

**DICHLOROMETHANE EMISSION
TEST SURVEY**

FOR

UNIVERSAL SERVICES UK LTD

PRA Project No : 74981-44

27 March 2012



ENVIRONMENTAL SERVICES TEST REPORT

Project No. 74981-44

Test Dates 14th March 2012

Report Date 27th March 2012

Client UNIVERSAL SERVICES UK LTD
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FAO John Royce

Work requested Dichloromethane Emission Test Survey

A handwritten signature in black ink, appearing to read 'T. Sullivan', is positioned above the printed name.

Work carried out by T. Sullivan
Environmental Services

A handwritten signature in black ink, appearing to read 'T.J. Glazier', is positioned above the printed name.

Approved by T.J. Glazier, P. Collins
Authorised Signatory

CONTENTS

	Page
Client Details	1
Contents	2
1.0 Introduction	3
2.0 Test Procedures	3
2.1 Sampling Locations	3
2.2 Flow Measurement	3
2.3 Dichloromethane Emission	4
3.0 Test Results	4
3.1 Flow Measurement	4
3.2 Dichloromethane Emission	4
4.0 Discussion	5
5.0 Conclusions	5
APPENDIX 1 Diagram of Vapour Degreaser	6
APPENDIX 2 Calculations	7
APPENDIX 3 Test Data	9

DICHLOROMETHANE EMISSION TEST SURVEY

1.0 Introduction

Universal Services UK Ltd operates a powder coating process at their site. Part of this process involves surface cleaning of parts using a vapour degreaser. The vapour degreaser uses dichloromethane which has a risk phrase of R40 (limited evidence of carcinogenic effect) making it a designated risk phrase material. The aim of this test survey is to provide emission data to assess compliance against the emission limits given in Process Guidance Note PG6/45(11) "Surface Cleaning".

The emission testing was carried out on the 14 March 2012 by Tim Sullivan, MCERTS Accreditation No. MM03456. This report presents the test procedures, results and observations, as well as the conclusions and recommendations made.

2.0 Test Procedures

2.1 Sampling Locations

A description of the sampling locations is given in table 1.0. A diagram of the release point is shown in appendix 1.

Table 1 Sampling locations

Release Point	Dimensions (mm)	Sample Location
Vapour Degreaser Extract Stack	circular duct 300 dia.	Single sample port (10 mm diameter) 0.5 m above the fan.

2.2 Flow Measurement

The gas velocity and volume flow rate was measured using a calibrated ellipsoidal nose pitot tube and calibrated micromanometer.

The gas temperature was measured using a calibrated digital temperature indicator and K type probe. The temperature was measured at a single point in the duct/louvre. This was considered sufficient as the temperature is unlikely to vary for the LEV system operating at ambient temperature.

2.3 Dichloromethane Emission

The emission of dichloromethane was carried out using ANASORB CSC coconut charcoal adsorption tubes and personal sampling pumps in accordance with MDHS 96 “Volatile organic compounds in air (4)”, 2000.

The adsorption tubes were sent to a UKAS accredited laboratory where the tubes were solvent desorbed and analysed using gas chromatography.

3.0 TEST RESULTS

All measurements were taken under typical operating conditions and are reported at reference conditions 273 K and 1013 m.bar.

The methods of calculating the gas velocity, volume flow and dichloromethane emission concentration are shown in appendix 2. The test data for gas velocity and dichloromethane emissions are shown in appendix 3.

3.1 Flow Measurement

The gas velocity and volume flow measured are shown in table 2.

Table 2 Flow

Test Number	Date & Time	Gas Velocity (m/s)	Volume Flow at STP (m ³ /h)
1	14 March : 09.50	5.03	1243
2	14 March : 11.50	4.18	1034

3.2 Dichloromethane Emission

The concentration levels dichloromethane (DCM) from the vapour degreaser extract stack are shown in table 3.0.

