

# PARTICULATE MONITORING SYSTEMS CALIBRATION CERTIFICATE



**Customer:** Clark-Drain Ltd  
**Location:** Yaxley  
**Calibration Date:** 11<sup>th</sup> September 2008  
**PCME Job No:** J28077817  
**Instrument:** DT770  
**Channel ID:** Galvanising Bath  
**Channel Number:** CH1

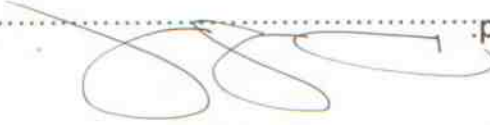
| Calculations                            |      |                                           |
|-----------------------------------------|------|-------------------------------------------|
| Run 1                                   | 2.00 | 8.39                                      |
| Run 2                                   | 1.50 | 7.82                                      |
| Run 3                                   | 1.33 | 7.65                                      |
| Averages                                | 1.61 | 7.96                                      |
| Instrument Average (mg/m <sup>3</sup> ) |      | Iso Sampling Average (mg/m <sup>3</sup> ) |

|                     |        |
|---------------------|--------|
| Existing Cal Factor | 0.4872 |
|---------------------|--------|

$$\frac{\text{Iso sampling average}}{\text{Existing cal factor}} \times \text{Instrument average}$$

**New Cal Factor @ Stack Conditions** 2.400

**Recommended Recalibration Due** 11<sup>th</sup> September 2009

Signed:  Dave Sinclair, Service Manager

**AIR & EMISSIONS TESTING GROUP**

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**Stack Emissions Testing Report**  
Total Particulate Matter  
Hydrogen Chloride  
Lead

**PCME Limited**  
**Clark Drain Limited**  
**Galvanising Bath**

**Sampling Date/s:** 11th September 2008  
**Job Number:** LAB 08056

|                         |                             |
|-------------------------|-----------------------------|
| Report Date / Version:  | 6th October 2008/ Version 1 |
| Report By:              | Daniel Pyke                 |
| MCERTS Level:           | MM 03 163                   |
| MCERTS Number:          | Level 2                     |
| Technical Endorsements: | TE1, TE2, TE3 & TE4         |
| Report Approved By:     | Andrew Palliser             |
| MCERTS Number:          | MM 03 161                   |
| Business Title:         | Level 2 - Business Manager  |
| Technical Endorsements: | TE1, TE2, TE3 & TE4         |
| Signature:              |                             |

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### Stack Emissions Monitoring Objectives

Clark Drain Limited operates a galvanising process at Yaxley which is subject to a PPC Permit, under the Pollution Prevention & Control Regulations 2000.

Scientifics Limited were commissioned by PCME Limited to carry out stack emissions monitoring to determine the release of prescribed pollutants from the following Plant under Normal operating conditions:

The results of these tests shall be used to demonstrate compliance with a set of emission limit values for prescribed pollutants as specified in the Plant's PPC Permit, IPPC 12/92.

| Plant                  |  | Galvanising Bath    |  |
|------------------------|--|---------------------|--|
| Operator               |  | Scientifics Limited |  |
| PPC Permit: IPPC 12/92 |  | PCME Limited        |  |
|                        |  | Clark Drain Limited |  |
|                        |  | Station Road        |  |
|                        |  | Yaxley              |  |
|                        |  | Cambridgeshire      |  |
|                        |  | PE17 3EG            |  |

### Stack Emissions Monitoring

Scientifics Limited - Stockport Laboratory  
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Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

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## Emissions Summary

Yaxley, Clark Drain Limited  
Galvanising Bath  
11th September 2008

| Parameter                                        | Units              | Result | Uncertainty | Limit |
|--------------------------------------------------|--------------------|--------|-------------|-------|
| Total Particulate Matter                         | mg/m <sup>3</sup>  | 2.4    | 15          | 15    |
| Particulate Emission Rate                        | g/hr               | 167    | -           | -     |
| Hydrogen Chloride                                | mg/m <sup>3</sup>  | 1.2    | 0.26        | 30    |
| Hydrogen Chloride Emission Rate                  | g/hr               | 16     | 3.4         | -     |
| Lead                                             | mg/m <sup>3</sup>  | 0.039  | 0.0081      | -     |
| Lead Emission Rate                               | g/hr               | 0.38   | 0.079       | -     |
| Moisture                                         | %                  | 2.34   | 0.23        | -     |
| Stack Gas Temperature                            | °C                 | 39     | -           | -     |
| Stack Gas Velocity                               | m/s                | 7.2    | -           | -     |
| Gas Volumetric Flow Rate (Actual)                | m <sup>3</sup> /hr | 11187  | -           | -     |
| Gas Volumetric Flow Rate (STP, Wet)              | m <sup>3</sup> /hr | 9689   | -           | -     |
| Gas Volumetric Flow Rate (STP, Dry)              | m <sup>3</sup> /hr | 9412   | -           | -     |
| Gas Volumetric Flow Rate at Reference Conditions | m <sup>3</sup> /hr | 9689   | -           | -     |

where ND = None Detected

All results are mean values, with pollutant concentrations expressed at reference conditions.  
Reference conditions are 273K, 101.3Pa, without correction for water vapour content.

EXECUTIVE SUMMARY (Page 3 of 7)

| Parameter                       | Sampling Date       | Sampling Times | Sampling Duration |
|---------------------------------|---------------------|----------------|-------------------|
| Total Particulate Matter Run 1  | 11th September 2008 | 10:55 - 11:59  | 64 minutes        |
| Total Particulate Matter Run 2  | 11th September 2008 | 12:11 - 13:11  | 64 minutes        |
| Total Particulate Matter Run 3* | 11th September 2008 | 13:24 - 14:14  | 52 minutes        |
| Hydrogen Chloride               | 11th September 2008 | 13:10 - 14:10  | 60 minutes        |
| Lead                            | 11th September 2008 | 10:55 - 11:59  | 32 minutes        |

\*Sampling stopped after 52 minutes as a blocked filter was affecting the pulling power of the pump and therefore the isokinetic rate would have been non-compliant.

| Process Details |                |                           |                  |
|-----------------|----------------|---------------------------|------------------|
| Parameter       | Process Status | Feedstock (if applicable) | Abatement System |
|                 | Normal         | Continuous                | Bag Filter       |
|                 | On             | None Visible              | Plume Appearance |

## EXECUTIVE SUMMARY (Page 4 of 7)

### Monitoring Methods

The selection of standard methods employed by Scientifics is determined, wherever possible by the hierarchy of method selection outlined in Environment Agency Technical Guidance Document (Monitoring) M2, i.e. CEN, ISO, BS, US EPA etc.

The tables below summarise the monitoring methods, techniques and technical procedures employed, and details any deviations from the aforementioned hierarchy.

