: 0.06
TEMPERATURE

TIME FROM RELEASE (SECS*10**2)

TRIAL: 012  TYPE: UNANT  UNITS: DEGREES C
AVERAGING TIME: 9.6 SEC  X: 400 M  Y: 350 M  Z: 5.0 M
MEAN OF RUN UP: 13.50  MEAN OF RUN DOWN: 13.07

E38
WIND VELOCITY (M/S)

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: UAMA  UNITS: M/S
AVERRAGE TIME:  0.6 SEC  X:  400 M  Y:  350 M  Z:  20.0 M
MEAN OF RUN UP:  2.85  MEAN OF RUN DOWN:  2.24
WIND VELOCITY

TIME FROM RELEASE (SECS*10**2)

TRIAL: 012  TYPE: UANA  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 500 M  Y: 350 M  Z: 2.0 M
MEAN OF RUN UP: 1.73  MEAN OF RUN DOWN: 1.13

E43
TEMPERATURE

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: UANT  UNITS: DEGREES C
AVERAGING TIME: 0.6 SEC  X: 500 M  Y: 350 M  Z: 2.0 M
MEAN OF RUN UP: 11.26  MEAN OF RUN DOWN: 10.67
TRIAL: 012  TYPE: UANB  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 500 M  Y: 350 M  Z: 15.0 M
MEAN OF RUN UP: -0.88  MEAN OF RUN DOWN: -0.63
WIND VELOCITY

TIME FROM RELEASE (SECS*10**2)

TRIAL: 012  TYPE: UANA  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 500 M  Y: 350 M  Z: 15.0 M
MEAN OF RUN UP: 3.17  MEAN OF RUN DOWN: 2.24
TRIAL: 012  TYPE: UAHW  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 500 M  Y: 350 M  Z: 15.0 M
MEAN OF RUN UP:  -0.07  MEAN OF RUN DOWN:  -0.09
TRIAL: 012  TYPE: UANT  UNITS: DEGREES C
AVERAGING TIME: 0.6 SEC  X: 500 M  Y: 350 M  Z: 15.0 M
MEAN OF RUN UP: 16.66  MEAN OF RUN DOWN: 16.08
INSOLATION

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: SOLA  UNITS: W/M**2

AVERAGING TIME: 0.6 SEC  X: 700 M  Y: 500 M  Z: 0.4 M

MEAN OF RUN UP: 26.23  MEAN OF RUN DOWN: 6.81
TRIAL: 012  TYPE: UANB  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 300 M  Y: 550 M  Z: 2.0 M
MEAN OF RUN UP:  -0.45  MEAN OF RUN DOWN:  -0.37
TEMPERATURE

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012 TYPE: UANT UNITS: DEGREES C
AVERAGING TIME: 0.6 SEC X: 300 M Y: 550 M Z: 2.0 M
MEAN OF RUN UP: 14.92 MEAN OF RUN DOWN: 14.44
TIME FROM RELEASE (SECS*10**2)

TRIAL: 012  TYPE: UANB  UNITS: M/S
AVERAGING TIME: 0.6 SEC  X: 300 M  Y: 550 M  Z: 15.0 M
MEAN OF RUN UP:  -0.75  MEAN OF RUN DOWN:  -0.65
WIND VELOCITY

TIME FROM RELEASE (SECS*10**-2)

TRIAL: 012  TYPE: UAHW  UNITS: M/S

AVERAGING TIME: 0.6 SEC  X: 300 M  Y: 550 M  Z: 15.0 M

MEAN OF RUN UP: -0.08  MEAN OF RUN DOWN: -0.06
Trial: 012  Type: WHDG  Units: Degrees
Averaging Time: 0.6 SEC  X: 400 M  Y: 950 M  Z: 10.0 M
Mean of Run Up: 38.34  Mean of Run Down: 45.08
MEAN OF RUN UP: 56.47 MEAN OF RUN DOWN: 63.60
AVERAGING TIME: 0.8 SEC X: 480 M Y: 950 M Z: 10.0 M
TRIAL: 012 TYPE: RHUM UNITS: PER CENT

TIME FROM RELEASE (SECS*10**2):
-2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
MEAN OF RUN UP: 11.26
MEAN OF RUN DOWN: 10.60
AVERAGING TIME: 0.6 SEC  X: 400 M  Y: 950 M  Z: 10.0 M
TRIAL: 012  TYPE: AIR  UNITS: DEGREES C

TIME FROM RELEASE (SECS*10**2-2)

-2 -1.0 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
0 10.0 10.1 10.2 10.3 10.4 10.5 10.6 10.7 10.8 10.9