

Report No. 4RS-CSI-080096-R188127

**AIR QUALITY MONITORING FOR RESPIRABLE DUST :  
LUL TRAIN OPERATORS AND PLATFORM STAFF**

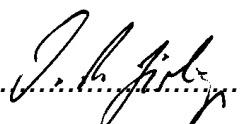
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Issue Date: 13<sup>th</sup> October 2008

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### CONTENTS

|   | Page |
|---|------|
| Executive Summary .....   | 4    |
| 1.Introduction .....  | 5    |
| 2.Technical Background.....   | 5    |
| 3.Method .....  | 6    |
| 4.Analysis.....   | 6    |
| 5.Results .....   | 7    |
| 6.Discussions and Conclusions .....                                     | 9    |
| Table 1: Central Line Train Operators .....                             | 10   |
| Table 2: Jubilee Line Train Operators.....                              | 11   |
| Table 3: Circle and Hammersmith Line Train Operators .....              | 12   |
| Table 4: Northern Line Train Operators .....                            | 13   |
| Table 5: Piccadilly Line Train Operators .....                          | 14   |
| Table 6: Victoria Line Train Operators .....                            | 15   |
| Table 7: Bakerloo Line Train Operators .....                            | 16   |
| Table 8: Hampstead Station .....  | 17   |
| Table 9: Baker Street Station.....                                      | 17   |
| Table 10: Euston Square Station.....                                    | 18   |
| Table 11: Aldgate East Station .....                                    | 18   |
| Table 12: Elephant and Castle Station .....                             | 19   |
| Table 13: Piccadilly Circus Station .....                               | 19   |
| Table 14: Tottenham Court Road Station .....                            | 20   |
| Table 15: Vauxhall Station.....   | 20   |
| Table 16: Kings Cross Station .....                                     | 21   |
| Table 17: Train Operator Respirable Crystalline Silica Monitoring ..... | 22   |
| Figure 1 : Cyclone Dust Head.....                                       | 23   |
| Appendix 1 : Crystalline Respirable Silica Results.....                 | 24   |

### **Executive Summary**

At the request of Louise Stokes, London Underground Limited, personal dust monitoring for respirable dust exposure was to be undertaken on Station and Train Operator Staff at various stations and train lines. Selected samples from Train Operator Staff were also analysed for crystalline silica. The samples were collected by respirable dust cyclone heads worn by the Station and Train Operator Staff during their shifts. In addition, static air sampling was undertaken to assist in the assessment of airborne dust levels in cases where little or no platform duties were carried out by Station Staff.

The Stations where monitoring was carried out were Hampstead, Aldgate, Euston, Baker Street, Piccadilly Circus, Tottenham Court Road, Elephant & Castle, Vauxhall and Kings Cross. Train Operator dust exposure monitoring was carried out on the Central, Jubilee, Bakerloo, Circle and Hammersmith & City, Northern, Piccadilly and Victoria Lines.

For Train Operator Staff the results showed that respirable dust concentration levels were all below  $1 \text{ mg/m}^3$ . These results are not directly comparable to the similar dust monitoring carried out previously as the Train Operator Duties were unavoidably different. However, as a general indication, the respirable dust concentration exposure levels for Train Operator Staff were similar to those measured previously. The lowest levels were recorded for Train Operators working on the Jubilee and Central Lines.

For Station Staff on duty the dust levels measured were also all below  $1 \text{ mg/m}^3$ , and therefore well below the Workplace Exposure Limit of  $4 \text{ mg/m}^3$  (long term 8 hour weighted average). Results for the static samples were similar to those measured previously.

Lower dust concentrations were recorded from personal samples taken from staff on Gateline duties than from those on Platform duties. At some stations, platform duties had not been scheduled, however the combined results of personal samples from Station Staff and the static monitoring samples indicate that the respirable dust concentrations at the stations assessed were below the Workplace Exposure Limit of  $4 \text{ mg/m}^3$  (long term 8 hour time weighted average).

Selected samples taken from collectors worn by Train Operator Staff were analysed for crystalline silica content by the Institute of Occupational Medicine. In all cases, the levels found were below the detection limit of  $<0.01 \text{ mg/filter}$ , and were therefore well below the Workplace Exposure Limit of  $0.1 \text{ mg/m}^3$ .

## **Air Quality Monitoring for Respirable Dust : Train Operators and Platform Staff**

### **1. Introduction**

- 1.1 LUL Procedure No. 3-05106-601 (Issue 1 Cat 5) contains requirements for dust monitoring on the Underground.
- 1.2 At the request of Louise Stokes, London Underground Limited, personal monitoring for respirable dust exposure was to be undertaken on Station Staff conducting platform duties (Station Assistant Trains, SATS) and Train Operators whilst driving.
- 1.3 In addition, one sample from each Line, collected whilst monitoring Train Operator exposure, was to be analysed for crystalline silica.
- 1.4 The specific stations and locations where monitoring was requested were:

| <b>Stations</b>      | <b>Platform Locations</b>                             |
|----------------------|---|
| Aldgate East         | District Line   |
| Baker Street         | Jubilee, Bakerloo and Circle Lines                    |
| Elephant and Castle  | Bakerloo and Northern Lines                           |
| Euston Square        | Circle and Hammersmith Lines                          |
| Hampstead            | Northern Line   |
| King's Cross         | Northern, Piccadilly, Metropolitan and Victoria Lines |
| Piccadilly Circus    | Bakerloo Line   |
| Tottenham Court Road | Central and Northern Lines                            |
| Vauxhall             | Victoria Line   |

- 1.5 Train operator monitoring was to be carried out on the Central, Bakerloo, Piccadilly, Jubilee, Northern, Circle and Hammersmith & City and Victoria Lines.
- 1.6 It is known that the highest levels of airborne dust are found in tunnel and cut and cover sections of the track. Therefore monitoring was not scheduled for the Metropolitan or District Lines as the Circle and Hammersmith Lines covered the relevant cut and cover sections.

