HE 16 / 1544

Compliance Monitoring
of the Cooler Plant, BBF Plant, Tub 1 and Dryer Plant Releases

at

Sundown Products Limited

Station Road
Tilbrook
Huntingdon
PE28 0JY

Study Period: 4th February 2016

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SUNDOWN PRODUCTS LIMITED
STATION ROAD
TILBROOK
HUNTINGDON
PE28 0JY

10th February 2016

FAO: Mr Simon Stock

REPORT REF: - HE 16 / 1544

COMPLIANCE MONITORING
OF THE COOLER PLANT, BBF PLANT, TUB 1 AND DRYER PLANT RELEASES

1 INTRODUCTION

This compliance monitoring study was undertaken to determine data to assess Total Particulate Matter and Oxygen release concentrations sourced from the Sundown Products Limited operational activities, as required by the provisions of the site's LA-PPC/EPR permit.

The report relates to studies undertaken on 4th February 2016 by Halcyon Environmental personnel in respect of the determination of releases sourced from specific production operations; these being permitted under the direction of Huntingdon Council.

The study was reported by Mr T Growcott B.Sc. (Hons). MRSC. C.Chem. MIMF. The author was formally trained in source monitoring by Clean Air Engineering (CAe), Societe General de Surveillance (SGS) and BASF.

Halcyon is a member of the Source Testing Association and Surface Engineering Association.

Monitoring was undertaken over a continuous period per stack to determine the results quoted and in accordance with the following Source Testing Association (STA) codes of practice; -

Document	Title
M 1054	STA Minimum Standards Of Testing And Reporting.
M 1055	STA Code Of Practice.
QGN001	Guidance On Assessing Uncertainty In Stack Emission Monitoring.

The assistance of all site personnel in undertaking this study is gratefully acknowledged.

Releases were monitored at the following locations; -

Stack Reference	Plant Activity	Processed materials
S1	Dryer Plant stack	Animal Feed
S2	Cooler Plant stack	Animal Feed
S3	BBF Plant stack	Animal Feed
S4	Tub 1 Filter Plant Stack	Animal Feed

Monitoring was undertaken at relevant locations to establish the concentrations of those analytes detailed within the site's environmental permit.

1.2 SUMMARY

(i) The sampling, monitoring and analytical procedures undertaken in this report have determined analyte data for the site - sourced releases as per this study specification.

Substance	Permit Limit mg/m^3	HE 16 / 1544 Total Particulate Matter Determined Result mg/m^3
S1 Dryer Plant Stack	150	11.155
S2 Cooler Plant Stack	150	5.055
S3 BBF Plant Stack	20	3.550
S4 Tub 1 Filter Plant Stack	20	3.48

S1 is reported at 273K, 101.3 kPa wet gas corrected to 17% oxygen.

S2, S3 and S4 are reported at 273K, 101.3 kPa, wet gas without O_2 correction.

(ii) Sampling, monitoring and analytical procedures have determined compliant releases with respect to the concentration limits detailed under permit documentation.

(iii) Release discharge colour has been determined in accordance with current protocols and established as less than Ringelmann Shade 0.5.

(iv) Releases have been assessed and found to be free from droplets.

(v) Flow and mean velocity determinations have established data for the tested release points which have established compliance with site permit provisions.

1.3 CONCLUSIONS

All analytes determined in the study were determined to be compliant with the site's permit provisions.

In evaluating the results quoted herein, the following uncertainty is declared; -

UNCERTAINTY FOR PARTICULATE SAMPLING TO EN 13284 -1: 2002 PRINCIPAL UNCERTAINTIES FOR PARTICULATE SAMPLE OF 10mg					
Balance (PBS) at 100mg	= 0.022mg	95%		0.0220	0.0005
Volume Measurement (Schlumberger)(Labcal) 400L	= 0.5% of vol	2 litres	4	4.000	16.0000
	+ resolution	0.2 litres	0.025	0.1200	0.0144
DGM	= 2.3%			4.6000	21.1600
Change in DGM temperature	= 10/293			0.0341	0.0012
Change in atmospheric pressure	= 2/1013			0.0020	0.0000
No change in humidity (dry gas)					
No change in oxygen (LEV System)					
				Sum Sqs	37.1761
				Sq rt	6.0972
				Expanded Result	**6.1%**

Tim Growcott B Sc (Hons) MRSC C Chem C Sci MIMF
Senior Partner

SUND 1544 LAPPC REP

SECTION 2

SAMPLING AND MONITORING STRATEGIES

2 SAMPLING AND MONITORING STRATEGIES

2.1 SAMPLING STRATEGY

The main sampling and monitoring studies were completed following initial determination of the main duct and stack thermal and flow profiles as detailed in BS13284 Part 1.

The data reported herein was determined to be compliant with the provisions of this specification, using the following instrumentation.

Mean efflux velocity data was determined using 2 off Airflow Developments model PVM 100 electronic micro manometers used in conjunction with 2 off Airflow Developments BS 1042 type 2A pitot systems, with in line type K thermocouples.

Calibrated flow, temperature and pressure measurement devices were also used in these procedures.

Pressure, humidity and temperature measurements were determined using Huger-Sutronics instrumentation.

Gas volumes were measured using AGL model 6 gas boxes.

Gas temperatures were conditioned using BEI Tester's Choice instrumentation.

2.2 SAMPLING EQUIPMENT

Sampling was undertaken using dedicated sampling trains as defined for each methodology.

2.2.1 TOTAL PARTICULATE MATTER AND METALS DETERMINATIONS

(i) TPM Determination by BS13284 Part 1.

The procedure employed was that detailed in BS13284 Part 1. Air was extracted from the test stack isokinetically via a purpose built Andersen stack sampling train, with the venturi nozzle located directly in the duct/stack portals to minimise condensation losses.

The filter holder was located immediately adjacent to sampling nozzle, but external to the stack body. The filters were submitted to Halcyon personnel for post sampling reweighing.

2.2.2 OXYGEN AND WATER (MOISTURE) CONTENT DETERMINATIONS

Water (moisture) content was determined in accordance with BS EN 14790.

Oxygen was determined in accordance with ISO 12039.

2.2.3 SAMPLING AND CALCULATION PROTOCOLS

All sampling and monitoring procedures were based on basic isokinetic sampling strategies (+/- 10 % I), to assess process uniformity, with continuous on line assessment of flow rate and dynamic velocity measurements during process operation as required by the site authorisation documentation.

All flow rate and velocity measurement instrumentation was checked prior to, during and after each sampling run. All sampling planes and points of determination were corrected in accordance with isokinetic correction Ka coefficients as detailed in Source Testing Association protocols.

Calculation of Velocity of Flow:

The basic formula for calculating velocity of flow from velocity pressure is:

$$\text{Velocity Pressure (Pv)} = \tfrac{1}{2}\,\rho\,V^2$$

Where:

Pv is Velocity Pressure in pascals

ρ is the density of dry air (free of CO_2) at 1013 mb, 273 K in kg/m^3.

V is velocity in metres per second.

Dry air contains 78.1% Nitrogen (as N_2), 20.9% Oxygen (as O_2), 0.9% Argon (as Ar) and traces of CO_2 (0.03%), Ne, He, Kr, Xe, H_2, CH_4, N_2O, O_3, SO_2, NO_2, NH_3, CO, & I_2.

Atomic Weight of Nitrogen is 14, Oxygen is 16, and Argon is 40. Molecular Weight if Nitrogen (N_2) is 28, Oxygen (O_2) is 32 and Argon (Ar) is 40.

Molar Density of a complex gas mixture, such as air, can be calculated using the proportions of gas present, and the molecular weights of the component gases. Thus using the 3 principal components of dry air:

Molar gas density = 0.781 x 28 (for N_2) + 0.209 x 32 (for O_2) + 0.009 x 40 (for Ar)
= 28.916

When the figures are made more accurate, and all the other trace gases added into the equation, Molar Gas Density of Air works out to be **28.9644**. This is normally approximated to 29.

The following calculations can be utilised (in most cases), where molar gas density is in the range of 28-30. In some combustion stacks the density can be found to be outside this range, in which case the calculations need to be modified by substituting the actual value into the basic equation, and following the calculation through.