Table 3 Concentration

Test / Time	Wt. of DCM (µg)	Volume Sampled (litres)	DCM Conc. (mg.m ⁻³)	Average Volume Flow (m ³ /h)	Mass Emission (g/h)
Test 1 – 10.20	818	1.62	504.9	1138	574.6
Test 2 – 10.40	854	1.80	474.4	1138	539.9
Test 3 – 11.15	39	1.89	20.6	1138	23.4

4.0 Discussion

PG6/45 states that where the combined mass emission of all R40 solvents is greater than or equal to 100g/h, an emission limit of 20 mg.m⁻³ for the combined concentration of the individual solvents must apply.

The first two test samples were taken over two complete cleaning cycles(i.e. cover closed; cover opened, lowering of basket, close cover, clean parts, open cover, remove basket, close cover). The third test sample was taken when the vapour degreaser was empty and the cover was closed.

The average mass emission for dichloromethane over 2 complete cleaning cycles was 557.2 g/h. Therefore the mass emission is above the initial mass emission criteria of 100 g/h. The average dichloromethane concentration from the vapour degreaser extract stack was 489.6 mg.m⁻³. Therefore the concentration from the vapour degreaser is above the emission limit of 20 mg.m⁻³.

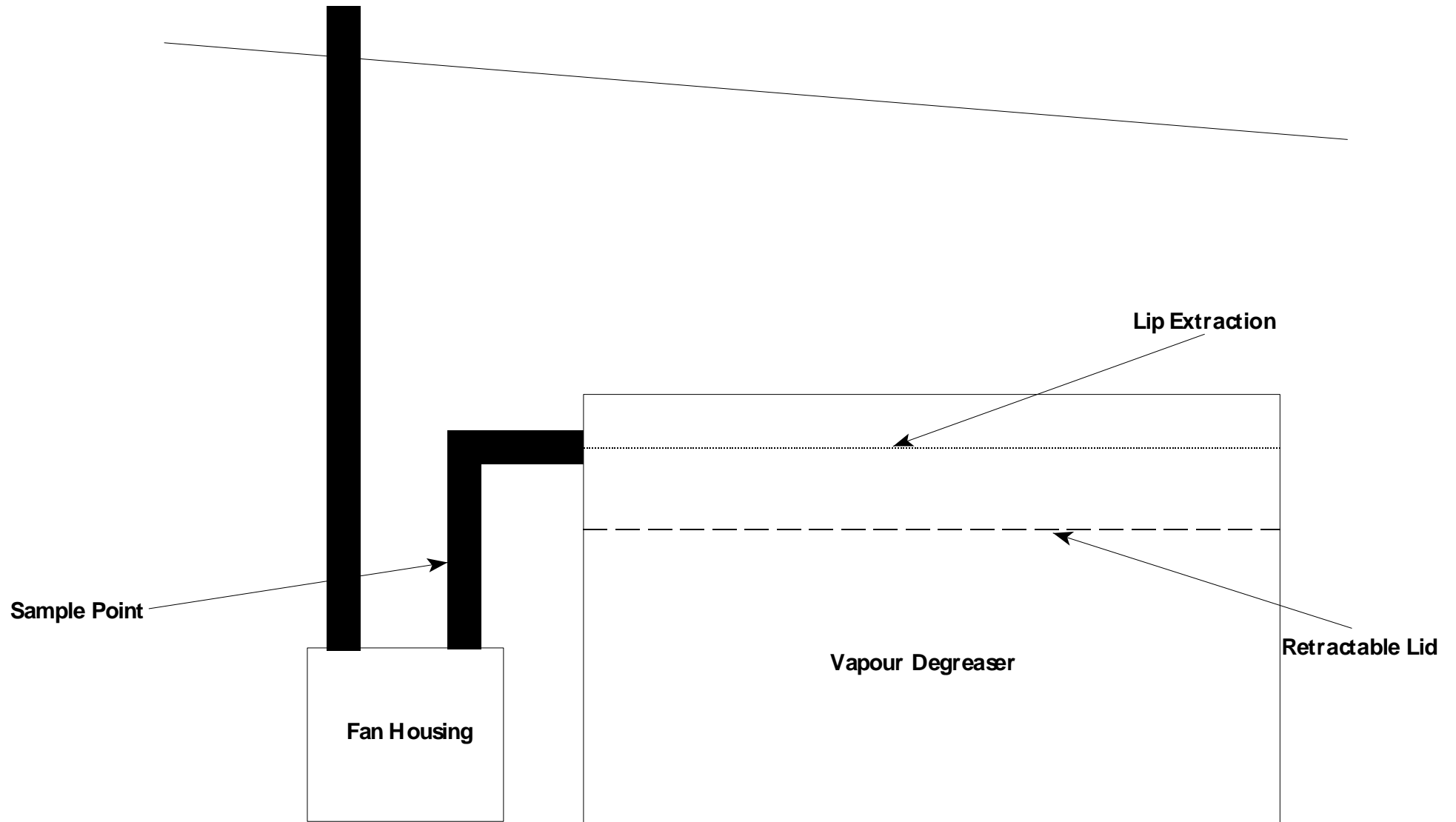
When the vapour degreaser was empty and the cover was closed the mass emission was below 100 g/h.