### **2. Technical Background**

- 2.1 The health effects concerning inhalation exposure to dust are dependent upon the size, shape and composition of the particles. In occupational health, general dust is classified in terms of particle size, termed either as inhalable, or respirable. The inhalable fraction of dust is defined as particles that can be inhaled and deposited throughout the respiratory tract, i.e. from the nasal to the alveolar region in the lungs. Respirable dust is the term given to dust particles that are small enough to penetrate and therefore largely deposit in the alveolar region.

- 2.2 Respirable and inhalable dusts are currently assessed against the respective Workplace Exposure Limits (WEL's) of 4 mg/m<sup>3</sup> and 10 mg/m<sup>3</sup> averaged over an 8-hour reference period (Health and Safety Executive Document EH40/05 and amendments October 2007).
- 2.3 Prolonged exposure to respirable quartz may result in silicosis a progressive and irreversible condition in which healthy lung tissue becomes replaced with areas of fibrosis. The HSE Workplace Exposure Limit (WEL) for respirable crystalline silica has been set at a level of 0.1 mg/m<sup>3</sup> averaged over an 8-hour reference period (HSE Document EH40/05 and amendments October 2007).

### **3. Method**

- 3.1 Respirable dust levels were measured following the guidance set out in the Health & Safety Executive Document MDHS 14/3: General methods for sampling and gravimetric analysis of respirable and inhalable dust, and in house test procedure 4R-E206 Issue 5.
- 3.2 Sampling pumps equipped with respirable dust cyclone dust heads were worn by the Train Operators and Station Staff. The locations and location codes are given in the results tables. An example of a cyclone dust head is shown in Figure 1. Monitoring was carried out at each of the stations for one shift; timed to include the peak hours. Monitoring of the Train Operators was carried out over three shifts on each Line, again timed to include peak hours.
- 3.3 One of the primary aims was to obtain monitoring data for a shift on each occasion. This was either achieved by a sequence of individuals wearing the same sampling head, or each wearing a separate sampling head. Where separate sampling heads were used, each was run for sufficient time to allow the filter to make a measurable weight gain.
- 3.4 The samples were collected on glass fibre type A/E filters for gravimetric analysis, or GLA 5000 PVC filters to allow both gravimetric analysis and then subsequent analysis for respirable quartz by infra red spectroscopy be conducted.
- 3.5 In locations where there would be little or no duties on the platforms, static sampling pumps were set up in strategic locations where possible. It should however be noted that static results are not the same as personal sampling results, although they can be indicative in some circumstances.

### **4. Analysis**

- 4.1 The samples taken on site were returned to the laboratory and gravimetric analysis undertaken in accordance with MDHS 14/3.
- 4.2 Following gravimetric analysis of the personal respirable dust samples, selected static respirable dust samples, together with blanks were submitted to the Institute of Occupational Medicine (IOM) for quartz analysis.

### 5. Results

#### 5.1 Train Operators

The monitoring was primarily aimed at assessing the exposure of the train operators during travel to respirable dust by means of personal sampling. Selected respirable dust samples, together with blanks, were submitted to the Institute of Occupational Medicine (IOM) for quartz analysis. In the following results summary, the focus is on the personal samples where possible.

##### 5.1.1 Central Line

The respirable dust exposure levels measured are given in Table 1. The levels measured on the 19<sup>th</sup>, 20<sup>th</sup> and 21<sup>st</sup> May 2008 were from 0.09 to 0.17 mg/m<sup>3</sup>.

##### 5.1.2 Jubilee Line

The respirable dust exposure levels measured are given in Table 2. The levels measured on the 13<sup>th</sup>, 16<sup>th</sup> and 17<sup>th</sup> May 2008 were from 0.07 to 0.16 mg/m<sup>3</sup>.

##### 5.1.3 Circle and Hammersmith Lines

The respirable dust exposure levels measured are given in Table 3. The levels measured on the 18<sup>th</sup>, 19<sup>th</sup> and 20<sup>th</sup> June 2008 were from 0.06 to 0.22 mg/m<sup>3</sup>.

##### 5.1.4 Northern Line

The respirable dust exposure levels measured are given in Table 4. The levels measured on the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> June 2008 were from 0.08 to 0.32 mg/m<sup>3</sup>.

##### 5.1.5 Piccadilly Line

The respirable dust exposure levels measured are given in Table 5. The levels measured on the 28<sup>th</sup>, 29<sup>th</sup> and 30<sup>th</sup> May 2008 were from 0.16 to 0.37 mg/m<sup>3</sup>.

##### 5.1.6 Victoria Line

The respirable dust exposure levels measured are given in Table 6. The levels measured on the 10<sup>th</sup>, 11<sup>th</sup> and 12<sup>th</sup> June 2008 were from 0.15 to 0.61 mg/m<sup>3</sup>.

##### 5.1.7 Bakerloo Line

The respirable dust exposure levels measured are given in Table 7. The levels measured on the 5<sup>th</sup>, 6<sup>th</sup> and 9<sup>th</sup> June 2008 were from 0.22 to 0.34 mg/m<sup>3</sup>.

#### 5.2 Station Staff

The monitoring was primarily aimed at assessing the exposure of staff carrying out platform duties to respirable dust by means of personal sampling. Where no platform duties were carried out static samples were taken, these however cannot directly replace personal samples. In the following results summary, the focus is on the personal samples where possible.

##### 5.2.1 Hampstead Station

The results for the monitoring at Hampstead Station are given in Table 8. The monitoring was carried out on the 9<sup>th</sup> May 2008. The results of the personal samples for the staff on gate line duties were between 0.02 and 0.05 mg/m<sup>3</sup>. The results of the static samples on the platforms were between 0.97 and 1.14 mg/m<sup>3</sup>.