One mole of gas occupies 22.4136 litres at 273 K, 1013mb. (Normally approximated to 22.4). One mole of air occupies the same volume and weighs 28.9644 g. Thus the **Density of Dry Air** at 273 K, 1013 mb works out at 1.292 Kg/m^3. The precise figure is 1.2928 Kg/m^3. If this figure is entered into the initial equation

$$Pv = \tfrac{1}{2}\,\rho\,V^2$$

It calculates out to

Velocity (metres per second) $= 1.244\sqrt{Pv}$ (at 273 K, 1013 mb)

or

Velocity (metres per second) $= 1.280\sqrt{Pv}$ (at ambient: 289 K, 1013mb)

This equation can be applied at or near standard conditions. Where conditions vary significantly from standard, corrections can be made according to the following formula:

$$V = 1.280\sqrt{\frac{1013 \times T \times 101300}{Pa \times 289 \times (101300+Ps)} \times Pv}$$

This equation corrects for atmospheric pressure (Pa), expressed in millibars, Temperature expressed in Kelvin (T), and static pressure in the stack (Ps) in pascals. It multiplies out to give:

$$V = 762.7 \sqrt{\frac{T \times Pv}{Pa\ (101300+Ps)}} \quad x\ Pv$$

Where:

V	=	Velocity of Flow on metres per second	(ms^{-1})
T	=	Temperature in Kelvin (Kelvin =^{o} Celsius + 273)	(K)
Pv	=	Velocity Pressure in pascals	(Pa)
Ps	=	Static Pressure in pascals	(Pa)
Pa	=	Atmospheric Pressure in millibars (1 millibars = 100 pascals)	(mb)

To apply this equation, Pv should be entered as the root mean square of all velocity pressure readings. But where the majority of the readings do not vary by more than 25% from the mean figure, the mean provides a satisfactory answer.

The equation gives velocity of flow at temperature T, static pressure Ps, and atmospheric pressure Pa.

Measurement of Airflow in Stacks:

Correct isokinetic sampling is dependent on accurate assessment of air velocity in the duct or flue. Because of the potentially hot, acid conditions found in flues, the instrument of choice for measuring flow is one that measures differential pressure, and does not insert an instrument with electronic or moving parts into the duct.

Pressure in Ducts:

There are 4 factors that affect the perceived pressure in a duct:

1. Movement of air produces a measurable Velocity Pressure (also known as Dynamic Pressure).

2. Static Pressure, is exerted in all directions, by the compression, expansion, or heating process that is moving the air.

3. Atmospheric (Barometric) Pressure

4. Temperature.

Micro manometer & Pitot Tube:

The pitot tube is the differential pressure probe, it is designed to create minimal turbulence in the flow. The British Standard design has an ellipsoidal nose, which is inserted to face the flow. The tube is very directional and needs to be accurately aligned into the flow, to produce the best result.

Unfortunately the pressure bearing on the nose of the instrument is Velocity Pressure, but with the addition of static pressure.

To eliminate this problem, the pitot tube is made with a separate tapping to measure static pressure alone. The BS tube is made double, with tappings at right angles to the flow, whereas the American S type pitot consists of two separate tubes 180^{o} opposed. The two types of pitot tube have different response factors (sometimes called the K factor), and this may require the use of a correction factor in calculating flow. The response factor for the BS type is 1.0 and for the S type is 0.85.

The original instrument for measuring air pressure is the U tube manometer. By attaching the two tappings of the pitot tube, one to each side of the manometer, Static Pressure is applied to both sides, and its effect is eliminated, allowing a direct reading of Velocity Pressure. The inclined manometer is an improvement on the U tube, because it allows for more accurate readings of pressure. However it does require careful leveling before use, and an electronic micro manometer is more user friendly.

With either type of instrument it is important that it is connected up with the Velocity Pressure tapping bearing on the positive side of the instrument.

Calculating & Presentation of Results (Measurements & Corrections):

Particulate sampling is always assessed gravimetrically (by weight). Filter material of all types is pre weighed, exposed in the sampling line and re-weighed.

This procedure may require drying of the filter medium before re-weighing, if the sampling was conducted at a temperature below the dew point. In all circumstances, filters require careful handling to avoid loss particulate, and also loss of original fibrous material. Weight of particulate collected is thus derived from the difference of the two weights and is normally expressed in milligrams (g^{-3}) or micrograms (g^{-6}). The balance should be calibrated against a traceable standard before and after each batch of filters is weighed / re-weighed.

Volume of gas collected is normally determined either by multiplying sampling flow rate (litres/minute) by time elapsed (minutes) to get a final volume in litres, or by utilising a direct reading from a gas meter. In both cases, volume calculated is at ambient temperature and pressure and requires correcting to standard conditions. The gas meter or flow meter should be regularly re-calibrated against a traceable standard, and this may impose an extra calibration factor on the results to obtain correct ambient volume.

If the sampling line, does not include a silica gel trap, but only a condensate trap, (as in the BCURA or CEGB Mk111A) the air passing to the meters can be assumed to be water saturated at ambient conditions, and this too required compensation.

Schedule A & B processes require presentation of results in milligrams per cubic metre, and / or parts per million, as standardised to the following conditions:

Temperature	273K (0^o Celsius)
Barometric Pressure	101.3KPa, (1013mb)
Humidity	Dry
Oxygen	3%, 6%, 8%, 11%, 15%, 18% (depending of combustion process)

The various calculations and conversions are explained in the subsequent paragraphs.

Determination of Isokinetic Sampling Rate:

To obtain correct samples of particulates, turbulence caused by sampling must be minimised. This is achieved by making the velocity of flow into the sampling probe equal to the velocity flow moving along the duct or stack. This sampling technique is called isokinetic sampling, and its use enables the collection of representative samples, by eliminating the distortion of sample reliability caused by variation in proportion of light particulates collected.

Velocity of flow is determined by the use of pitot tube and micro manometer. This is normally calculated at the stack temperature. The gas volume measuring equipment is normally functioning at about ambient temperature. (Gas moving along the sampling line rapidly cools to ambient)

To calculate isokinetic flow rate, first the gas velocity must be calculated as at ambient. This is done using the standard gas equation. (See Calculation of Results).

$$\frac{\text{Pressure x Volume}}{\text{Temperature}} = \text{Constant}$$

Thus for a stack of uniform width volume is proportional to velocity, hence:

$$\text{Velocity}_{\text{ambient}} = \frac{\text{pressure}_{\text{stack}} \text{ x Velocity}_{\text{stack}} \text{ x Temperature}_{\text{ambient}}}{\text{Temperature}_{\text{stack}} \text{ x Pressure}_{\text{ambient}}}$$

As atmospheric pressure remains equal this item cancels out of the equation.

Sampling rate (litres per minute) is a function of stack velocity (metres per second) and probe tip area (square centimetres), derived from pr^2. The rationale is as below:

$$\text{Metres per second (m/s) x } \frac{100}{60} = \text{centimetres per minute (cm/min)}$$

$$\text{Centimetres per minute (cm/min) x Square centimetres (cm}^2\text{) = Cubic Centimetres per minute (cm}^3\text{/min)}$$

$$\frac{\text{Cubic Centimetres per minute (cm}^3\text{/min)}}{1000} = \text{Litres per minute (l/min)}$$

Thus:

$$\textbf{Sampling Rate (l/min)} = \frac{\textbf{Ambient Stack Flow (m/s) x Tip area (cm}^2\textbf{)}}{\textbf{600}}$$

Determination of Flue Gas Density:

Stack gas density is determined by measuring the concentration of Carbon Dioxide, Carbon Monoxide and Oxygen in the stack. The residual dry atmospheric gas is assumed for the purpose of this calculation to be Nitrogen. Nitrogen concentration is calculated as follows:

$$\% N_2 = 100 - (\% CO_2 + \% O_2 + \% CO)$$

The proportion if each gas in the dry mixture can then be utilised to calculate the dry molar gas density as shown previously:

$$\textbf{Molar Dry Gas Density (Dd)} = \left(\%CO_2 \times \frac{44}{100}\right) + \left(\% O_2 \times \frac{32}{100}\right) + \left(\%CO + \%N_2 \times \frac{28}{100}\right)$$

Flue gases however also contain water. The water is condensed out of the sampling line, (to protect the sampling pump), and is weighted.

The volume of gas occupied by the collected condensate water can be calculated from the volume occupied by 1 mole of standard gas (ie. 22.4 litres at 273K, 1013mb).

$$\textbf{Gas Phase Volume of Water (litres) = Weight of Water (grams) x } \frac{\textbf{22.4}}{\textbf{28}}$$

Dry gas volume of the sample is measured by the gas meter in the sampling line. Total gas volume (wet) collected is therefore the sum of the calculated water volume above and the dry gas volume measured.