### Sampling Methods with Subsequent Analysis

| Species                       | Standard Method | Scientifics Technical Procedure | UKAS Lab Number | MCERTS Accredited Method | Limit of Detection (LOD)  | MU of Method +/- % | MU +/- % |
|-------------------------------|-----------------|---------------------------------|-----------------|--------------------------|---------------------------|--------------------|----------|
| TPM                           | BS EN 13284-1   | AE 006                          | 1015            | Yes                      | 0.38 mg/m <sup>2</sup>    | 30%                | 11%      |
| Lead                          | BS EN 14365     | AE 028                          | 1015            | Yes                      | 0.1 mg/m <sup>2</sup>     | 30%                | 21%      |
| HCl                           | BS EN 1911      | AE 018                          | 1015            | Yes                      | 0.01961 mg/m <sup>2</sup> | 30%                | 21%      |
| H <sub>2</sub> O <sup>1</sup> | BS EN 14790     | AE 004                          | 1015            | Yes                      | 0.1%                      | 10%                | -        |

<sup>1</sup> - H<sub>2</sub>O is measured concurrently with TPM testing.

Analytical Methods

The following tables list the analytical methods employed together with the custody and archiving details:

Sampling Methods with Subsequent Analysis

| Species          | Analytical Technique | Analytical Procedure | UKAS Lab Number | UKAS Accredited | Laboratory | Sample Location | Archive Period |
|------------------|----------------------|----------------------|-----------------|-----------------|------------|-----------------|----------------|
| TPM              | Gravimetric          | AE 006               | 1015            | Yes             | Stockport  | Stockport       | 3 months       |
| Lead             | ICP - MS             | AE 028               | 1015            | Yes             | Harwell    | Harwell         | 3 months       |
| HCl              | Ion Chromatography   | AE 019               | 1015            | Yes             | Harwell    | Harwell         | 3 months       |
| H <sub>2</sub> O | Gravimetric          | AE 004               | 1015            | Yes             | Stockport  | N/A             | N/A            |

# EXECUTIVE SUMMARY (Page 6 of 7)

## Sampling Location

| Sampling Plane Validation Criteria            | Value | Units | Requirement | Compliance | Method    |
|-----------------------------------------------|-------|-------|-------------|------------|-----------|
| Lowest Differential Pressure                  | 39    | Pa    | > 5 Pa      | Yes        | All       |
| Lowest Gas Velocity                           | 7.0   | m/s   | -           | -          | -         |
| Highest Gas Velocity                          | 9.7   | m/s   | -           | -          | -         |
| Ratio of Above                                | 1.4   | 1     | < 3 - 1     | Yes        | All       |
| Mean Velocity                                 | 7.9   | m/s   | -           | -          | -         |
| Angle of flow with regard to duct axis        | 4     | °     | < 15°       | Yes        | All       |
| No local negative flow                        | -     | -     | -           | Yes        | All       |
| Highly homogeneous flow stream / gas velocity | -     | -     | -           | Yes        | ISO 10396 |

## Duct Characteristics

| Sample Port Size | Number Used | Orientation | Number Ports / Line | In Stack / Out Stack Filtration |
|------------------|-------------|-------------|---------------------|---------------------------------|
| 4 inch BSP       | 1           | Horizontal  | 8                   | In Stack                        |
| Non-Iso          | 1           | Horizontal  | 1                   | Out Stack                       |

| Type       | Value | Units          |
|------------|-------|----------------|
| Circular   | 0.74  | m              |
| Area       | 0.43  | m <sup>2</sup> |
| Port Depth | 100   | mm             |

## Sampling Lines & Sample Points

## Sampling Platform

| General Platform Information                                             | Permanent / Temporary Platform | Inside / Outside |
|--------------------------------------------------------------------------|--------------------------------|------------------|
| Platform has vertical base boards (approximately 0.25 m high)            | Yes                            | Yes              |
| Platform has removable chains / self closing gates at the top of ladders | Yes                            | Yes              |
| Handrail / obstructions do not hamper insertion of sampling equipment    | Yes                            | Yes              |
| Depth of Platform = Minimum of 2m or Probe Length + 1m                   | No                             | No               |

| M1 Platform requirements | Minimum Platform Area 5 m <sup>2</sup> | Platform has 2 levels or handrails (approximately 0.5 m & 1.0 m high) | Platform has vertical base boards (approximately 0.25 m high) | Platform has removable chains / self closing gates at the top of ladders | Handrail / obstructions do not hamper insertion of sampling equipment | Depth of Platform = Minimum of 2m or Probe Length + 1m |
|--------------------------|----------------------------------------|-----------------------------------------------------------------------|---------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------------|
| Yes                      | Yes                                    | Yes                                                                   | Yes                                                           | Yes                                                                      | Yes                                                                   | Yes                                                    |
| No                       | No                                     | No                                                                    | No                                                            | No                                                                       | No                                                                    | No                                                     |

In order to meet the requirements of BS EN 13284-1, it would be recommended that the sampling platform be increased in size to the minimum required of 5m<sup>2</sup>, with a depth behind each port of 2m

## Sampling Location / Platform Improvement Recommendations

## EXECUTIVE SUMMARY (Page 7 of 7)

### Sampling & Analytical Method Deviations

#### One Sampling Line

Only 1 sampling line was used as only one point was accessible. However, the number of points was doubled on the available line to meet the requirements of the standard.

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| Position                  | Qualifications                                                                                                      |
|---------------------------|---------------------------------------------------------------------------------------------------------------------|
| Environmental Team Leader | Daniel Pryke<br>MCERTS Level 2, Technical Endorsements 1, 2, 3 & 4<br>MM 03 163<br>BSc (Hons) Environmental Studies |
| Environmental Technician  | Mark Sproson<br>MCERTS Level 1<br>MM 03 178<br>BSc (Hons) Historical Studies                                        |

STACK EMISSIONS MONITORING TEAM

APPENDIX 1 - Stack Emissions Monitoring Team

Environmental Team Leader

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

TOTAL PARTICULATE MATTER SUMMARY

Clark Drain Limited, Yaxley  
Galvanising Bath  
11th September 2008

| Test  | Sampling Times | Duration | Concentration | Emission Rate |
|-------|----------------|----------|---------------|---------------|
| Run 1 | 10:55 - 11:59  | 64       | 9.8           | 97            |
| Run 2 | 12:11 - 13:11  | 64       | 9.2           | 89            |
| Run 3 | 13:24 - 14:14  | 52       | 9.0           | 100           |
| Mean  | -              | 64       | 9.4           | 95            |