### 5.2.2 Baker Street Station

The results for the monitoring at Baker Street Station are given in Table 9. The monitoring was carried out on the 7<sup>th</sup> May 2008. The results for the personal samples for staff on platform duties were between 0.01 and 0.42 mg/m<sup>3</sup>. The results of the static samples on the platforms were between 0.36 and 0.57 mg/m<sup>3</sup>.

### 5.2.3 Euston Square Station

The results for the monitoring at Euston Square Station are given in Table 10. The monitoring was carried out on the 12<sup>th</sup> May 2008. The result for the personal sample for the member of staff on gate line duties was 0.36 mg/m<sup>3</sup>. The result for the Station Supervisor (who spent a considerable period of time in the office) was 0.06 mg/m<sup>3</sup>. The results of the static samples taken on the platforms were between 0.55 and 0.85 mg/m<sup>3</sup>.

### 5.2.4 Aldgate East

The results for the monitoring at Aldgate East Station are given in Table 11. The monitoring was carried out on the 6<sup>th</sup> May 2008. The results for the personal sample for the member of staff on gate line duty was 0.15 mg/m<sup>3</sup>, the results for those on platform duties were in the range 0.20 to 0.23 mg/m<sup>3</sup>. The result for the Station Supervisor was 0.16 mg/m<sup>3</sup>. The results of the static sample from the platform was 0.65 mg/m<sup>3</sup>.

### 5.2.5 Elephant and Castle

The results for the monitoring at Elephant and Castle Station are given in Table 12. The monitoring was carried out on the 8<sup>th</sup> May 2008. The results for the personal samples for staff on duty were between 0.04 and 0.75 mg/m<sup>3</sup>. The results of the static samples on the platforms were between 0.31 and 0.52 mg/m<sup>3</sup>.

### 5.2.6 Piccadilly Circus Station

The results for the monitoring at Piccadilly Circus Station are given in Table 13. The monitoring was carried out on the 14<sup>th</sup> May 2008. The results for the personal samples for staff on platform duties were between 0.44 and 0.96 mg/m<sup>3</sup>. The results of the static samples on the platforms were between 0.63 and 0.90 mg/m<sup>3</sup>.

### 5.2.7 Tottenham Court Road Station

The results for the monitoring at Tottenham Court Road Station are given in Table 14. The monitoring was carried out on the 15<sup>th</sup> May 2008. The result for the personal sample for the member of staff on platform duties was 0.30 mg/m<sup>3</sup>. The results for the personal samples for members of staff on gate line duties were between 0.06 and 0.24 mg/m<sup>3</sup>. The results of the static samples on the platforms were between 0.59 and 0.89 mg/m<sup>3</sup>.

### 5.2.8 Vauxhall Station

The results for the monitoring at Vauxhall Station are given in Table 15. The monitoring was carried out on the 16<sup>th</sup> May 2008. The results for the personal samples for staff on gate line duties were between 0.09 and 0.16 mg/m<sup>3</sup>. Another member of staff was on both gate line and platform duties and that personal sample had a slightly higher result of 0.29 mg/m<sup>3</sup>. The results of the static samples on the platforms were between 0.54 and 0.64 mg/m<sup>3</sup>.

### 5.2.9 Kings Cross Station

The results for the monitoring at Kings Cross Station are given in Table 16. The monitoring was carried out on the 13<sup>th</sup> May 2008. The results for the personal



samples for members of staff on gate line duties were between 0.09 and 0.15 mg/m<sup>3</sup>. The results for the personal sample for the members of staff on platform duties were between 0.40 and 0.51 mg/m<sup>3</sup>. The results of the static samples on the platforms were between 0.51 and 0.62 mg/m<sup>3</sup>.

- 5.3 The IOM certificates for the analysis of quartz on the seven samples taken during the train operator monitoring across all of the different Lines, plus the blank (control) sample, i.e. filter numbers 080096/P1 to 080096/P8, are included in Appendix 1. The results for each of the Lines are given in Table 17. For each filter, the level of crystalline silica present was below the detection limit (i.e. <0.01 mg/filter) which in turn gave a silica concentration of <0.01 mg/m<sup>3</sup> for each sample taken.

## **6. Discussions and Conclusions**

- 6.1 The levels of airborne respirable dust measured for personal samples on Train Operators on the following lines: Central, Jubilee, Circle and Hammersmith & City, Northern, Piccadilly, Victoria and Bakerloo were all below the Workplace exposure limit for respirable dust of 4 mg/m<sup>3</sup> (long term 8 hour time weighted average).
- 6.2 The levels of respirable quartz (crystalline silica) were all less than the detection limit (i.e. <0.01 mg/filter) and thus significantly below the Workplace exposure limit of 0.1 mg/m<sup>3</sup> (long term 8 hour time weighted average).
- 6.3 The levels of airborne respirable dust measured for personal samples taken on staff carrying out platform duties as part of their shifts at the following stations: Hampstead, Baker Street, Kings Cross, Piccadilly Circus, Tottenham Court Road and Vauxhall were all below the Workplace exposure limit for respirable dust of 4 mg/m<sup>3</sup> (long term 8 hour time weighted average).
- 6.4 Platform duties were not scheduled at all of the stations. However, the results of the static samples on the platforms and personal samples worn by personnel on the gate lines suggest that personal exposure to respirable dust on the platforms would be below the Workplace exposure limit for respirable dust of 4 mg/m<sup>3</sup> (long term 8 hour time weighted average).
- 6.5 Compared to the previous monitoring exercise (4RS-RH-060755-R148027, issued March 2007) the majority of the results for the Train Operators are very similar. However, the results of those from the Central and Bakerloo lines are lower this time round compared to those from 2007.
- 6.6 Although not all of the duties and locations were monitored exactly the same as that performed in 2007, those that were repeated, or performed in similar locations, generally gave similar results with no really significant variations.