Total (Wet) Gas Volume = Dry Gas Volume + Gas phase Water Volume

Using the above relationship, the proportion of dry gas in the total volume collected, (Mole Faction of Dry Gas), can be calculated as follows:

$$\textbf{Mole Fraction of dry gas (Md)} = \frac{\textbf{Dry gas volume}}{\textbf{Total gas volume}}$$

Mole fraction of wet gas can be calculated similarly, or as

Mole fraction of wet gas (Mw) = 1 - Mole fraction of dry gas (Md)

Density of stack gas can then be calculated from the density of dry stack gas calculated above, and the Mole Fractions calculated.

Thus:

Molar Density
of dry gas (Dd) x Mole fraction of dry gas (Md) + 18 (1 - Md) =
Molar Stack gas density (Ds)

This latter equation is identical in methodology to the earlier equation for deriving molar gas density of dry gas, but now includes an extra derived function for water

$$\text{Molar stack gas density (Ds)} = \text{Md}\ \frac{(\%CO2 \times 46}{100} + \frac{\%O2 \times 32}{100} + \frac{\%N2 + \%CO \times 28}{100}) + \text{Mw}\ \frac{(\%H2O \times 18}{100})$$

In most cases the Molar Stack Gas Density will work out as 29 $\pm$ 1. In this case, the normal equation for stack flow will prove to be satisfactory.

Calculation of Volume Flow:

Volume flow is calculated from flow velocity and internal area of the stack or duct as follows:

Volume flow ($m^3\ min^{-1}$) = Velocity (ms^{-1}) x Internal Area of Duct (m^2) x 60

Internal area of duct is calculated as:

pr^2 for a circular duct,
or base x height for a square duct.

To convert m^3min^{-1} to cubic feet per minute (cfm) multiply by 35.315

Oxygen makes up about 20.9% of normal air, this is used in the correction factor, which is as follows:

$$\textbf{Corrected Pollutant Concentration (mg/m}^3\textbf{)} = \frac{\textbf{(20.9 - Standard } O_2\textbf{\%)}}{\textbf{(20.9 - Measured } O_2\textbf{\%)}} \times \textbf{Measured Conc}^n$$

This means that where a combustion process is running more efficiently than required, the correction factor will effectively decrease the final corrected concentration of pollutant.

Conversely, where the process is inefficient, the Oxygen correction can dramatically increase the final result.

The correction is only used in combustion processes, and is applied identically to all pollutant gases and particles.

Temperature and Pressure:

Assuming that stack gases obey the standard Gas Laws, then:

$$\frac{\text{Atmospheric Pressure (mb)} \times \text{Volume (m}^3\text{)}}{\text{Temperature (K)}} = \text{Molar Gas Content}$$

or

$$\frac{PV}{T} = K$$

The Molar Gas Constant equals 8.3143 J K^{-1} mol^{-1}

A more useful expression of the Gas Law is:

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

This can be expressed to find an unknown as

$$V_1 = \frac{P_2V_2}{T_2} \times \frac{T_1}{P_1}$$

The correction equation can therefore be expressed as:

$$\textbf{Standardised Volume} = \frac{\textbf{Recorded Pressure}}{\textbf{Std Pressure (1013)}} \times \frac{\textbf{Std Temperature (273)}}{\textbf{Recorded Temperature}} \times \textbf{Recorded Volume}$$

For this correction to work, any unit of pressure can be utilised (inches of water, millimetres of mercury, millibars, kilopascals etc.) provided that the standard atmosphere is expressed in similar units. Temperature must however be worked in Absolute Units e.g. Kelvin (K = ^oC + 273.15) or Rankine (^oR = ^oF + 459.67)

2.2.4 INITIAL STACK PROFILE STUDY

As per the provisions of BS13284 Part 1, a stack profile study was addressed prior to monitoring and sampling.

This study was undertaken at 17points in two trans axial assessments at the sampling portal locations. All stack monitoring locations were determined to be within the Tmin:Tmax and Vmin:Vmax criteria defined in the standard. Each point in the study was monitored over a minimum 2-minute period.

The study determined that the temperature variance across the two measured planes variances were within method tolerance specification.

In this assessment the relative ratio of the cross sectional area of the stack and Andersen sampling head were determined.

The filter holder csa was noted as less than 10% of the stack/duct csa, however, it was decided to maintain the filter body outside of the air streams.

The csa. of the sample line was calculated on a 64 mm. diameter.

During sampling the Andersen line was threaded into each portal with a purpose made adaptor with high temperature insulation to minimise air bleed into the stack. Maximum bleed rates were determined as < 0.2 %.

2.2.5 DEVIATIONS FROM STANDARDS

The following points were noted during the study; -

(i) For the next study all 3 locations will require the installation of compliant portals, as defined in Technical Guidance Note M1.

2.2.6 CLIMATE CONDITIONS

The following climatic conditions were noted.

Parameter	Units	04.02.2016
Ambient Temperature	K	283.4
Atmospheric Pressure	kPas	100.9
Visibility	M	>1000
Wind Direction	-	NW
Wind Speed	Kph	<5
Climatics	-	Dull and overcast

SECTION 3

SUBSTANCES AND THEIR STANDARD METHODS

3 SUBSTANCES AND THEIR STANDARD METHODS

Substance	Standard or Method
Total Particulate Matter	BS13284 Part 1

The data determined in this study may be utilised for further baseline comparisons against previous studies.

Halcyon systems also encompass the recent STA publication; -

"Guidance on Assessment Measurement Uncertainty in Stack Releases Monitoring"
- STA Quality Task Group – Dr J Pullen.

SECTION 4

MEAN EFFLUX VELOCITY DATA

4 MEAN EFFLUX VELOCITY RESULTS

The following results were determined; -

Stack Ref.	Stack Dim. (m)	Cross Sectional Area (m^2)	Tmax:Tmin	Vmax:Vmin	Mean Efflux Velocity at T (m/sec)
S1 Dryer Plant stack	1.00	0.7850	Within Specification	Within Specification	12.02 @ 331.96 K
S2 Cooler Plant	1.00	0.7850	Within Specification	Within Specification	9.18 @ 295.48 K
S3 BBF Plant stack	0.50	0.1960	Within Specification	Within Specification	22.86 @ 6310.01 K
S4 Filter Plant stack	0.43	0.1450	Within Specification	Within Specification	20.18 @ 300.35 K

The field sheets are retained in Halcyon's IT systems.

Stack Ref	BS 2742C Ringlemann Shade	Water Droplets
S1	< 0.5	None
S2	< 0.5	None
S3	< 0.5	None
S4	< 0.5	None

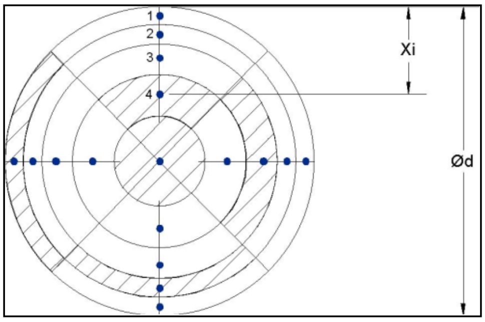
Velocity results were determined access 2 planes, 90^o opposed with 17 test points. Testing was undertaken @ 2 mins per test location.