Reference conditions are 273K, 101.3Pa, without correction for water vapour content

|                            |                   |      |
|----------------------------|-------------------|------|
| Overall Blank Value        | mg/m <sup>3</sup> | 0.74 |
| Daily Emission Limit Value | mg/m <sup>3</sup> | 15   |
| Weighting Uncertainty      | ± mg              | 0.29 |

|                     |      |     |
|---------------------|------|-----|
| Acetone Blank Value | mg/l | 5.0 |
| Acceptable Value    | mg/l | 10  |

| Test                                                                             | 1                                          | 2            | 3            | Units               |
|----------------------------------------------------------------------------------|--------------------------------------------|--------------|--------------|---------------------|
| Absolute pressure of stack gas, $P_s$                                            | 750.8                                      | 750.8        | 751.4        | mm Hg               |
| Barometric pressure, $P_b$                                                       | 750.8                                      | 750.8        | 751.4        | mm Hg               |
| Stack static pressure, $P_{static}$                                              | 8.2                                        | 8.2          | 751.4        | mm Hg               |
| Volume of water vapour collected, $V_{water}$                                    |                                            |              |              |                     |
| Silica gel weight increase                                                       | 23                                         | 32           | 27           | g                   |
| Total volume of liquid collected, $V_L$                                          | 23                                         | 32           | 27           | ml                  |
| Volume of gas metered dry, $V_{meter}$                                           | 0.0284                                     | 0.0387       | 0.0335       | $m^3$               |
| Volume of gas sample through gas meter, $V_g$                                    | 1.1840                                     | 1.1480       | 1.1080       | $m^3$               |
| Gas meter correction factor, $V_g$                                               | 1.0602                                     | 1.0642       | 1.0642       | -                   |
| Average dry gas meter temperature, $T_m$                                         | 17.2                                       | 17.7         | 17.9         | $^{\circ}C$         |
| Average pressure drop across orifice, $\Delta h$                                 | 56.5                                       | 64.9         | 72.6         | mm H <sub>2</sub> O |
| Volume of gas metered wet, $V_{meter}$                                           | 1.1829                                     | 1.1395       | 1.1018       | $m^3$               |
| Volume of gas metered wet, $V_{meter}$                                           |                                            |              |              |                     |
| Volume of gas metered at $O_2$ Ref. Cond., $V_{meter@O_2}$                       | 1.2113                                     | 1.1792       | 1.1353       | $m^3$               |
| Is the process subject to MDO or LCPD? (if yes, no favourable oxygen correction) | No                                         | No           | No           |                     |
| % oxygen measured in gas stream, act% $O_2$                                      | 20.9                                       | 20.9         | 20.9         | %                   |
| % oxygen reference condition/21.0 (assume no $O_2$ correction)                   | 21.0                                       | 21.0         | 21.0         | %                   |
| $O_2$ Reference Factor                                                           | $O_2 \text{ Ref} = 21.0 - \text{act}\%O_2$ | No $O_2$ Ref | No $O_2$ Ref |                     |
| $V_{meter} \times \text{Reference Factor} = (V_{meter}) (O_2 \text{ Ref})$       |                                            | No $O_2$ Ref | No $O_2$ Ref | $m^3$               |
| Moisture content, $B_{wet}$                                                      |                                            |              |              |                     |
| $B_{wet} = \frac{V_{water}}{V_{meter} + V_{water}}$                              | 0.023                                      | 0.034        | 0.029        | $m^3$               |
| Molecular weight of dry gas stream, $M_d$                                        |                                            |              |              |                     |
| $CO_2$                                                                           | 0.5                                        | 0.5          | 0.5          | %                   |
| $O_2$                                                                            | 20.9                                       | 20.9         | 20.9         | %                   |
| Total                                                                            | 21.4                                       | 21.4         | 21.4         | %                   |
| $N_2$ (100 - Total)                                                              | 78.6                                       | 78.6         | 78.6         | %                   |
| Molecular weight of stack gas (wet), $M_g$                                       |                                            |              |              |                     |
| $M_g = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$                                 | 28.92                                      | 28.92        | 28.92        | g/gmol              |
| $M_g = M_d(1 - B_{wet}) + 18(B_{wet})$                                           | 28.66                                      | 28.55        | 28.59        | g/gmol              |
| Velocity of stack gas, $V_s$                                                     | 34.97                                      | 34.97        | 34.97        |                     |
| Pilot tube velocity constant, $K_p$                                              | 0.84                                       | 0.84         | 0.84         |                     |
| Velocity pressure coefficient, $C_p$                                             | 4.22                                       | 4.10         | 5.46         |                     |
| Average of velocity heads, $\Delta P_{avg}$                                      | 2.06                                       | 2.02         | 2.34         | mm H <sub>2</sub> O |
| Average square root of velocity heads, $\sqrt{\Delta P}$                         | 1.43                                       | 1.42         | 1.53         |                     |
| Average stack gas temperature, $T_s$                                             | 38                                         | 38           | 37           | $^{\circ}C$         |
| $V_s = \frac{\sqrt{M_d(P_s)}}{(K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)}$           | 7.27                                       | 7.18         | 8.26         | $m/s$               |

# ISOKINETIC SAMPLING EQUATIONS 1

## APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

### Total Particulate Matter

# ISOKINETIC SAMPLING EQUATIONS 2

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

| Test                                                     | Units       | 1         | 2         | 3         |
|----------------------------------------------------------|-------------|-----------|-----------|-----------|
| Actual flow of stack gas, $Q_s$                          | $m^3$       | 0.43      | 0.43      | 0.43      |
| Dry total flow of stack gas, $Q_{s,dry}$                 | $m^3/min$   | 187.6     | 185.3     | 213.1     |
| Conversion factor (K/mm.Hg)                              | -           | 0.3592    | 0.3592    | 0.3592    |
| $Q_{s,dry} = (Q_s)P_s(0.3592(1-B_{H_2O}))$               | $m^3/min$   | 158.7     | 155.0     | 180.1     |
| Dry total flow of stack gas at X% $O_2$ , $Q_{s,dryO_2}$ | -           | 0.3592    | 0.3592    | 0.3592    |
| Conversion factor (K/mm.Hg)                              | $m^3/min$   | No O2 Ref | No O2 Ref | No O2 Ref |
| $Q_{s,dryO_2} = (Q_s)P_s(0.3592(1-B_{H_2O}-REF))$        | -           | 0.3592    | 0.3592    | 0.3592    |
| Wet total flow of stack gas, $Q_{s,wet}$                 | -           | 0.3592    | 0.3592    | 0.3592    |
| Conversion factor (K/mm.Hg)                              | $m^3/min$   | 162.6     | 160.4     | 185.5     |
| $Q_{s,wet} = (Q_s)P_s(0.3592)$                           | -           | 0.3592    | 0.3592    | 0.3592    |
| Percent isokinetic, %I                                   | -           | 162.6     | 160.4     | 185.5     |
| Nozzle diameter, $D_n$                                   | mm          | 7.90      | 7.90      | 7.90      |
| Nozzle area, $A_n$                                       | $mm^2$      | 49.02     | 49.02     | 49.02     |
| Total sampling time, $t$                                 | min         | 64        | 64        | 64        |
| $\%I = (4.6388E6)/(T_s + 273)(V_{std})$                  | %           | 102.2     | 100.8     | 103.2     |
| $(P_s)(V_s)(A_n)(t)(1-B_{H_2O})$                         | -           | Yes       | Yes       | Yes       |
| Acceptable isokinetic range 95% to 115%                  | -           | Yes       | Yes       | Yes       |
| Mass of particulate collected on filter, $M_f$           | g           | 0.0092    | 0.0098    | 0.0092    |
| Mass of particulate collected in probe, $M_p$            | g           | 0.0028    | 0.0010    | 0.0010    |
| Mass of total particulate collected, $M_t$               | g           | 0.0120    | 0.0109    | 0.0102    |
| $C_{wet} = M_t/V_{wet}$                                  | $mg/m^3$    | 9.90      | 9.24      | 8.96      |
| $C_{dry} = M_t/V_{dry}$                                  | $mg/m^3$    | 10.14     | 9.56      | 9.26      |
| $C_{dryO_2} = M_t/V_{dryO_2}$                            | $mg/m^3$    | No O2 Ref | No O2 Ref | No O2 Ref |
| Particulate Emission Rates, E                            | $g/hr$      | 96.5      | 88.9      | 100.0     |
| $E = [(C_{dry})(Q_{s,dry})]/1000$                        | -           | 180       | 180       | 180       |
| Pre-conditioning temperature                             | $^{\circ}C$ | 39        | 39        | 38        |
| Maximum filtration temperature                           | $^{\circ}C$ | 160       | 160       | 160       |
| Post-conditioning temperature                            | $^{\circ}C$ |           |           |           |