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 1: Central Line Train Operators**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION            | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|----------------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/74     | RD  | 1078604, TO, Driving train | 19/05/08 | 08:48      | 11:30       | 2.2                  | 356.4                     | 0.09   | West Ruislip Depot → West Ruislip → North Acton → Epping → West Ruislip → Leytonstone → West Ruislip |
|               |   | 8210903, TO, Driving train | 19/05/08 | 11:30      | 13:00       | 2.2                  | 198                       |  |  |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/79     | RD  | 6483869, TO, Driver | 20/05/08 | 07:48      | 10:30       | 2.2                  | 356.4                     | 0.13   | West Ruislip Depot → West Ruislip → North Acton → Epping → West Ruislip → Leytonstone → West Ruislip |
|               |   | 0752089, TO, Driver |          | 10:30      | 13:30       | 2.2                  | 396                       |  |  |
|               |   | 0225667, TO, Driver |          | 13:30      | 13:55       | 2.2                  | 55                        |  |  |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/P1     | RD  | 5548969, TO, Driver | 21/05/08 | 07:49      | 10:30       | 2.2                  | 354.2                     | 0.17   | West Ruislip Depot → West Ruislip → North Acton → Epping → West Ruislip → Leytonstone → West Ruislip |
|               |   | 0354863, TO, Driver |          | 10:30      | 11:30       | 2.2                  | 132                       |  |  |
|               |   | 8983866, TO, Driver |          | 11:30      | 11:55       | 2.2                  | 55                        |  |  |

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 2: Jubilee Line Train Operators**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/P6     | RD  | 3726964, TO, Driver | 13/06/08 | 08:20      | 09:30       | 2.2                  | 154                       | 0.16   | Wembley Park → Stratford → Stanmore → Stratford → Stanmore → Stratford |
|               |   | 3726964, TO, Driver |          | 10:45      | 14:40       | 2.2                  | 517                       |  |  |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/157    | RD  | 3954867, TO, Driver | 16/06/08 | 08:35      | 12:10       | 2.2                  | 451                       | 0.10   | Wembley Park → Stratford → Stanmore → Stratford → Stanmore → Stratford |
|               |   | 3954867, TO, Driver |          | 12:50      | 14:50       | 2.2                  | 264                       |  |  |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/167    | RD  | 3954867, TO, Driver | 17/06/08 | 08:20      | 10:00       | 2.2                  | 220                       | 0.07   | Wembley Park → Stratford → Stanmore → Stratford → Stanmore → Stratford |
|               |   | 6828089, TO, Driver |          | 10:00      | 13:50       | 2.2                  | 506                       |  |  |

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 3: Circle and Hammersmith Line Train Operators**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/P7     | RD  | 8249862, TO, Driver | 18/06/08 | 08:40      | 10:30       | 2.2                  | 242                       | 0.10   | Edgware Road → Sth Kensington →<br>Edgware Road → Sth Kensington →<br>Edgware Road → Sth Kensington →<br>Edgware Road → Sth Kensington →<br>Edgware Road |
|               |   | 8786861, TO, Driver |          | 10:30      | 13:20       | 2.2                  | 374                       |  |  |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED   |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/159    | RD  | 0366964, TO, Driver | 19/06/08 | 09:00      | 10:20       | 2.2                  | 176                       | 0.06   | Edgware Road → Sth Kensington →<br>Edgware Road → Sth Kensington →<br>Edgware Road → Sth Kensington →<br>Edgware Road |
|               |   | 8590961, TO, Driver |          | 10:20      | 13:20       | 2.2                  | 398                       |  |   |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED   |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/176    | RD  | 0404961, TO, Driver | 20/06/08 | 15:45      | 16:50       | 2.2                  | 143                       | 0.22   | Hammersmith → Barking →<br>Edgware Road → Sth Kensington →<br>Edgware Road → Sth Kensington →<br>Edgware Road |
|               |   |                     |          | 18:10      | 19:05       | 2.2                  | 121                       |  |   |
|               |   |                     |          | 20:00      | 22:00       | 2.2                  | 264                       |  |   |

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 4: Northern Line Train Operators**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED   |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/102    | RD  | 3285869, TO, Driver | 02/06/08 | 08:10      | 09:10       | 2.2                  | 132                       | 0.19   | Golders Green → Morden →<br>Edgware → Morden<br>→ Golders Green |
|               |   | 1403501, TO, Driver |          | 09:10      | 11:15       | 2.2                  | 275                       |  |   |
|               |   | 3035089, TO, Driver |          | 11:15      | 11:30       | 2.2                  | 33                        |  |   |
|               |   | 2505802, TO, Driver |          | 11:30      | 13:30       | 2.2                  | 264                       |  |   |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED   |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/P3     | RD  | 1799763, TO, Driver | 03/06/08 | 06:45      | 10:25       | 2.2                  | 484                       | 0.08   | Golders Green → Morden →<br>Edgware → Golders Green → Morden<br>→ Golders Green |
|               |   | 0880866, TO, Driver |          | 10:25      | 13:30       | 2.2                  | 407                       |  |   |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED   |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/111    | RD  | 2369668, TO, Driver | 04/06/08 | 08:00      | 11:30       | 2.2                  | 462                       | 0.32   | Morden → High Barnet → Kennington<br>→ High Barnet → Edgware → Morden |
|               |   | 0880866, TO, Driver |          | 11:30      | 13:00       | 2.2                  | 198                       |  |   |
|               |   | 1045864, TO, Driver |          | 13:00      | 14:00       | 2.2                  | 132                       |  |   |