Pitot Measurements

BS3405:		BS 13284-1	
BS 6911-1	Y	*Please tick the relevant box*	

Client:	*Sundown Products Limited*	**Date:**	*4th February 2016*	
Address:	*Station Road*	**Operator:**	*T Growcott*	
	Tilbrook	**Job Number:**	*HE 16 / 1544*	
	Huntingdon	**Location:**	*Dryer Stack S1*	
	PE 28 0JY	**Instruments:**	*1m Pitot + PVM 100 Micromanometer*	
Details of Duct:	*Steel*		**Atmos. P (pa)**	**Atmos. Temp K**
Duct Shape:	*Circular*	**Initial:**	100.7	283
Dimension / Dia.:	**1.000m**	**Final:**	101.1	283.8
Area:	**0.7850m^2**	**Mean:**	*100.9*	*283.4*
	Axis 1:	**Axis 2:**	**Gas Homogeneity Check:**	20 Point CO Test Pass

Traverse Point	Temp K	Temp K^2	Velocity kPa	V^2
1	331.7	110024.89	92	8464
2	331.9	110157.61	94	8836
3	332	110224	96	9216
4	332.2	110356.84	98	9604
5	331.8	110091.24	92	8464
6	331.9	110157.61	93	8649
7	331.9	110157.61	94	8836
8	332.1	110290.41	97	9409
9	331.8	110091.24	90	8100
10	331.9	110157.61	92	8464
11	331.9	110157.61	92	8464
12	332.2	110356.84	93	8649
13	331.7	110024.89	90	8100
14	331.9	110157.61	91	8281
15	332	110224	93	8649
16	332.2	110356.84	94	8836
17	332.3	110423.29	96	9216
Total	*5643.4*	*1873410.14*	*1587*	*148237*
Average	*331.964706*	*110200.5965*	*93.35294118*	*8719.823529*
RMS		331.9647518		93.37999534

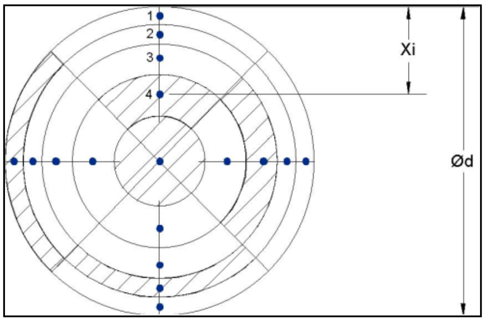


O2 reference	17%
Humidity %	81
Ambient K	283.4
Negative Pressure	Pass
Drift Angle	< 15 degrees
Dry Gas Correction	N/A
Pitot Correction	N/A
T Correction	N/A
Vmax : Vmin	Pass
Tmax : Tmin	Pass
V_{rms}	93.37999534
Pitot Calibration	*1.002*
Static Pressure Pv (Pascals)	-1.47
Mean Stack Temperature K	331.9647518

Pitot Measurements

BS3405:		**BS 13284-1**	
BS 6911-1	**Y**	*Please tick the relevant box*	

Client:	*Sundown Products Limited*	**Date:**	*4th February 2016*	
Address:	*Station Road*	**Operator:**	*T Growcott*	
	Tilbrook	**Job Number:**	*HE 16 / 1544*	
	Huntingdon	**Location:**	*Dryer Stack S2*	
	PE 28 0JY	**Instruments:**	*1m Pitot + PVM 100 Micromanometer*	
Details of Duct:	*Steel*		**Atmos. P (pa)**	**Atmos. Temp K**
Duct Shape:	*Circular*	**Initial:**	100.7	283
Dimension / Dia.:	**1.000m**	**Final:**	101.1	283.8
Area:	**0.7850m^2**	**Mean:**	*100.9*	*283.4*
	Axis 1:	**Axis 2:**	**Gas Homogeneity Check:**	20 Point CO Test Pass



Traverse Point	Temp K	Temp K^2	Velocity kPa	V^2		
1	295.2	87143.04	54	2916		
2	295.4	87261.16	55	3025		
3	295.6	87379.36	56	3136		
4	296	87616	58	3364		
5	295.4	87261.16	52	2704		
6	295.4	87261.16	53	2809		
7	295.6	87379.36	54	2916	**O2 reference**	17%
8	295.7	87438.49	55	3025	**Humidity %**	81
9	295.2	87143.04	50	2500	**Ambient K**	283.4
10	295.3	87202.09	51	2601	**Negative Pressure**	Pass
11	295.5	87320.25	53	2809	**Drift Angle**	< 15 degrees
12	295.5	87320.25	54	2916	**Dry Gas Correction**	N/A
13	295.2	87143.04	53	2809	**Pitot Correction**	N/A
14	295.4	87261.16	55	3025	**T Correction**	N/A
15	295.5	87320.25	56	3136	**Vmax : Vmin**	Pass
16	295.6	87379.36	57	3249	**Tmax : Tmin**	Pass
17	295.7	87438.49	59	3481	**V_{rms}**	54.46045516
Total	***5023.2***	***1484267.66***	***925***	***50421***	**Pitot Calibration**	*1.002*
Average	***295.482353***	***87309.86235***	***54.41176471***	***2965.941176***	**Static Pressure Pv (Pascals)**	-1.39
RMS		**295.4824231**		**54.46045516**	**Mean Stack Temperature K**	295.4824231

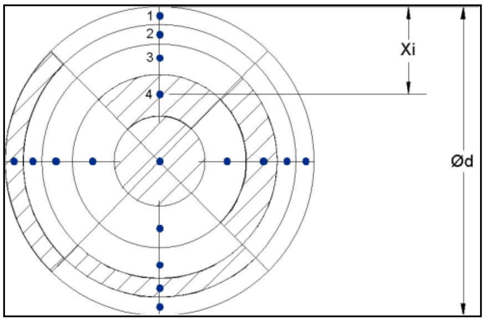
Pitot Measurements

BS3405:		BS 13284-1	
BS 6911-1	Y	*Please tick the relevant box*	

Client:	*Sundown Products Limited*	**Date:**	*4th february 2016*	
Address:	*Station Road*	**Operator:**	*T Growcott*	
	Tilbrook	**Job Number:**	*HE 16 / 1544*	
	Huntingdon	**Location:**	*S3 BBF Stack*	
	PE 28 0JY	**Instruments:**	*1m Pitot + PVM 100 Micromanometer*	
Details of Duct:	*Steel*		**Atmos. P (pa)**	**Atmos. Temp K**
Duct Shape:	*Circular*	**Initial:**	100.7	283
Dimension / Dia.:	**0.5m**	**Final:**	101.1	283.8
Area:	**0.1960m²**	**Mean:**	*100.9*	*283.4*

	Axis 1:		**Axis 2:**	**Gas Homogeneity Check:**	20 Point CO Test Pass

Traverse Point	Temp K	Temp K²	Velocity kPa	V²
1	309.8	95976.04	372	138384
2	309.9	96038.01	374	139876
3	310.2	96224.04	377	142129
4	310.3	96286.09	380	144400
5	309.9	96038.01	375	140625
6	310.2	96224.04	379	143641
7	310.4	96348.16	380	144400
8	310.6	96472.36	381	145161
9	309.7	95914.09	370	136900
10	309.8	95976.04	372	138384
11	309.9	96038.01	379	143641
12	309.9	96038.01	379	143641
13	309.6	95852.16	379	143641
14	309.8	95976.04	380	144400
15	309.9	96038.01	380	144400
16	310.1	96162.01	382	145924
17	310.2	96224.04	382	145924
Total	*5270.2*	*1633825.16*	*6421*	*2425471*
Average	*310.011765*	*96107.36235*	*377.7058824*	*142674.7647*
RMS		310.0118745		377.7231323

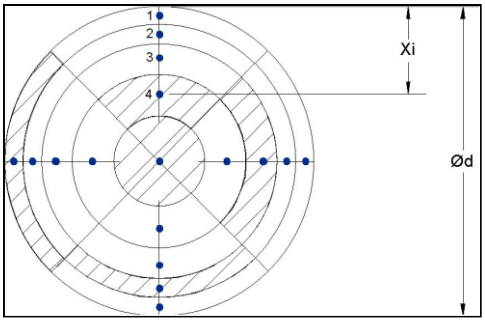


O2 reference	17%
Humidity %	81
Ambient K	283.4
Negative Pressure	Pass
Drift Angle	< 15 degrees
Dry Gas Correction	N/A
Pitot Correction	N/A
T Correction	N/A
Vmax : Vmin	Pass
Tmax : Tmin	Pass
V_{rms}	377.7231323
Pitot Calibration	*1.002*
Static Pressure Pv (Pascals)	-1.52
Mean Stack Temperature K	310.0118745

Pitot Measurements

BS3405:		BS 13284-1	
BS 6911-1	Y	*Please tick the relevant box*	

Client:	*Sundown Products Limited*	Date:	*4th February 2016*	
Address:	*Station Road*	Operator:	*T Growcott*	
	Tilbrook	Job Number:	*HE 16 / 1544*	
	Huntingdon	Location:	*S4 Tub 1*	
	PE 28 0JY	Instruments:	*1m Pitot + PVM 100 Micromanometer*	
Details of Duct:	*Steel*		Atmos. P (pa)	Atmos. Temp K
Duct Shape:	*Circular*	Initial:	100.7	283
Dimension / Dia.:	0.43m	Final:	101.1	283.8
Area:	0.1450m^2	Mean:	*100.9*	*283.4*
	Axis 1:	Axis 2:	Gas Homogeneity Check:	20 Point CO Test Pass