# TOTAL PARTICULATE MATTER QUALITY ASSURANCE CHECKLIST

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

| Leak Test Results                | Run 1 | Run 2 | Run 3 | Units             |
|----------------------------------|-------|-------|-------|-------------------|
| Mean Sampling Rate               | 19.8  | 19.1  | 22.7  | litre/min         |
| Pre-sampling Leak Rate           | 0.03  | 0.05  | 0.04  | litre/min         |
| Post-sampling Leak Rate          | 0.04  | 0.06  | 0.06  | litre/min         |
| Acceptable Leak Rate             | 0.40  | 0.38  | 0.45  | litre/min         |
| Leak Tests Acceptable            | Yes   | Yes   | Yes   | -                 |
| Overall Blank Value              | Value | Value | Value | Units             |
| Overall Blank Value              | 0.74  | 0.74  | 0.74  | mg/m <sup>3</sup> |
| Daily Emission Limit Value       | 15    | 15    | 15    | mg/m <sup>3</sup> |
| Acceptable Blank Value           | 1.5   | 1.5   | 1.5   | mg/m <sup>3</sup> |
| Overall Blank Acceptable         | Yes   | Yes   | Yes   | -                 |
| Isokinetic Criterion Compliance  | Value | Value | Value | Units             |
| Isokinetic Variation             | 102.2 | 100.6 | 103.2 | %                 |
| Acceptable Isokineticity         | Yes   | Yes   | Yes   | -                 |
| Total Particulate Matter Filters | Value | Value | Value | Units             |
| Filter Material                  | QF    | QF    | QF    | -                 |
| Filter Size                      | 47    | 47    | 47    | mm                |

|                |               |                                    |                          |                            |                       |
|----------------|---------------|------------------------------------|--------------------------|----------------------------|-----------------------|
| Field Blank    | -             | 0.03                               | 0.02                     | -                          | -                     |
| Run 1          | 13.10 - 14.10 | 7.04                               | -                        | -                          | 68                    |
| Sampling Times |               | Concentration<br>mg/m <sup>3</sup> | LOD<br>mg/m <sup>3</sup> | Limit<br>mg/m <sup>3</sup> | Emission<br>Rate g/hr |

|                                   |                     |                  |                     |                  |                     |
|-----------------------------------|---------------------|------------------|---------------------|------------------|---------------------|
| Clark Clark Drain Limited, Yaxley | 11th September 2008 | Galvanising Bath | 11th September 2008 | Galvanising Bath | 11th September 2008 |
|-----------------------------------|---------------------|------------------|---------------------|------------------|---------------------|

## HYDROGEN CHLORIDE SUMMARY

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

| Parameter | Run 1 | Total<br>ug | 2nd Absorber<br>ug | Absorption<br>Efficiency | Required | Pass / Fail |
|-----------|-------|-------------|--------------------|--------------------------|----------|-------------|
| HCl       |       | 718.5       | 23.7               | 97                       | 95       | Passed      |

ABSORPTION EFFICIENCY - HYDROGEN CHLORIDE

| Absorbers & Absorption Solutions | Type of Absorbers | Absorption Solutions |
|----------------------------------|-------------------|----------------------|
|                                  | Glass             | HPLC Water           |

| Filtration                     | Value | Units | GF = Glass Fibre<br>QF = Quartz Fibre |
|--------------------------------|-------|-------|---------------------------------------|
| Filter Material                | QF    | -     |                                       |
| Filter Size                    | 47    | mm    |                                       |
| Maximum Filtration Temperature | 150   | °C    |                                       |

| Leak Test Results       | Run 1 | Units     |
|-------------------------|-------|-----------|
| Mean Sampling Rate      | 1.7   | litre/min |
| Pre-sampling Leak Rate  | 0.03  | litre/min |
| Post-sampling Leak Rate | 0.01  | litre/min |
| Acceptable Leak Rate    | 0.03  | litre/min |
| Leak Tests Acceptable   | Yes   | -         |

HYDROGEN CHLORIDE QUALITY ASSURANCE CHECKLIST

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

# APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

## LEAD SUMMARY

Clark Drain Limited, Yaxley

Galvanising Bath

11th September 2008

| Test        | Sampling Times | Concentration<br>mg/m <sup>3</sup> | LOD<br>mg/m <sup>3</sup> | Limit<br>mg/m <sup>3</sup> | Emission<br>Rate g/hr |
|-------------|----------------|------------------------------------|--------------------------|----------------------------|-----------------------|
| Run 1       | 13.10 - 14.10  | 0.039                              | -                        | -                          | 0.36                  |
| Field Blank | -              | < 0.0001                           | -                        | -                          | -                     |