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 5: Piccadilly Line Train Operators**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED   |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/88     | RD  | 5094861, TO, Driver | 28/05/08 | 07:52      | 11:25       | 2.2                  | 468.6                     | 0.37   | Oakwood → Heathrow Airport 4 → Acton → Cockfosters → Heathrow Airport → Oakwood |
|               |   | 0424189, TO, Driver |          | 11:25      | 12:00       | 2.2                  | 77                        |  |   |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED   |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/93     | RD  | 5205962, TO, Driver | 29/05/08 | 06:55      | 09:15       | 2.2                  | 308                       | 0.22   | Oakwood → Heathrow Airport 4 → Acton → Cockfosters → Acton Town → Rayners Lane → Acton Town → Oakwood |
|               |   | 7616968, TO, Driver |          | 09:15      | 13:00       | 2.2                  | 495                       |  |   |
|               |   | 8534767, TO, Driver |          | 13:00      | 14:00       | 2.2                  | 132                       |  |   |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/P2     | RD  | 5549961, TO, Driver | 30/05/08 | 07:05      | 09:05       | 2.2                  | 264                       | 0.16   | Oakwood → Heathrow Airport 4 → Acton → Rayners Lane → Acton Town → Cockfosters |
|               |   | 8434966, TO, Driver |          | 09:09      | 10:00       | 2.2                  | 112.2                     |  |  |
|               |   | 1049763, TO, Driver |          | 10:00      | 12:00       | 2.2                  | 264                       |  |  |

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 6: Victoria Line Train Operators**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED   |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/135    | RD  | 0262663, TO, Driver | 10/06/08 | 07:45      | 10:45       | 2.2                  | 396                       | 0.61   | Seven Sisters → Brixton →<br>Walthamstow Central → Brixton →<br>Walthamstow Central → Brixton →<br>Walthamstow Central → Brixton →<br>Walthamstow Central → Brixton → |
|               |   | 5154307, TO, Driver |          | 10:45      | 13:45       | 2.2                  | 396                       |  |   |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/P5     | RD  | 5411964, TO, Driver | 11/06/08 | 05:30      | 06:35       | 2.2                  | 143                       | 0.15   | Seven Sisters → Brixton →<br>Walthamstow Central → Brixton →<br>Walthamstow Central → Brixton →<br>Walthamstow Central → Brixton →<br>Walthamstow Central → Brixton →<br>Walthamstow Central → Brixton |
|               |   | 9085862, TO, Driver |          | 06:35      | 10:45       | 2.2                  | 550                       |  |  |
|               |   | 8012964, TO, Driver |          | 10:45      | 12:00       | 2.2                  | 165                       |  |  |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED   |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/144    | RD  | 2234964, TO, Driver | 12/06/08 | 05:30      | 06:35       | 2.2                  | 143                       | 0.17   | Seven Sisters → Brixton →<br>Walthamstow Central → Brixton →<br>Walthamstow Central → Brixton →<br>Walthamstow Central → Brixton →<br>Walthamstow Central → Brixton |
|               |   | 5030767, TO, Driver |          | 06:35      | 11:30       | 2.2                  | 649                       |  |   |

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 7: Bakerloo Line Train Operators**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/P4     | RD  | 5901089, TO, Driver | 05/06/08 | 07:30      | 10:30       | 2.2                  | 396                       | 0.22   | Queens Park → Elephant and Castle<br>→ Harrow and Wealdstone →<br>Elephant and Castle → Harrow and<br>Wealdstone → Elephant and Castle →<br>Harrow and Wealdstone → Elephant<br>and Castle |
|               |   | 3685663, TO, Driver |          | 10:30      | 13:30       | 2.2                  | 396                       |  |  |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/119    | RD  | 6108961, TO, Driver | 06/06/08 | 07:15      | 09:45       | 2.2                  | 330                       | 0.28   | Queens Park → Elephant and Castle<br>→ Harrow and Wealdstone →<br>Elephant and Castle → Harrow and<br>Wealdstone → Elephant and Castle →<br>Harrow and Wealdstone → Elephant<br>and Castle |
|               |   | 2821868, TO, Driver |          | 09:45      | 10:15       | 2.2                  | 66                        |  |  |
|               |   | 6056089, TO, Driver |          | 10:15      | 13:00       | 2.2                  | 363                       |  |  |

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | ROUTE COVERED  |
|---------------|---|---------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/130    | RD  | 3118867, TO, Driver | 09/06/08 | 07:00      | 09:40       | 2.2                  | 352                       | 0.34   | Queens Park → Elephant and Castle<br>→ Harrow and Wealdstone →<br>Elephant and Castle → Harrow and<br>Wealdstone → Elephant and Castle →<br>Harrow and Wealdstone → Elephant<br>and Castle |
|               |   | 1620907, TO, Driver |          | 09:40      | 13:30       | 2.2                  | 506                       |  |  |



## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 8: Hampstead Station**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION                  | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | LOCATIONS & COMMENTS  |
|---------------|---|----------------------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/25     | RD  | 3869089                          | 09/05/08 | 07:30      | 10:30       | 2.2                  | 396                       | 0.02   | Gate line duties  |
| 080096/26     | RD  | Static on Platform 1, northbound | 09/05/08 | 07:32      | 11:30       | 2.2                  | 523.6                     | 0.97   | On gate by tunnel entrance where train enters platform.           |
| 080096/28     | RD  | Static on Platform 2, southbound | 09/05/08 | 07:32      | 13:32       | 2.2                  | 792                       | 1.14   | On gate by tunnel entrance where train enters platform.           |
| 080096/27     | RD  | 7814189                          | 09/05/08 | 08:30      | 09:30       | 2.2                  | 132                       | 0.05   | Gate line duties. On break from 09:30 to 10:30 outside of station |
|               |   |                                  |          | 10:30      | 13:00       | 2.2                  | 462                       |  |   |