Traverse Point	Temp K	Temp K^2	Velocity kPa	V^2		
1	299.4	89640.36	261	68121		
2	300.2	90120.04	263	69169		
3	300.4	90240.16	263	69169		
4	300.5	90300.25	265	70225		
5	299.8	89880.04	262	68644		
6	300.3	90180.09	264	69696		
7	300.4	90240.16	264	69696	O2 reference	17%
8	300.4	90240.16	266	70756	Humidity %	81
9	300.2	90120.04	261	68121	Ambient K	283.4
10	300.4	90240.16	261	68121	Negative Pressure	Pass
11	300.6	90360.36	262	68644	Drift Angle	< 15 degrees
12	300.8	90480.64	263	69169	Dry Gas Correction	N/A
13	300.2	90120.04	264	69696	Pitot Correction	N/A
14	300.4	90240.16	263	69169	T Correction	N/A
15	300.6	90360.36	264	69696	Vmax : Vmin	Pass
16	300.6	90360.36	264	69696	Tmax : Tmin	Pass
17	300.8	90480.64	267	71289	V_{rms}	263.3580654
Total	*5106*	*1533604.02*		*1179077*	Pitot Calibration	*1.002*
Average	*300.352941*	*90212.00118*	*0*	*69357.47059*	Static Pressure Pv (Pascals)	-1.77
RMS		300.3531275		263.3580654	Mean Stack Temperature K	300.3531275

SECTION 5

ANALYTICAL RESULTS

5.1 RESULTS

The following results were determined; -

Stack Ref.	Total Particulate Matter (mg/m^3) at reference conditions
S1 Dryer Plant stack	11.155
S2 Cooler Plant stack	5.055
S3 BBF Plant stack	3.550
S3 Filter Plant stack	3.48

Dryer Plant stack S1 – Total Particulate Matter

Job Number:	HE 16 / 1544
Client:	Sundown Products
Date:	4th February 2016
Release Point Stack Ref	S1
Instrument Type	Anderson Portable No. 1
Tester	T Growcott
STA Reference	MM 03 / 314
MIDS Guidance	Duplicate Samples + Blank
Droplet Test	Free from droplets
Tmax : Tmin	Pass
Vmax : Vmin	< 3.1
-ve Pressure	Pass
Drift Angle	< 15°
Homogeneous Gas Test	Pass
Leak Rate	< 0.02 cfm
Sampling Plane	Compliant
DGM Inlet Temp	82
DGM Outlet Temp	83
Test Method	BS13284 Part 1
Stack gas temp K	383.4
Sample Number	1544/TPM/001/002
Test Start (Ti)	12.05.00
Test Finish (Tf)	13.15.00
Test Duration (mins)	70
No. of Samples	2 x 30 mins
Test max (mg/m^3)	12.09
Test min (mg/m^3)	10.22
Mean Reading (mg/m^3) @ reference conditions	11.155
Oxygen (%)	18.31
Moisture (%)	5.98

Cooler Plant stack S2 – Total Particulate Matter

Job Number:	HE 16 / 1544
Client:	Sundown Products
Date:	4th February 2016
Release Point Stack Ref	S2
Instrument Type	Anderson Portable No. 2
Tester	T Growcott
STA Reference	MM 03 / 314
MIDS Guidance	Duplicate Samples + Blank
Droplet Test	Free from droplets
Tmax : Tmin	Pass
Vmax : Vmin	< 3.1
-ve Pressure	Pass
Drift Angle	$< 15^{o}$
Homogeneous Gas Test	Pass
Leak Rate	< 0.02 cfm
Sampling Plane	Compliant
DGM Inlet Temp	17
DGM Outlet Temp	17
Test Method	BS13284 Part 1
Stack gas temp K	295.17
Sample Number	1544/TPM/001/002
Test Start (Ti)	12.10.00
Test Finish (Tf)	13.19.00
Test Duration (mins)	69
No. of Samples	2 x 30 mins
Test max (mg/m^3)	5.14
Test min (mg/m^3)	4.97
Test mean (mgm^3)	5.055
Oxygen (%)	20.77

BBF Plant stack S3 – Total Particulate Matter

Job Number:	HE 16 / 1544
Client:	Sundown Products
Date:	4th February 2016
Release Point Stack Ref	S3
Instrument Type	Anderson Portable No. 1
Tester	T Growcott
STA Reference	MM 03 / 314
MIDS Guidance	Duplicate Samples + Blank
Droplet Test	Free from droplets
Tmax : Tmin	Pass
Vmax : Vmin	< 3.1
-ve Pressure	Pass
Drift Angle	$< 15^o$
Homogeneous Gas Test	Pass
Leak Rate	< 0.02 cfm
Sampling Plane	Compliant
DGM Inlet Temp	19
DGM Outlet Temp	19
Test Method	BS13284 Part 1
Stack gas temp K	314.96
Sample Number	1544/TPM/001/002
Test Start (Ti)	10.50.00
Test Finish (Tf)	11.58.00
Test Duration (mins)	68
No. of Samples	2 x 30 mins
Test max (mg/m^3)	3.97
Test min (mg/m^3)	3.13
Mean Reading (mg/m^3) @ reference conditions	3.55
Oxygen (%)	20.84

Filter Plant stack S4 – Total Particulate Matter

Job Number:	HE 16 / 1544
Client:	Sundown Products
Date:	4th February 2016
Release Point Stack Ref	S4
Instrument Type	Anderson Portable No. 1
Tester	T Growcott
STA Reference	MM 03 / 314
MIDS Guidance	Duplicate Samples + Blank
Droplet Test	Free from droplets
Tmax : Tmin	Pass
Vmax : Vmin	< 3.1
-ve Pressure	Pass
Drift Angle	< 15^o
Homogeneous Gas Test	Pass
Leak Rate	< 0.02 cfm
Sampling Plane	Compliant
DGM Inlet Temp	16
DGM Outlet Temp	17
Test Method	BS13284 Part 1
Stack gas temp K	383.4
Sample Number	1544/TPM/001/002
Test Start (Ti)	11.05.00
Test Finish (Tf)	12.12.00
Test Duration (mins)	67
No. of Samples	2 x 30 mins
Test max (mg/m^3)	3.57
Test min (mg/m^3)	3.39
Mean Reading (mg/m^3) @ reference conditions	3.48
Oxygen (%)	20.86

SECTION 7

VISUAL ASSESSMENT

7 VISUAL ASSESSMENT

7.1 VISUAL ASSESSMENT

In accordance with the provisions of the site's permit assessment of releases was undertaken throughout the monitoring period.

The assessment was carried out with reference to the methods and procedures detailed in BS 2742C:2009.

The process related releases from the stacks were evaluated, the emission discharge colour for the systems was determined as colourless and less than Ringelmann shade 0.5 throughout the study.

APPENDIX 1

STACK SAMPLING SCHEMATIC

Planning and performing a stack test

DETERMINE NECESSITY OF A SOURCE TEST
- Decide on data required
- Determine that source test will give this data
- Analyse cost

RESEARCH LITERATURE
- Basic process operation
- Type of pollutant emitted from process
- Physical state at source conditions
- Probable points of emission from process
- Read sampling reports from other processes sampled:
  1. Problems to expect
  2. Examinations of variables
     a. H_2O vapour
     b. Temperature at source
- Study analytical procedures used for processing test samples

STATE SOURCE TEST OBJECTIVES
- Process evaluation
- Process design data
- Regulatory compliance

EACH STACK TEST SHOULD BE CONSIDERED AN ORIGINAL SCIENTIFIC EXPERIMENT

DESIGN EXPERIMENT
- Develop sampling approach
- Select equipment to meet test objectives
- Select analytical methods
- Evaluate possible errors or biases and correct sampling approach
- Determine man power, period for test
- Determine time required for test with margin for breakdowns
- Thoroughly evaluate entire experiment with regard to applicable source and UK guidelines

PRE-SURVEY SAMPLING SITE
- Locate hotels and restaurants in area
- Contact plant personnel
- Inform plant personnel of testing objectives and requirements for completion
- Note shift changes
- Determine accessibility of sampling site
- Evaluate safety
- Determine port locations and applications to BS 13284-1 or ISO 9096:2003
- Locate electrical power supply to site
- Locate rest rooms and food at plant
- Drawings, photographs, or blueprints of sampling site
- Evaluate applicability of sampling approach from experiment design
- Note any special equipment needed

FINALISE TEST PLANS
- Incorporate pre-survey into experiment design
- Submit experiment design for approval by client
- Set test dates and durations