Reference conditions are 273K, 101.3Pa, without correction for water vapour content

|           |                     |       |
|-----------|---------------------|-------|
| Method    | Unit                | Value |
| Flow rate | m <sup>3</sup> /min | 0.05  |
| Flow rate | m <sup>3</sup> /min | 0.05  |
| Flow rate | m <sup>3</sup> /min | 0.05  |

|           |                     |       |
|-----------|---------------------|-------|
| Method    | Unit                | Value |
| Flow rate | m <sup>3</sup> /min | 0.05  |
| Flow rate | m <sup>3</sup> /min | 0.05  |
| Flow rate | m <sup>3</sup> /min | 0.05  |

|           |                     |       |
|-----------|---------------------|-------|
| Method    | Unit                | Value |
| Flow rate | m <sup>3</sup> /min | 0.05  |
| Flow rate | m <sup>3</sup> /min | 0.05  |
| Flow rate | m <sup>3</sup> /min | 0.05  |

|                                                     |        |                     |
|-----------------------------------------------------|--------|---------------------|
| Units                                               | 1      |                     |
| Absolute pressure of stack gas, $P_s$               | 751.5  | mm Hg               |
| Barometric pressure, $P_b$                          | 752.0  | mm Hg               |
| Stack static pressure, $P_{stack}$                  |        | mm Hg               |
| $P_s = P_b + P_{stack}$                             |        |                     |
|                                                     | 13.6   |                     |
| Volume of water vapour collected, $V_{wet}$         | 37     | g                   |
| Silica gel weight increase                          | 0.0459 | $m^3$               |
| $V_{wet} = (0.001245)(V_s)$                         |        |                     |
| Volume of gas metered dry, $V_{mdr}$                | 1.5100 | $m^3$               |
| Volume of gas sample through gas meter, $V_m$       | 1.0642 | $m^3$               |
| Gas meter correction factor, $Y_g$                  | 1.0642 | -                   |
| Average dry gas meter temperature, $T_m$            | 26.7   | $^{\circ}C$         |
| Average pressure drop across orifice, $\Delta H$    | 84.6   | mm H <sub>2</sub> O |
| $V_{mdr} = (0.3592)(V_m)(P_s + \Delta H/13.6)(Y_g)$ | 1.4596 | $m^3$               |
| $T_m + 273$                                         |        |                     |
| Volume of gas metered wet, $V_{mstw}$               | 1.5055 | $m^3$               |
| $V_{mstw} = V_{mdr} + V_{wet}$                      |        |                     |
| Moisture content, $B_{wp}$                          | 0.030  | $m^3$               |
| $B_{wp} = \frac{V_{wet}}{V_{mstw} + V_{wet}}$       |        |                     |
| Molecular weight of dry gas stream, $M_d$           |        |                     |
| CO <sub>2</sub>                                     | 0.5    | %                   |
| O <sub>2</sub>                                      | 20.9   | %                   |
| Total                                               | 21.4   | %                   |
| N <sub>2</sub> (100 - Total)                        | 78.6   | %                   |
| $M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$    | 28.92  | g/gmol              |
| Molecular weight of stack gas (wet), $M_s$          |        |                     |
| $M_s = M_d(1 - B_{wp}) + 18(B_{wp})$                | 28.58  | g/gmol              |

# ISOKINETIC SAMPLING EQUATIONS 1

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

LEAD

| Test                                                     | Units               | Value  | Calculation                                                   |
|----------------------------------------------------------|---------------------|--------|---------------------------------------------------------------|
| Velocity of stack gas, $V_s$                             | m/s                 | 34.97  | $V_s = (K_p)(C_p)(\sqrt{P})(\sqrt{V_s} + 273)$                |
| Pilot tube velocity constant, $K_p$                      | -                   | 0.84   |                                                               |
| Velocity pressure coefficient, $C_p$                     | -                   | 6.37   |                                                               |
| Average of velocity heads, $\Delta P_{avg}$              | mm H <sub>2</sub> O | 2.52   |                                                               |
| Average square root of velocity heads, $\sqrt{\Delta P}$ | mm H <sub>2</sub> O | 41     |                                                               |
| Average stack gas temperature, $T_g$                     | °C                  | 8.96   |                                                               |
| Actual flow of stack gas, $Q_a$                          | m <sup>3</sup>      | 0.43   | $Q_a = (60)(A_s)(V_s)$                                        |
| Area of stack, $A_s$                                     | m <sup>2</sup>      | 231.3  |                                                               |
| Dry total flow of stack gas, $Q_{std}$                   | m <sup>3</sup> /min | 0.3582 | $Q_{std} = (Q_a)(P_s)(1-B_s)$                                 |
| Conversion factor (Kmm.Hg)                               | -                   | 192.8  |                                                               |
| Wet total flow of stack gas, $Q_{wet}$                   | m <sup>3</sup> /min | 0.3582 | $Q_{wet} = (Q_a)(P_s)(1-B_s)$                                 |
| Conversion factor (Kmm.Hg)                               | -                   | 198.9  |                                                               |
| Percent isokinetic, %I                                   | %                   | 110.8  | $\%I = \frac{(P_s)(V_s)(A_s)(1-B_s)}{(P_a)(V_a)(A_a)(1-B_a)}$ |
| Nozzle diameter, $D_n$                                   | mm                  | 7.90   |                                                               |
| Nozzle area, $A_n$                                       | mm <sup>2</sup>     | 49.02  |                                                               |
| Total sampling time, $t$                                 | min                 | 60     |                                                               |
| Acceptable isokinetic range 95% to 115%                  | -                   | Yes    |                                                               |

## ISOKINETIC SAMPLING EQUATIONS 2

### APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

## LEAD

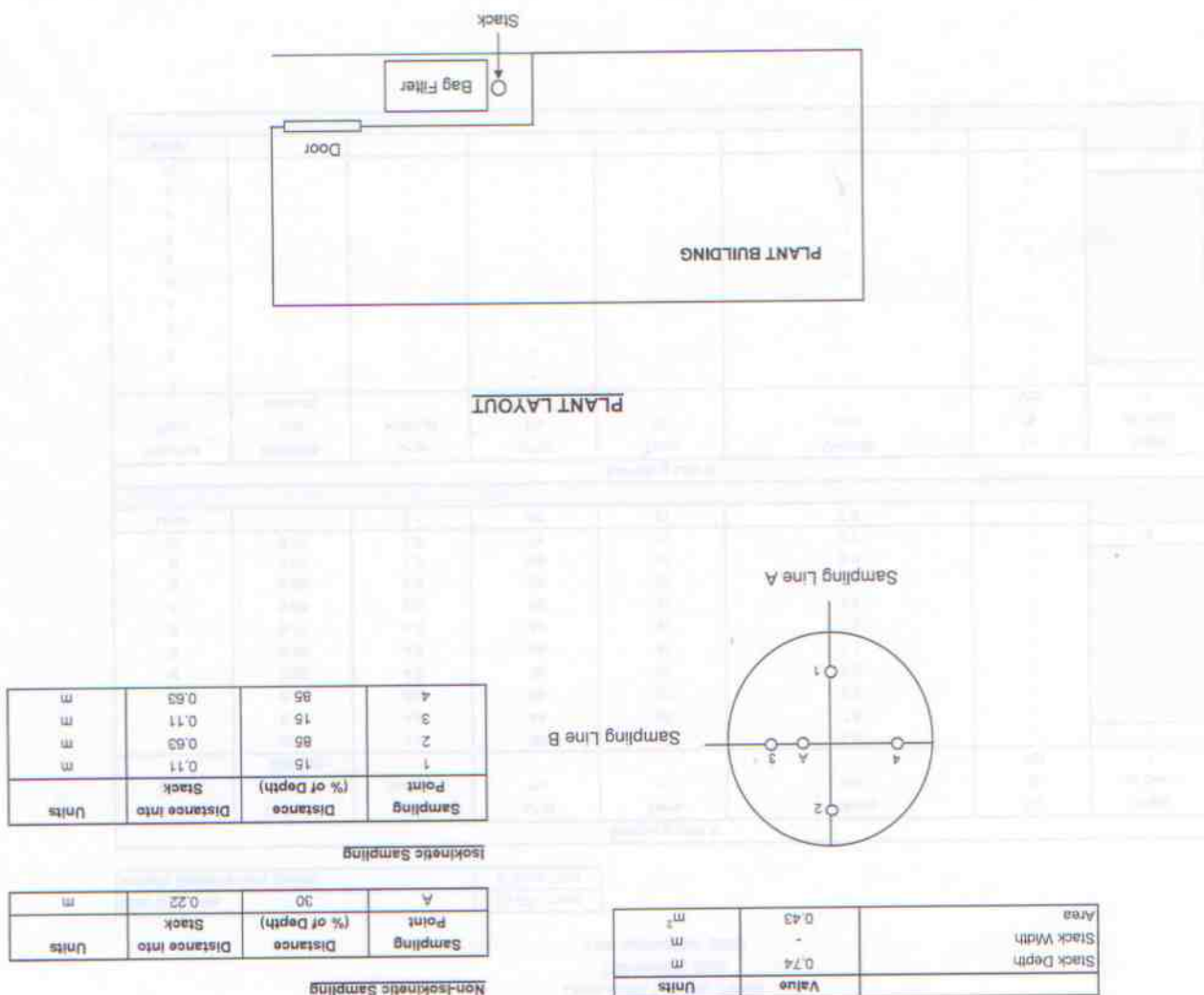
APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY

Clark Drain Limited, Yaxley  
Galvanising Bath  
11th September 2008

|                             |               |
|-----------------------------|---------------|
| Time of Survey              | 10.40 - 10.45 |
| Velocity Measurement Device | S-Type Pitot  |

| Sampling Line A |                        |                                      |                      |            |                 |                     |                     |
|-----------------|------------------------|--------------------------------------|----------------------|------------|-----------------|---------------------|---------------------|
| Point           | Distance into duct (m) | $\Delta P$ pit<br>mmH <sub>2</sub> O | $\Delta P$ pit<br>Pa | Temp<br>°C | Velocity<br>m/s | O <sub>2</sub><br>% | Angle of Sight<br>° |
| 1               | 0.04                   | 4.0                                  | 39                   | 30         | 7.0             | -                   | 2                   |
| 2               | 0.11                   | 4.5                                  | 44                   | 30         | 7.5             | -                   | 4                   |
| 3               | 0.19                   | 4.0                                  | 39                   | 30         | 7.0             | -                   |                     |
| 4               | 0.26                   | 4.0                                  | 39                   | 30         | 7.0             | -                   |                     |
| 5               | 0.33                   | 4.0                                  | 39                   | 31         | 7.1             | -                   |                     |
| 6               | 0.41                   | 4.5                                  | 44                   | 31         | 7.5             | -                   | 4                   |
| 7               | 0.48                   | 5.0                                  | 49                   | 31         | 7.9             | -                   |                     |
| 8               | 0.56                   | 6.0                                  | 59                   | 31         | 8.6             | -                   |                     |
| 9               | 0.63                   | 7.0                                  | 69                   | 31         | 9.3             | -                   |                     |
| 10              | 0.70                   | 7.5                                  | 74                   | 31         | 9.7             | -                   | 4                   |
| Mean            | -                      | 5.1                                  | 49                   | 31         | 7.9             | -                   |                     |
| Sampling Line B |                        |                                      |                      |            |                 |                     |                     |
| Point           | Distance into duct (m) | $\Delta P$ pit<br>mmH <sub>2</sub> O | $\Delta P$ pit<br>Pa | Temp<br>°C | Velocity<br>m/s | O <sub>2</sub><br>% | Angle of Sight<br>° |
| 1               | -                      | -                                    | -                    | -          | -               | -                   | -                   |
| 2               | -                      | -                                    | -                    | -          | -               | -                   | -                   |
| 3               | -                      | -                                    | -                    | -          | -               | -                   | -                   |
| 4               | -                      | -                                    | -                    | -          | -               | -                   | -                   |
| 5               | -                      | -                                    | -                    | -          | -               | -                   | -                   |
| 6               | -                      | -                                    | -                    | -          | -               | -                   | -                   |
| 7               | -                      | -                                    | -                    | -          | -               | -                   | -                   |
| 8               | -                      | -                                    | -                    | -          | -               | -                   | -                   |
| 9               | -                      | -                                    | -                    | -          | -               | -                   | -                   |
| 10              | -                      | -                                    | -                    | -          | -               | -                   | -                   |
| Mean            | -                      | -                                    | -                    | -          | -               | -                   | -                   |



# APPENDIX 3 - Calibratable Equipment Checklist & Calibration Gases

## CALIBRATEABLE EQUIPMENT CHECKLIST

| Extractive Sampling    |                |                        | Instrumental Analyzers |                           |                | Miscellaneous          |                |           |
|------------------------|----------------|------------------------|------------------------|---------------------------|----------------|------------------------|----------------|-----------|
| Equipment              | Equipment I.D. | Equipment              | Equipment I.D.         | Equipment                 | Equipment I.D. | Equipment              | Equipment I.D. | Equipment |
| Control Box DGM        | 1001           | Horiba PG-250 Analyzer | -                      | Laboratory Balance        | 0001/0652      | Control Box DGM        | 1001           | 1387      |
| Box Thermocouples      | 1002           | Horiba PG-200 Cooler   | -                      | Tape Measure              | 1387           | Box Thermocouples      | 1002           | 1003      |
| Water In Thermocouple  | 1004           | JCT JCC P-1 Cooler     | -                      | Stopwatch                 | 1380           | Water In Thermocouple  | 1004           | 1005      |
| Water Out Thermocouple | 1005           | Tateo 350 Analyzer     | -                      | Protractor                | 1003           | Water Out Thermocouple | 1005           | 1006      |
| Control Box Timer      | 1003           | Tateo 339 Cooler       | -                      | Barometer                 | 0936           | Control Box Timer      | 1003           | 1007      |
| Umbilical              | 1006           | FT-IR                  | -                      | Digital Micromanometer    | 0685           | Umbilical              | 1006           | 1008      |
| Oven Box               | 1790           | FT-IR Oven Box         | -                      | Digital Temperature Meter | 0933           | Oven Box               | 1790           | 1009      |
| Probe                  | 1165           | Burnham 3006 FID       | -                      | Stack Thermocouple        | 1131           | Probe                  | 1165           | 1010      |
| IS-Pilot               | 0954           | Signal 3010 MINIFID    | -                      | Drycal                    | -              | IS-Pilot               | 0954           | 1011      |
| L-Pilot                | -              | Signal 3030 FID        | -                      | Mass Flow Controller      | -              | L-Pilot                | -              | 1012      |
| Size Balancer          | 1331           | Servomex 579A          | -                      | Mass Flow Control Box     | -              | Size Balancer          | 1331           | 1013      |
| Last Impinger Arm      | -              | JCT Heated Head Filter | -                      | 1m Heated Line            | -              | Last Impinger Arm      | -              | 1014      |
| Calipers               | 1215           | -                      | -                      | 5m Heated Line (1)        | -              | Calipers               | 1215           | 1015      |
| Small DGM              | -              | -                      | -                      | 5m Heated Line (2)        | -              | Small DGM              | -              | 1016      |
|                        |                |                        |                        | 10m Heated Line (1)       | -              |                        |                | 1017      |
|                        |                |                        |                        | 10m Heated Line (2)       | -              |                        |                | 1018      |
|                        |                |                        |                        | 15m Heated Line (1)       | -              |                        |                | 1019      |
|                        |                |                        |                        | 15m Heated Line (2)       | -              |                        |                | 1020      |
|                        |                |                        |                        | 20m Heated Line           | -              |                        |                | 1021      |