5.0 Conclusions and Recommendations

1. The dichloromethane emission is above the mass emission criteria of 100g/h and is also above the concentration limit of 20 mg.m⁻³.
2. It is recommended that a workplace exposure assessment is carried out on the vapour degreaser operator with the extraction system turned off.
3. If the workplace exposure survey shows that the operator is not being exposed to harmful levels of dichloromethane when the extraction is switched off then it is recommended that the extract system is removed and the vapour degreaser is operated without extraction.

APPENDIX 1

Diagram of Vapour Degreaser Extract Stack



APPENDIX 2

Calculations

1.0 Gas Flow Calculations

i) Gas velocity at S.T.P (273 K and 1013 m.bar)

$$V_{STP} = 1.29\sqrt{H_V}$$

where V_{STP} = gas velocity at STP (m/s)

K_p = pitot correction factor
= 0.997

1.29 = gas density at 273 K and 1013 m.bar

$\sqrt{H_V}$ = mean square root of the velocity pressure (Pa)

ii) Actual gas velocity (V_A)

$$V_A = V_{STP} \times \sqrt{\frac{T}{273} \times \frac{1013}{0.01(H_S) + B}}$$

where V_{STP} = gas velocity at STP (m/s)

T = temperature of gas in duct (K)

H_S = static pressure (Pa)

B = atmospheric pressure (m.bar)

iii) Actual Gas Flowrate (Q)

$$Q = V_A \times A \times 3600$$

where Q = gas flowrate (m^3/h)

V_A = actual gas velocity (m/s)

A = X sectional area of vent (m^2)

iv) Gas flowrate at STP (Q_{STP})

$$Q_{STP} = Q \times \frac{273}{T} \times \frac{B}{1013}$$

where Q = gas flowrate at STP (m^3/h)

T = temperature of gas in stack (K)

B = barometric atmospheric pressure (m.bar)

2.0 Dichloromethane Concentration

i) Actual Volume Sampled (V_A)

$$V_A = F \times t$$

where F = pump flow rate (l/min)
t = time sampled

ii) Volume sampled at S.T.P (273K and 1013 m.bar)

$$V_{STP} = V_A \times \frac{273}{T} \times \frac{P}{1013}$$

where V_A = actual volume (litres)
T = temperature in stack (K)
P = atmospheric pressure (m.bar)

iii) Concentration (mg.m^{-3}) = $\frac{M}{V_{STP}}$

where M = mass of dichloromethane (μg)
 V_{STP} = volume sampled at STP (litres)