PREPARE FILTERS AND REAGENTS
- Mark filters with insoluble ink
- Desiccate to constant weight
- Record weights in permanent laboratory file
- Copy file on site record
- Measure double distilled H_2O for impinges
- Weigh silica gel
- Clean sample storage containers

CALIBRATE EQUIPMENT
- DGM
- Determine console Delta H
- Nozzles
- Thermometers and thermocouples
- Pressure gauges
- Orsat
- Pitot tube and probe
- Nomographs

PREPARE EQUIPMENT FOR TEST
- Assemble and confirm operation
- Prepare for transportation
- Include spare parts and reserve equipment

CONFIRM TRAVEL AND SAMPLE TEAM ACCOMMODATIONS AT SITE

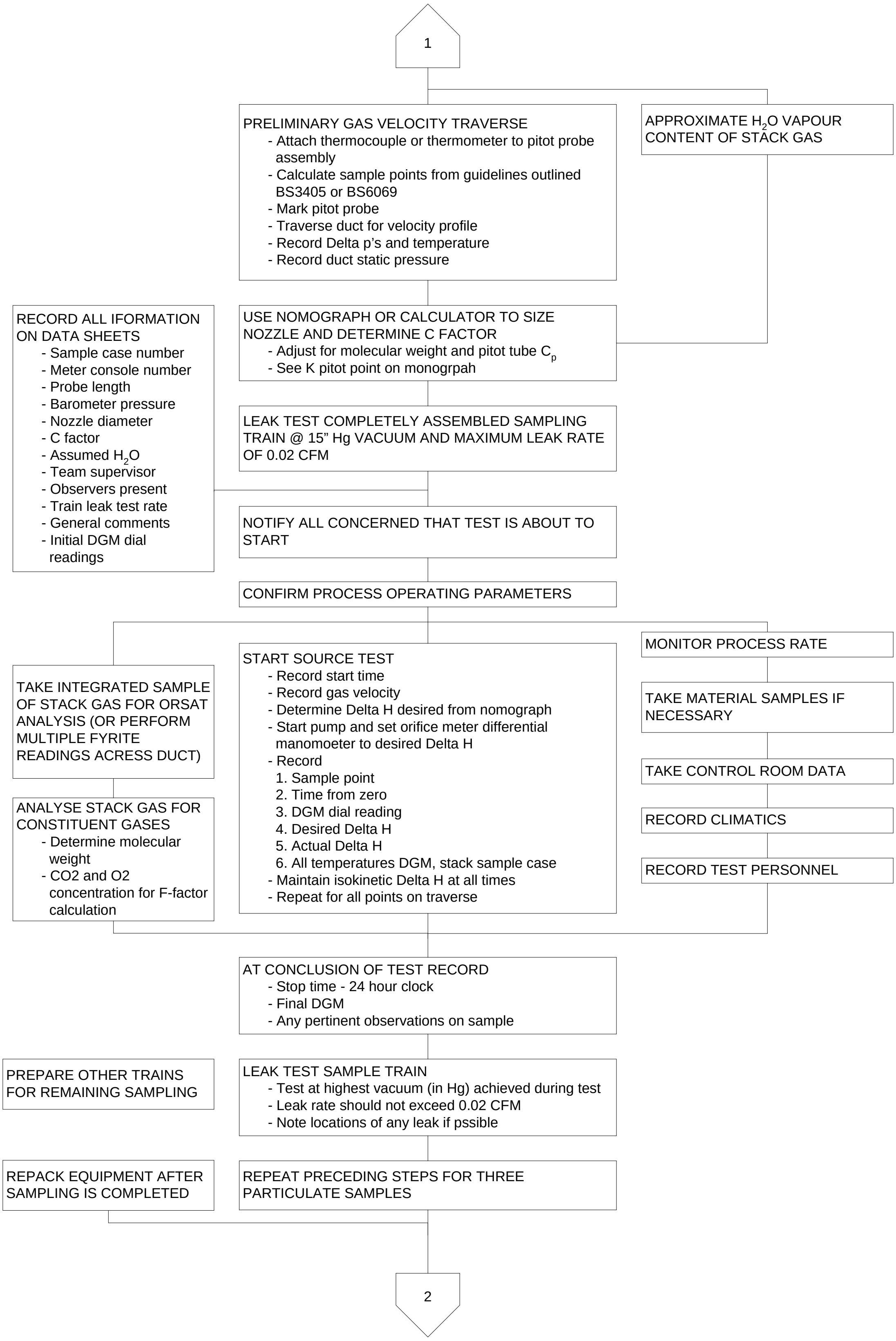
CONFIRM TEST FATE AND PROCESS OPERATION
- Final step before travel arriving at site

ARRIVAL AT SITE
- Notify plant and regulatory agency personnel
- Review test plans with all concerned
- Check weather forecasts
- Confirm process operation parameters in control room

SAMPLING FOR PARTICULATE EMISSIONS
- Carry equipment to sampling site
- Locate electrical connections
- Assemble equipment

DETERMINE APPROXIMATE MOLECULAR WEIGHT OF STACK GAS USING FYRITE AND NOMOGRAPHS

1


1
PRELIMINARY GAS VELOCITY TRAVERSE
- Attach thermocouple or thermometer to pitot probe assembly
- Calculate sample points from guidelines outlined BS3405 or BS6069
- Mark pitot probe
- Traverse duct for velocity profile
- Record Delta p's and temperature
- Record duct static pressure
APPROXIMATE H_2O VAPOUR CONTENT OF STACK GAS
RECORD ALL IFORMATION ON DATA SHEETS
- Sample case number
- Meter console number
- Probe length
- Barometer pressure
- Nozzle diameter
- C factor
- Assumed H_2O
- Team supervisor
- Observers present
- Train leak test rate
- General comments
- Initial DGM dial readings
USE NOMOGRAPH OR CALCULATOR TO SIZE NOZZLE AND DETERMINE C FACTOR
- Adjust for molecular weight and pitot tube C_p
- See K pitot point on monogrpah
LEAK TEST COMPLETELY ASSEMBLED SAMPLING TRAIN @ 15" Hg VACUUM AND MAXIMUM LEAK RATE OF 0.02 CFM
NOTIFY ALL CONCERNED THAT TEST IS ABOUT TO START
CONFIRM PROCESS OPERATING PARAMETERS
TAKE INTEGRATED SAMPLE OF STACK GAS FOR ORSAT ANALYSIS (OR PERFORM MULTIPLE FYRITE READINGS ACRESS DUCT)
ANALYSE STACK GAS FOR CONSTITUENT GASES
- Determine molecular weight
- CO2 and O2 concentration for F-factor calculation
START SOURCE TEST
- Record start time
- Record gas velocity
- Determine Delta H desired from nomograph
- Start pump and set orifice meter differential manometer to desired Delta H
- Record
1. Sample point
2. Time from zero
3. DGM dial reading
4. Desired Delta H
5. Actual Delta H
6. All temperatures DGM, stack sample case
- Maintain isokinetic Delta H at all times
- Repeat for all points on traverse
MONITOR PROCESS RATE
TAKE MATERIAL SAMPLES IF NECESSARY
TAKE CONTROL ROOM DATA
RECORD CLIMATICS
RECORD TEST PERSONNEL
AT CONCLUSION OF TEST RECORD
- Stop time - 24 hour clock
- Final DGM
- Any pertinent observations on sample
PREPARE OTHER TRAINS FOR REMAINING SAMPLING
LEAK TEST SAMPLE TRAIN
- Test at highest vacuum (in Hg) achieved during test
- Leak rate should not exceed 0.02 CFM
- Note locations of any leak if pssible
REPACK EQUIPMENT AFTER SAMPLING IS COMPLETED
REPEAT PRECEDING STEPS FOR THREE PARTICULATE SAMPLES
2

2

SAMPLE CLEAN-UP AND RECOVERY

- Clean samples in laboratory or other clean area removed from site and protected from the outdoors
- Note sample conditions
- Store samples in quality assurance containers
- Mark and label all samples
- Pack carefully for shipping if analysis is not done on site

ANALYSE SAMPLES

- Follow BS 13284-1, ISO 909:2003, EA, A1, A2, M1, M2 guidelines
- Document procedures and any variations employed
- Prepare analytical Report Data