NOTE: If the equipment I.D. is represented by a dash (-), then this piece of equipment has not been used for this test.

| Test | Equipment              | Equipment I.D. | Equipment              | Equipment I.D. | Equipment                 | Equipment I.D. | Equipment              | Equipment I.D. |
|------|------------------------|----------------|------------------------|----------------|---------------------------|----------------|------------------------|----------------|
| 1    | Control Box DGM        | 1001           | Horiba PG-250 Analyzer | -              | Laboratory Balance        | 0001/0652      | Control Box DGM        | 1001           |
| 2    | Box Thermocouples      | 1002           | Horiba PG-200 Cooler   | -              | Tape Measure              | 1387           | Box Thermocouples      | 1002           |
| 3    | Water In Thermocouple  | 1004           | JCT JCC P-1 Cooler     | -              | Stopwatch                 | 1380           | Water In Thermocouple  | 1004           |
| 4    | Water Out Thermocouple | 1005           | Tateo 350 Analyzer     | -              | Protractor                | 1003           | Water Out Thermocouple | 1005           |
| 5    | Control Box Timer      | 1003           | Tateo 339 Cooler       | -              | Barometer                 | 0936           | Control Box Timer      | 1003           |
| 6    | Umbilical              | 1006           | FT-IR                  | -              | Digital Micromanometer    | 0685           | Umbilical              | 1006           |
| 7    | Oven Box               | 1790           | FT-IR Oven Box         | -              | Digital Temperature Meter | 0933           | Oven Box               | 1790           |
| 8    | Probe                  | 1165           | Burnham 3006 FID       | -              | Stack Thermocouple        | 1131           | Probe                  | 1165           |
| 9    | IS-Pilot               | 0954           | Signal 3010 MINIFID    | -              | Drycal                    | -              | IS-Pilot               | 0954           |
| 10   | L-Pilot                | -              | Signal 3030 FID        | -              | Mass Flow Controller      | -              | L-Pilot                | -              |
| 11   | Size Balancer          | 1331           | Servomex 579A          | -              | Mass Flow Control Box     | -              | Size Balancer          | 1331           |
| 12   | Last Impinger Arm      | -              | JCT Heated Head Filter | -              | 1m Heated Line            | -              | Last Impinger Arm      | -              |
| 13   | Calipers               | 1215           | -                      | -              | 5m Heated Line (1)        | -              | Calipers               | 1215           |
| 14   | Small DGM              | -              | -                      | -              | 5m Heated Line (2)        | -              | Small DGM              | -              |

# MEASUREMENT UNCERTAINTY BUDGET - TOTAL PARTICULATE MATTER

## APPENDIX 4 - Measurement Uncertainty Budget Calculations

| Value | Units             |
|-------|-------------------|
| 15    | mg/m <sup>3</sup> |
| 9.4   | mg/m <sup>3</sup> |
| -     | % by volume       |

| Measured Quantities     | Symbol         | Value  | Units          |
|-------------------------|----------------|--------|----------------|
| Sampled Volume          | V <sub>s</sub> | 1.1829 | m <sup>3</sup> |
| Sampled Gas Temperature | T <sub>s</sub> | 290    | K              |
| Sampled Gas Pressure    | P <sub>s</sub> | 100.1  | KPa            |
| Sampled Gas Humidity    | H <sub>s</sub> | 0.0    | % by volume    |
| Oxygen Content          | O <sub>2</sub> | 20.9   | % by volume    |
| Mass of Particulate     | m              | 12.0   | mg             |
| Leak                    | L              | 0.18   | %              |
| Uncollected Mass        | UCM            | 0.90   | mg             |

NOTE: Sampled Gas Temperature, Pressure and Humidity are at the Dry Gas Meter.

| Standard Uncertainty    | Symbol         | Value | Units          | Uncertainty as a % | Uncertainty Required | Met? |
|-------------------------|----------------|-------|----------------|--------------------|----------------------|------|
| Sampled Volume          | V <sub>s</sub> | 0.024 | m <sup>3</sup> | 2.0                | ≤ 2%                 | Yes  |
| Sampled Gas Temperature | T <sub>s</sub> | 2.902 | K              | 1.0                | ≤ 1%                 | Yes  |
| Sampled Gas Pressure    | P <sub>s</sub> | 1.001 | KPa            | 1.0                | ≤ 1%                 | Yes  |
| Sampled Gas Humidity    | H <sub>s</sub> | 0.000 | % by volume    | 0.0                | ≤ 1%                 | Yes  |
| Oxygen Content          | O <sub>2</sub> | 0.000 | % by volume    | 0.0                | ≤ 10%                | Yes  |
| Mass of Particulate     | m              | 0.290 | mg             | 1.5                | ≤ 5% of ELV          | Yes  |
| Leak                    | -              | -     | -              | 0.2                | ≤ 2%                 | Yes  |
| Uncollected Mass        | -              | -     | -              | 1.6                | ≤ 10% of ELV         | Yes  |

| Parameter                                                     | Symbol | Value  | Units             | Uncertainty in Result | Units             | Uncertainty as a % | Units |
|---------------------------------------------------------------|--------|--------|-------------------|-----------------------|-------------------|--------------------|-------|
| Volume (STP)                                                  | V      | 1.0997 | m <sup>3</sup>    | 0.2413                | mg/m <sup>3</sup> | 2.57               | %     |
| Mass of Particulate                                           | m      | 12.0   | mg                | 0.2267                | mg/m <sup>3</sup> | 2.42               | %     |
| Leak                                                          | L      | 0.010  | mg/m <sup>3</sup> | 0.0096                | mg/m <sup>3</sup> | 0.10               | %     |
| Uncollected mass                                              | UCM    | 0.52   | mg                | 0.4062                | mg/m <sup>3</sup> | 4.33               | %     |
| Combined uncertainty                                          |        |        |                   | 0.5241                | mg/m <sup>3</sup> | 5.58               | %     |
| Uncertainty expressed at a 95% confidence level (where k = 2) |        |        |                   |                       |                   |                    |       |
|                                                               |        |        |                   | 1.0482                | mg/m <sup>3</sup> | 11.18              | %     |