3.0 Mass Emission

$$M = \text{mg.m}^{-3} \times Q \times 10^{-3}$$

where M = mass emission rate expressed (g.h^{-1})
 mg.m^{-3} = dichloromethane emission concentration (mg.m^{-3})
Q = gas flowrate ($\text{m}^3.\text{h}^{-1}$)

APPENDIX 3

Test Data

1.0 FLOW MEASUREMENTS

Universal Services UK Ltd

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1.1 Vapour Degeaser Extract Stack

Date:	14-Mar-12
Time:	09.50
Gas temperature (K)	286
Atmospheric pressure (m.bar)	1031
Static pressure (m.bar)	5.00
Duct diameter (m)	0.3
Area (m2)	0.0707

Distance Along Sample Line	Vel. Pressure Hv (Pa)	Sqrt Hv	Average Sqrt Hv (Pa)	Gas Velocity (m/s)
0.113D	18	4.24	3.86	5.03
0.500D	14	3.74		
0.887D	13	3.61		

Gas flowrate (m3/h)	1280
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Gas flowrate at STP (m3/h)	1243
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1.0 FLOW MEASUREMENTS

Universal Services UK Ltd

Project No : 74981-44

1.2 Vapour Degeaser Extract Stack

Date:	14-Mar-12
Time:	11.50
Gas temperature (K)	286
Atmospheric pressure (m.bar)	1031
Static pressure (m.bar)	5.00
Duct diameter (m)	0.3
Area (m ²)	0.0707

Distance Along Sample Line	Vel. Pressure Hv (Pa)	Sqrt Hv	Average Sqrt Hv (Pa)	Gas Velocity (m/s)
0.113D	10	3.16	3.21	4.18
0.500D	10	3.16		
0.887D	11	3.32		

Gas flowrate (m ³ /h)	1065
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Gas flowrate at STP (m ³ /h)	1034
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2.0 DICHLOROMETHANE MEASUREMENTS - VOLUMES SAMPLED

Universal Services UK Ltd

Project No : 74981-44

Standard Temperature (K) = 273

Standard Pressure (m.bar) = 1013

2.1 Vapour Degreaser Extract Stack - Test 1

Stack	Date	Pump	Temp K	Pressure m.bar	Flow Rate litres/minute	Sampling Time minutes	Actual Volume litres	Volume at STP litres
1	14-Mar	Sidekick	286	1031	0.09247	18	1.66	1.62

2.2 Vapour Degreaser Extract Stack - Test 2

Stack	Date	Pump	Temp K	Pressure m.bar	Flow Rate litres/minute	Sampling Time minutes	Actual Volume litres	Volume at STP litres
1	14-Mar	Sidekick	286	1031	0.09247	20	1.85	1.80

2.3 Vapour Degreaser Extract Stack - Test 3

Stack	Date	Pump	Temp K	Pressure m.bar	Flow Rate litres/minute	Sampling Time minutes	Actual Volume litres	Volume at STP litres
1	14-Mar	Sidekick	286	1031	0.09247	21	1.94	1.89

3.0 DICHLOROMETHANE MEASUREMENTS - WEIGHT COLLECTED

Universal Services UK Ltd

Project No : 74981-44

3.1 Vapour Degreaser Extract Stack - Test 1

Test	Date	Weight of Dichloromethane µg	Volume Sampled litres	Dichloromethane Concentration mg/m ³
1	14-Mar	818.00	1.62	504.9

3.2 Vapour Degreaser Extract Stack - Test 2

Test	Date	Weight of Dichloromethane µg	Volume Sampled litres	Dichloromethane Concentration mg/m ³
1	14-Mar	854.00	1.80	474.4

3.3 Vapour Degreaser Extract Stack - Test 3

Test	Date	Weight of Dichloromethane µg	Volume Sampled litres	Dichloromethane Concentration mg/m ³
1	14-Mar	39.00	1.89	20.6



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