CALCULATE

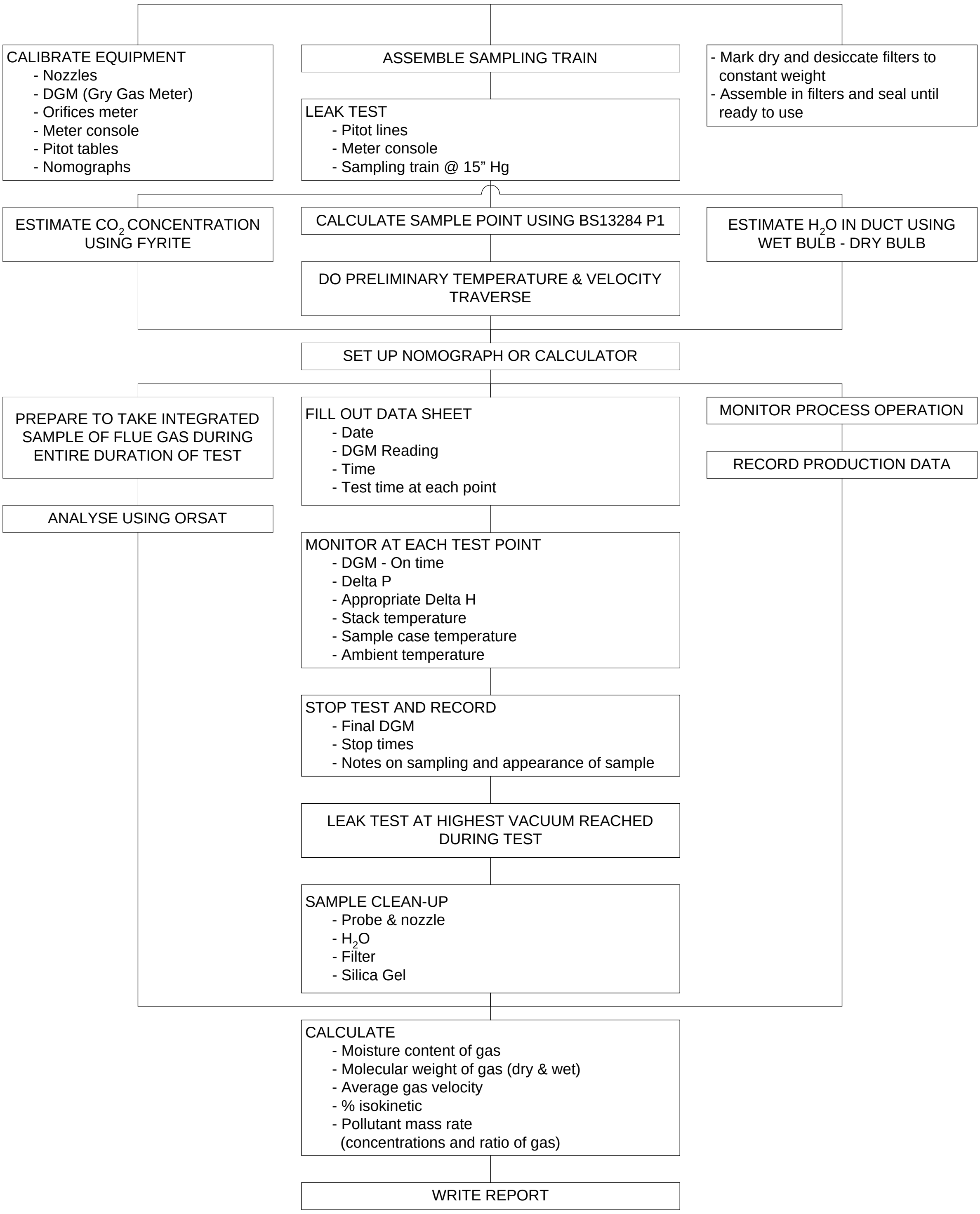
- Moisture content of stack gas
- Molecular weight of gas
- Volume sampled at standard conditions
- Concentration / standard volume
- Control device efficiency
- Volumetric flow rate of stack gas
- Calculate pollutant mass rate

WRITE REPORT

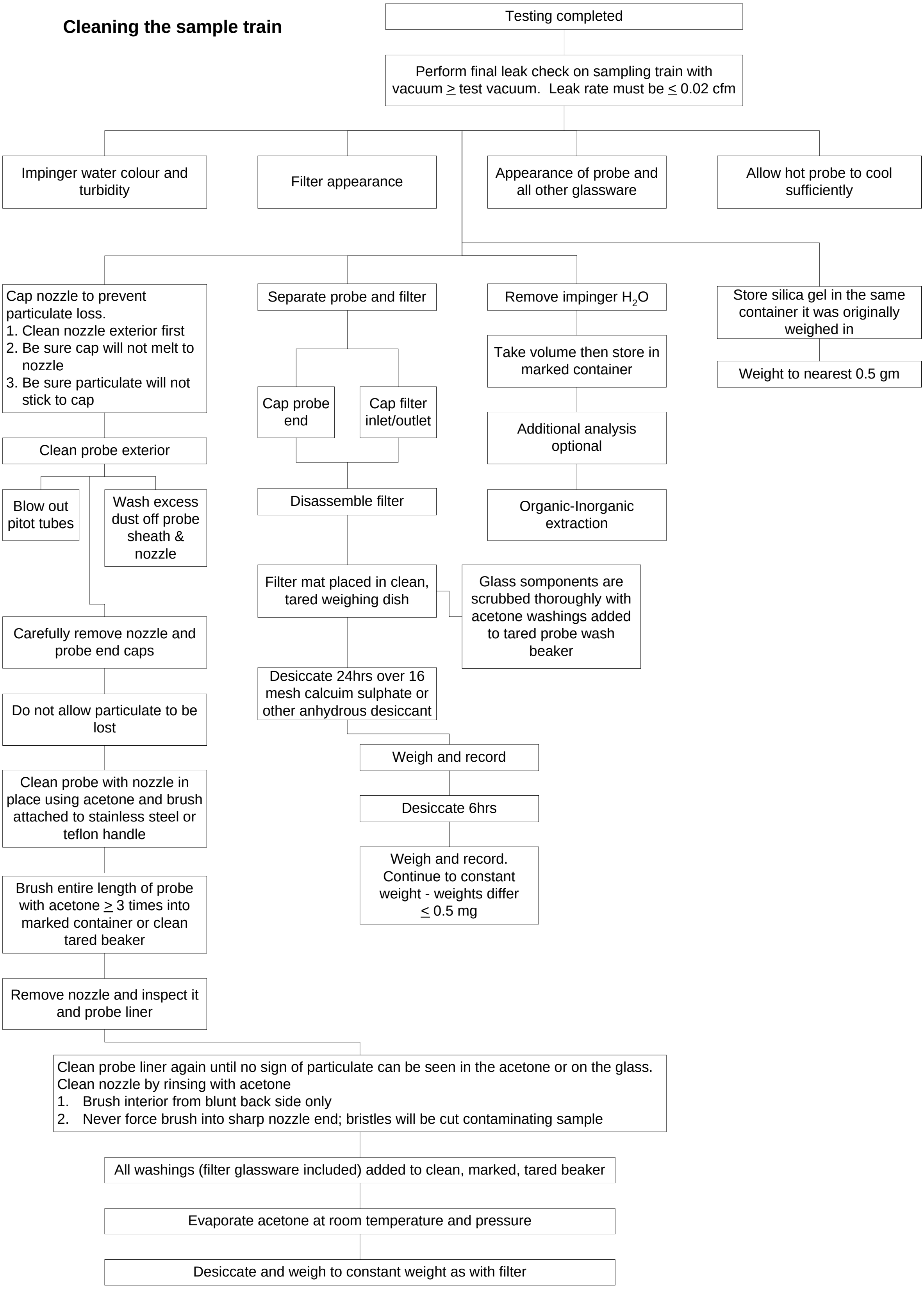
- Prepare as possible legal document
- Summarise results
- Illustrate calculations
- Give calculated results
- Include all raw data (process & test)
- Attach descriptions of testing and analytical methods
- Signature of analytical and test personnel