(k is a coverage factor which gives a 95% confidence in the quoted figures)

# APPENDIX 4 - Measurement Uncertainty Budget Calculations

## MEASUREMENT UNCERTAINTY BUDGET - LEAD

|          |                   |
|----------|-------------------|
| Value    | Units             |
| No Limit | mg/m <sup>3</sup> |
| 0.0393   | mg/m <sup>3</sup> |
| -        | % by volume       |

| Measured Quantities     | Symbol         | Value  | Units          |
|-------------------------|----------------|--------|----------------|
| Sampled Volume          | V <sub>s</sub> | 1.2113 | m <sup>3</sup> |
| Sampled Gas Temperature | T <sub>g</sub> | 293.0  | K              |
| Sampled Gas Pressure    | P <sub>g</sub> | 100.1  | KPa            |
| Sampled Gas Humidity    | H <sub>g</sub> | 0.0    | % by volume    |
| Leak                    | L              | 1.3    | %              |

| Standard Uncertainty | Symbol | Value | Units | Uncertainty as a % | Required | Met? |
|----------------------|--------|-------|-------|--------------------|----------|------|
|----------------------|--------|-------|-------|--------------------|----------|------|

|                         |                  |       |                |     |       |     |
|-------------------------|------------------|-------|----------------|-----|-------|-----|
| Sampled Volume          | uV <sub>s</sub>  | 0.002 | m <sup>3</sup> | 2.0 | ≤ 2%  | Yes |
| Sampled Gas Temperature | uT <sub>g</sub>  | 2.930 | K              | 1.0 | ≤ 1%  | Yes |
| Sampled Gas Pressure    | uP <sub>g</sub>  | 1.001 | KPa            | 1.0 | ≤ 1%  | Yes |
| Sampled Gas Humidity    | uH <sub>g</sub>  | 0.000 | % by volume    | 0.0 | ≤ 1%  | Yes |
| Oxygen Content          | uO <sub>2m</sub> | 20.67 | % by volume    | 0.0 | ≤ 10% | Yes |
| Leak                    | -                | -     | -              | 0.6 | ≤ 2%  | Yes |

| Parameter                                                                   | Symbol | Value  | Units             | Uncertainty | Units             | Uncertainty as a % |
|-----------------------------------------------------------------------------|--------|--------|-------------------|-------------|-------------------|--------------------|
| Volume (STP)                                                                | V      | 0.0939 | m <sup>3</sup>    | 0.1826      | mg/m <sup>3</sup> | 2.59               |
| Leak                                                                        | L      | 0.0239 | mg/m <sup>3</sup> | 0.0239      | mg/m <sup>3</sup> | 0.34               |
| Lab Result                                                                  | LAB    | 0.704  | mg                | 0.7044      | mg/m <sup>3</sup> | 10.00              |
| Combined uncertainty                                                        |        |        |                   | 0.9109      | mg/m <sup>3</sup> | 12.93              |
| Uncertainty expressed at a 95% confidence level (where k = 2)               |        |        |                   |             |                   |                    |
|                                                                             |        |        |                   | 1.4562      | mg/m <sup>3</sup> | 10.34              |
| (k is a coverage factor which gives a 95% confidence in the quoted figures) |        |        |                   |             |                   |                    |

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11th September 2008  
PPC Permit 12/92

# MEASUREMENT UNCERTAINTY BUDGET - HYDROGEN CHLORIDE

## APPENDIX 4 - Measurement Uncertainty Budget Calculations

| Value | Units             | Limit value | Measured concentration | Reference oxygen |
|-------|-------------------|-------------|------------------------|------------------|
| 30    | mg/m <sup>3</sup> |             | 7.04                   | % by volume      |
|       |                   |             |                        |                  |

| Measured Quantities     | Symbol          | Value  | Units          |
|-------------------------|-----------------|--------|----------------|
| Sampled Volume          | V <sub>s</sub>  | 0.1020 | m <sup>3</sup> |
| Sampled Gas Temperature | T <sub>s</sub>  | 293.0  | K              |
| Sampled Gas Pressure    | P <sub>s</sub>  | 100.1  | KPa            |
| Sampled Gas Humidity    | H <sub>s</sub>  | 0.0    | % by volume    |
| Oxygen Content          | O <sub>2m</sub> | 0.59   | %              |
| Leak                    | L               |        |                |

| Standard Uncertainty    | Symbol           | Value | Units          | Uncertainty as a % | Required Uncertainty | Met? |
|-------------------------|------------------|-------|----------------|--------------------|----------------------|------|
| Sampled Volume          | uV <sub>s</sub>  | 0.002 | m <sup>3</sup> | 2.0                | ≤ 2%                 | Yes  |
| Sampled Gas Temperature | uT <sub>s</sub>  | 2.930 | K              | 1.0                | ≤ 1%                 | Yes  |
| Sampled Gas Pressure    | uP <sub>s</sub>  | 1.001 | KPa            | 1.0                | ≤ 1%                 | Yes  |
| Sampled Gas Humidity    | uH <sub>s</sub>  | 0.000 | % by volume    | 0.0                | ≤ 1%                 | Yes  |
| Oxygen Content          | uO <sub>2m</sub> | -     | % by volume    | 0.6                | ≤ 2%                 | Yes  |
| Leak                    | -                | -     | -              | -                  | -                    | Yes  |

| Parameter                            | Symbol         | Value  | Units             | Uncertainty in Result | Units             | Uncertainty as a % | Units |
|--------------------------------------|----------------|--------|-------------------|-----------------------|-------------------|--------------------|-------|
| Volume (STP)                         | V              | 0.0939 | m <sup>3</sup>    | 0.1626                | mg/m <sup>3</sup> | 2.59               | %     |
| Factor for O <sub>2</sub> Correction | f <sub>c</sub> | -      | -                 | -                     | mg/m <sup>3</sup> | -                  | %     |
| Leak                                 | L              | 0.0239 | mg/m <sup>3</sup> | 0.0239                | mg/m <sup>3</sup> | 0.34               | %     |
| Lab Result                           | LAB            | 0.0000 | mg                | 0.7044                | mg/m <sup>3</sup> | 10.00              | %     |
| Combined uncertainty                 |                |        |                   | 0.7281                | mg/m <sup>3</sup> | 10.34              | %     |

Uncertainty expressed at a 95% confidence level (where k = 2)

1.4562

mg/m<sup>3</sup>

20.67

%

(k is a coverage factor which gives a 95% confidence in the quoted figures)