**Table 9: Baker Street Station**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION                    | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | LOCATIONS & COMMENTS                                   |
|---------------|---|------------------------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/6      | RD  | 3835189                            | 07/05/08 | 07:34      | 12:20       | 2.2                  | 629.2                     | 0.35   | Platform Duties  |
| 080096/7      | RD  | 2598189                            | 07/05/08 | 07:45      | 12:20       | 2.2                  | 605                       | 0.01   | Platform Duties  |
| 080096/8      | RD  | Static on Platform 5, EB, H&C line | 07/05/08 | 08:25      | 14:40       | 2.2                  | 825                       | 0.36   | On gate by tunnel entrance where train exits platform. |
| 080096/9      | RD  | 6973089                            | 07/05/08 | 07:37      | 14:00       | 2.2                  | 842.6                     | 0.42   | Platform Duties  |
| 080096/10     | RD  | 7305189                            | 07/05/08 | 07:36      | 12:48       | 2.2                  | 686.4                     | 0.25   | Platform Duties  |
| 080096/11     | RD  | Static on Platform 8, SB, Bakerloo | 07/05/08 | 10:25      | 14:30       | 2.2                  | 539                       | 0.57   | On gate by tunnel entrance where train exits platform. |
| 080096/12     | RD  | Static on Platform 7, SB, Jubilee  | 07/05/08 | 10:30      | 14:30       | 2.2                  | 528                       | 0.56   | On gate by tunnel entrance where train exits platform. |

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 10: Euston Square Station**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION                 | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | LOCATIONS & COMMENTS  |
|---------------|---|---------------------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/33     | RD  | Static on Platform 2, Eastbound | 12/05/08 | 09:30      | 13:30       | 2.2                  | 528                       | 0.55   | On gate by tunnel entrance where train exits platform.            |
| 080096/34     | RD  | Static on Platform 1, Westbound | 12/05/08 | 09:30      | 13:30       | 2.2                  | 528                       | 0.85   | On gate by tunnel entrance where train enters platform.           |
| 080096/35     | RD  | 2005708                         | 12/05/08 | 09:30      | 13:30       | 2.2                  | 528                       | 0.06   | Station Supervisor, mainly office based, little time on platforms |
| 080096/36     | RD  | 0819089                         | 12/05/08 | 10:45      | 13:45       | 2.2                  | 396                       | 0.36   | Gate Line duties  |

**Table 11: Aldgate East Station**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION       | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min)* | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | LOCATIONS & COMMENTS                           |
|---------------|---|-----------------------|----------|------------|-------------|-----------------------|---------------------------|--|--|
| 080096/1      | RD  | 6635967               | 06/05/08 | 07:21      | 11:55       | 2.2                   | 602.8                     | 0.23   | Customer Services Assistant on platform duties |
| 080096/2      | RD  | Static on EB platform | 06/05/08 | 07:29      | 11:32       | 2.2                   | 534.6                     | 0.65   | Located by headwall                            |
| 080096/3      | RD  | 3640869               | 06/05/08 | 07:54      | 13:57       | 2.2                   | 798.6                     | 0.16   | Supervisor                                     |
| 080096/4      | RD  | 4281965               | 06/05/08 | 08:01      | 12:01       | 2.2                   | 528.0                     | 0.20   | Customer Services Assistant on platform duties |
| 080096/5      | RD  | 7755002               | 06/05/08 | 09:24      | 14:00       | 2.2                   | 607.2                     | 0.15   | Customer Services Assistant on gateline duties |

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 12: Elephant and Castle Station**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION                      | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | LOCATIONS & COMMENTS                                    |
|---------------|---|--------------------------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/16     | RD  | 8305089                              | 08/05/08 | 08:00      | 11:35       | 2.2                  | 473                       | 0.04   | General station duties                                  |
| 080096/17     | RD  | Static Platform 2, SB, Northern line | 08/05/08 | 08:38      | 14:10       | 2.2                  | 730.4                     | 0.52   | On gate by tunnel entrance where train enters platform. |
| 080096/18     | RD  | 7711073                              | 08/05/08 | 08:30      | 12:00       | 2.2                  | 462                       | 0.05   | General station duties                                  |
| 080096/19     | RD  | 4961766                              | 08/05/08 | 08:30      | 14:00       | 2.2                  | 726                       | -*   | General station duties                                  |
| 080096/20     | RD  | 7784962                              | 08/05/08 | 08:36      | 12:08       | 2.2                  | 466.4                     | 0.75   | General station duties                                  |
| 080096/21     | RD  | Static Platform 4, NB, Bakerloo      | 08/05/08 | 08:35      | 14:12       | 2.2                  | 741.4                     | 0.31   | On gate by tunnel entrance where train enters platform. |

\* filter damaged, no result

**Table 13: Piccadilly Circus Station**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION                     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | LOCATIONS & COMMENTS                                   |
|---------------|---|-------------------------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/49     | RD  | 6571189                             | 14/05/08 | 07:40      | 10:40       | 2.2                  | 396                       | 0.81   | Platform duties, NB Bakerloo, Plat 1                   |
| 080096/50     | RD  | 8354189                             | 14/05/08 | 07:40      | 10:40       | 2.2                  | 396                       | 0.96   | Platform duties, SB Bakerloo, Plat 2                   |
| 080096/51     | RD  | 0473189                             | 14/05/08 | 07:40      | 12:45       | 2.2                  | 671                       | 0.44   | Platform duties, Plat 3 & 4, Piccadilly                |
| 080096/52     | RD  | Static on Platform 2, Bakerloo SB   | 14/05/08 | 07:45      | 13:00       | 2.2                  | 693                       | 0.90   | On gate by tunnel entrance where train exits platform. |
| 080096/53     | RD  | Static on Platform 4, Piccadilly WB | 14/05/08 | 07:46      | 12:55       | 2.2                  | 679.8                     | 0.63   | On gate by tunnel entrance where train exits platform. |

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 14: Tottenham Court Road Station**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION                   | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | LOCATIONS & COMMENTS                                   |
|---------------|---|-----------------------------------|----------|------------|-------------|----------------------|---------------------------|--|--|
| 080096/57     | RD  | 0078189                           | 15/05/08 | 07:55      | 12:05       | 2.2                  | 550                       | 0.30   | Platform duties, Platform 2, Central EB                |
| 080096/58     | RD  | 4372089                           | 15/05/08 | 08:20      | 12:00       | 2.2                  | 484                       | 0.06   | Gate line duties                                       |
| 080096/59     | RD  | 9843189                           | 15/05/08 | 08:20      | 12:00       | 2.2                  | 484                       | 0.24   | Gate line duties                                       |
| 080096/60     | RD  | Static on Platform 4, Northern SB | 15/05/08 | 07:30      | 12:50       | 2.2                  | 704                       | 0.59   | On gate by tunnel entrance where train exits platform. |
| 080096/61     | RD  | Static on Platform 1, Central WB  | 15/05/08 | 07:30      | 12:50       | 2.2                  | 704                       | 0.89   | On gate by tunnel entrance where train exits platform. |

**Table 15: Vauxhall Station**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION          | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | LOCATIONS & COMMENTS                                    |
|---------------|---|--------------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/65     | RD  | 9501967                  | 16/05/08 | 07:45      | 12:30       | 2.2                  | 627                       | 0.09   | Gate line duties  |
| 080096/66     | RD  | 7078189                  | 16/05/08 | 07:45      | 12:30       | 2.2                  | 627                       | 0.16   | Gate line duties  |
| 080096/67     | RD  | 2471074                  | 16/05/08 | 08:00      | 12:30       | 2.2                  | 594                       | 0.29   | Platform and gate line duties                           |
| 080096/68     | RD  | Static on Platform 1, NB | 16/05/08 | 08:00      | 13:00       | 2.2                  | 660                       | 0.54   | On gate by tunnel entrance where train exits platform.  |
| 080096/69     | RD  | Static on Platform 2, SB | 16/05/08 | 08:00      | 13:00       | 2.2                  | 660                       | 0.64   | On gate by tunnel entrance where train enters platform. |

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 16: Kings Cross Station**

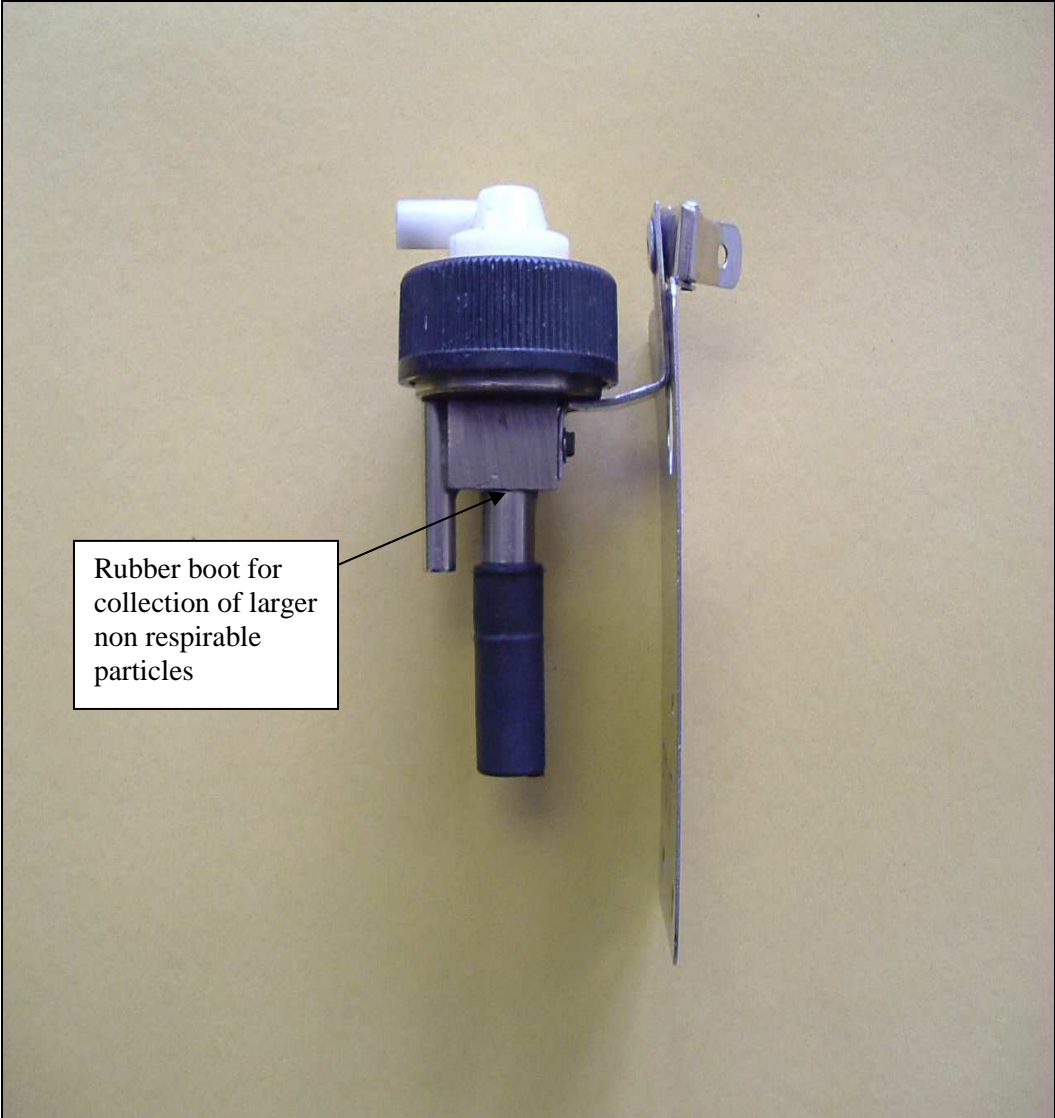
| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION                     | DATE     | START TIME | FINISH TIME | FLOW RATE<br>(l/min) | VOLUME OF AIR<br>(litres) | CALC. DUST CONC <sup>N</sup><br>(MG/M <sup>3</sup> ) | LOCATIONS & COMMENTS                                    |
|---------------|---|-------------------------------------|----------|------------|-------------|----------------------|---------------------------|--|---|
| 080096/40     | RD  | 3626189                             | 13/05/08 | 07:31      | 13:00       | 2.2                  | 723.8                     | 0.09   | Gate Line duties  |
| 080096/41     | RD  | 0535789                             | 13/05/08 | 07:30      | 13:10       | 2.2                  | 748                       | 0.40   | Platform duties, Northern line platforms                |
| 080096/42     | RD  | 4472963                             | 13/05/08 | 07:30      | 11:17       | 2.2                  | 499.4                     | 0.51   | Piccadilly line platform WB and duty control room       |
| 080096/43     | RD  | 0162862                             | 13/05/08 | 07:30      | 12:20       | 2.2                  | 638                       | 0.15   | Gate Line duties  |
| 080096/44     | RD  | Static on Platform 6, Piccadilly EB | 13/05/08 | 07:40      | 13:00       | 2.2                  | 704                       | 0.51   | On gate by tunnel entrance where train exits platform.  |
| 080096/45     | RD  | Static on Platform 3, Victoria NB   | 13/05/08 | 07:35      | 13:00       | 2.2                  | 715                       | 0.62   | On gate by tunnel entrance where train enters platform. |

## Air Quality Monitoring for Respirable Dust: Train Operators and Platform Staff

**Table 17: Train Operator Respirable Crystalline Silica Monitoring**

| FILTER NUMBER | SAMPLE TYPE<br>(RESPIRABLE DUST, RD,<br>INHALABLE DUST, ID) | SAMPLE LOCATION                                  | DATE     | VOLUME<br>OF AIR<br>(litres) | CRYSTALLINE<br>SILICA<br>(mg/filter) | CRYSTALLINE<br>SILICA<br>(mg/m <sup>3</sup> ) | LOCATIONS & COMMENTS   |
|---------------|---|--|----------|------------------------------|--------------------------------------|---|--|
| 080096/P1     | RD  | Central Line Train Operators<br>Driving Trains   | 21/05/08 | 541.2                        | < 0.01                               | < 0.01  | West Ruislip Depot → West Ruislip → North Acton →<br>Epping → West Ruislip → Leytonstone → West<br>Ruislip   |
| 080096/P6     | RD  | Jubilee Line Train Operator<br>Driving Trains    | 13/06/08 | 671                          | < 0.01                               | < 0.01  | Wembley Park → Stratford → Stanmore → Stratford<br>→ Stanmore → Stratford → Stanmore → Stratford   |
| 080096/P7     | RD  | Circle Line Train Operator<br>Driving Trains     | 18/06/08 | 616                          | < 0.01                               | < 0.01  | Edgware Road → Edgware Road → Edgware Road<br>→ Edgware Road → Edgware Road  |
| 080096/P3     | RD  | Northern Line Train Operator<br>Driving Trains   | 03/06/08 | 891                          | < 0.01                               | < 0.01  | Golders Green → Morden → Edgware →<br>Morden → Golders Green   |
| 080096/P2     | RD  | Piccadilly Line Train Operator<br>Driving Trains | 30/05/08 | 640.2                        | < 0.01                               | < 0.01  | Oakwood → Heathrow Airport 4 → Acton → Rayners<br>Lane → Acton Town → Cockfosters  |
| 080096/P5     | RD  | Victoria Line Train Operator<br>Driving Trains   | 11/06/08 | 858                          | < 0.01                               | < 0.01  | Seven Sisters → Brixton → Walthamstow Central →<br>Brixton → Walthamstow Central → Brixton →<br>Walthamstow Central → Brixton → Walthamstow<br>Central → Brixton → Walthamstow Central → Brixton |
| 080096/P4     | RD  | Bakerloo Line Train Operator<br>Driving Trains   | 05/06/08 | 792                          | < 0.01                               | < 0.01  | Queens Park → Elephant and Castle → Harrow and<br>Wealdstone → Elephant and Castle → Harrow and<br>Wealdstone → Elephant and Castle → Harrow and<br>Wealdstone → Elephant and Castle             |

**Figure 1 : Cyclone Dust Head**



## Appendix 1 : Crystalline Respirable Silica Results



WORKING FOR A HEALTHY FUTURE

### *CERTIFICATE OF ANALYSIS*

**ANALYSIS REQUESTED BY:** Chris Isgrove  
4-Rail Services Ltd  
Unit 11  
Ironbridge Close  
Great Central Way  
London  
NW10 0UF

**CONTRACT NO:** 14759

**PROJECT NO:** 610

**DATE OF ISSUE:** 09.07.08

**DATE SAMPLES RECEIVED:** 20.06.08

**DATE SAMPLES ANALYSED:** 09.07.08

**SAMPLES:** 8 x 25mm GLA-5000 PVC filters

**ANALYSIS REQUESTED:** Respirable crystalline silica by infra red

**METHOD:** The analysis was carried out using a method based on;

**MDHS 101:** Health and Safety Executive (2005). "Crystalline silica in respirable airborne dusts". Direct on filter analyses by infrared spectroscopy and X-ray diffraction. Methods for the Determination of Hazardous Substances No. 101. HMSO, London.

*Page 1 of 2*

### RESEARCH CONSULTING SERVICES

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0374



CONTRACT NO: 14759  
PROJECT NO: 610  
DATE OF ISSUE: 09.07.08

**RESULTS:**

| Sample Number | Quartz weight (mg) |
|---------------|--------------------|
| 080096/P1     | <0.01              |
| 080096/P2     | <0.01              |
| 080096/P3     | <0.01              |
| 080096/P4     | <0.01              |
| 080096/P5     | <0.01              |
| 080096/P6     | <0.01              |
| 080096/P7     | <0.01              |
| 080096/P8     | <0.01              |

Our detection limit for crystalline silica on filters by this method is 0.01 mg.

**COMMENTS:**

Opinions and interpretations herein are outside the scope of UKAS accreditation.

IOM Consulting cannot accept responsibility for samples sent for analysis that have been incorrectly collected or despatched.

ANALYSED BY: *S Clark*  
S Clark  
Mineralogy Section Manager

AUTHORISED BY: *A Searl*  
A Searl  
Director Analytical Services