SEND REPORT WITHIN MAXIMUM TIME TO INTERESTED PARTIES

Source Test Outline



Cleaning the sample train



APPENDIX 2

INSTRUMENT CALIBRATION LOG

HALCYON ENVIRONMENTAL CALIBRATION RECORD LOG

	Doc. Ref:	CL001

No.	Equipment	Serial Number	Model	Date of Calibration	Certificate Number
01	Airflow Developments	114575	PVM 100	As per supplied certificate	IC1146P
02	Airflow Developments	-	BS 1042 Pitot Tube	As per supplied certificate	IC1147P
03	Eurotron Gas Analyser	00724899	3000 Professional	As per supplied certificate	JMW
04	Eurotron	00724899	Probe	As per supplied certificate	20615
05	PCE	150613856	PFM 2 Micro-manometer	As per supplied certificate	HE 15 / 1445
06	PCE	150613856	PFM BS 1042 Pitot Tube	As per supplied certificate	HE 15 / 1445
07	PCE	150613857	PFM 2 Micro-manometer	As per supplied certificate	HE 15 / 1446
08	PCE	150613857	PFM BS 1042 Pitot Tube	As per supplied certificate	HE 15 / 1446
09	Casella	-	High Flow Pump 1	As per supplied certificate	HE 15 / 1447
10	Casella	-	High Flow Pump 2	As per supplied certificate	HE 15 / 1448
11	Casella	-	High Flow Pump 3	As per supplied certificate	HE 15 / 1449
12	Casella	-	High Flow Pump 4	As per supplied certificate	HE 15 / 1450
13	SKC	22721	22549 Rotameter 0.300mls/min	As per supplied certificate	HE 15 / 1451
14	Airflow Developments	-	1m BS 1042 Pitot Tube	As per supplied certificate	HE 15 / 1452
15	Digitron with pitot and thermo micro anemometer	451097801	PM 80	As per supplied certificate	HE 15 / 1453
16	Testo	-	325 - 1	As per supplied certificate	HE 15 / 1454
17	Testo	-	325 - 1	As per supplied certificate	HE 15 / 1455
18	Bubble Meter	22806	Optiflow 420	Monthly	HE 15 / 1456

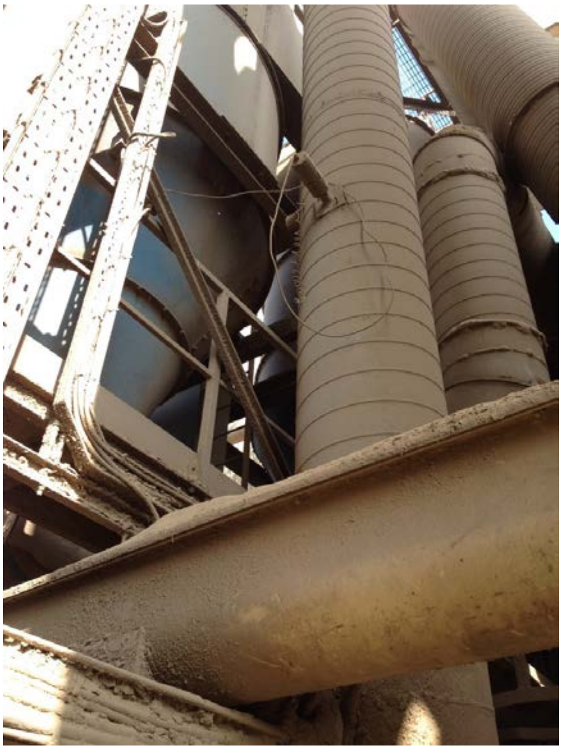
Issue Status:	*02*	*03*	*04*	*05*	*06*	*07*	*08*	*09*	*10*	*11*	12	**Compiled:**
Date of Issue	*10/2005*	*09/2006*	*12/2006*	*11/2007*	*12/2008*	*12/2009*	*12/2010*	*12/2011*	*12/2012*	*09/2013*	*12/2014*	*T Growcott*
Approved:												*Halcyon Environmental*

APPENDIX 3

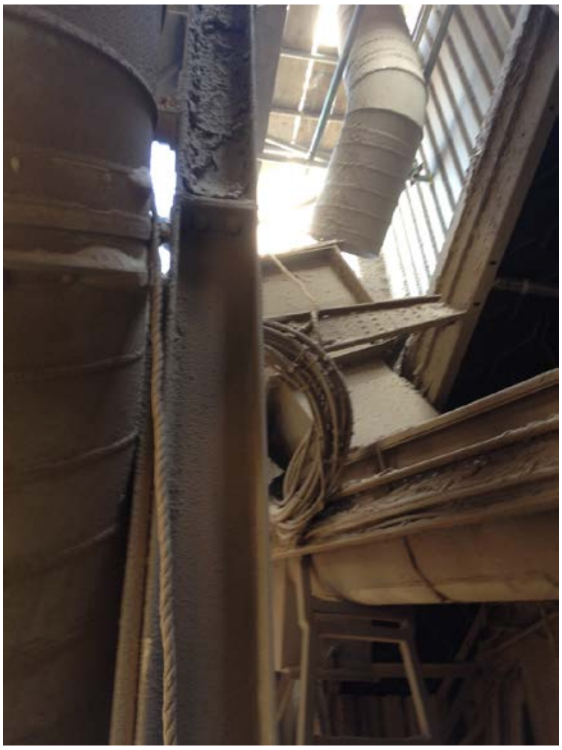
PHOTOGRAPHS

PHOTOGRAPH 1: S1 Dryer Plant Stack

PHOTOGRPH 2: S2 Cooler Plant Stack



PHOTOGRAPH 3: S3 BBF Plant



PHOTOGRAPH 4: S4 Tub 1 Filter Plant Stack

APPENDIX 4

STATEMENT OF COMPETENCY

Halcyon Environmental
27 Brunel Grove
The Woodlands
Perton
Wolverhampton
WV6 7YD

Mobile: 07779 008725

E-Mail: tim@halcyon-environmental.co.uk

Qualifications:
B Sc (Hons) Applied Chemistry
Member of the Royal Society of Chemistry MRSC
Chartered Chemist C.Chem
Chartered Scientist C.Sci
Member of the Institute of Metal Finishing (MIMF)
Member of the Source Testing Association (STA)
STA registration MM 03/314
Member of the American Chemical Society (MACS)

Current Position

Halcyon Environmental: Senior Partner

Responsible for the operation of a specialist environmental consultancy including sales and marketing, presentations, technical procedures, litigation protocol, analytical strategies and Environmental Management Systems Protocols.

Halcyon Environmental is a consultancy specifically committed to advise and support Industrial and Private Sector clients in achieving and effectively maintaining compliance with existing and new environmental legislation and is a member of the Metal Finishing Association and Surface Engineering Association.

Courses Attended

2011	Bruker; Introduction of Infra Red Spectroscopy	
2009	Lanyard Training and Working at Height – Kingfisher Access Course	
2008	STA M Certs Level 1 Training Course	
2008	STA M Certs TE3 Revision Training; Gases and Vapours by Extractive Manual Measurement	
2008	IEMA presentations	
	Introduction to the REACH Regulations	Rolls Royce Sinfin
	Introduction to the EUPD	Environment Agency
	Introduction to EPP	Environment Agency
2001/2/3/4/7/8	PCME; Total Particulate Monitoring – Isokinetic, Triboelectric, Tribostatic, Scintillation, Optical and CEM methods and systems	

2007	PCME; On Line, Real Time Monitoring and Calibration
2007	Environmental Compliance (ECL): An Introduction to BS 14181
2007	Environmental Compliance (ECL): Gas Monitoring Systems
2007	CBiss - Instrumental Continuous Gas Monitoring Applications
2006	PCME; Particulate Monitoring Techniques and Calibration Methods
2006	Turbidity Monitoring Techniques; Partech Instruments
2006	PCME; Dust Reporter 2 Software and Filter Management
2006	PCME; Improving OMA Score/ Interpreting Guidance Notes
2006	PCME; PMT in the Metal Industries – Case Studies
2006	MCERT for Effluent Monitoring; Partech Instruments
2005	PCME; – Continuous Particulate Monitoring Systems (CEMS)
2002	PCME; Optical and Probe based Technologies for Emission Monitoring
2002	PCME; CEMS Analyser Systems
2002	PCME / C Biss; Cross Duct, Heated Extractive and Drying Extractive Techniques and the requirements of CEMS Systems, MCERTS and OMA
2001	Disa An Introduction to Abatement Systems
2001	PCME Particulate Monitoring Solutions FMC
2001	PCME; Particle Velocity and Mass Monitoring Techniques FMC
2001	PCME; Ambient Monitoring Techniques FMC
2001	PCME; MCERTS and TUV Accreditation Schemes FMC
2000	PCME; Practical Demonstrations for TSP Pm and Pm 2.5 monitoring
2000	PCME; Monitoring of Suspended Solids in Gas Streams
2000	PCME; System Configuration and Reporting
2000	Servomex; The Continuous Monitoring of Gaseous Emissions
2000	PCME; Particulate Monitoring and the Workplace
1997	Air Pollution Standing Conference – NEC
1997	Monitoring as a Management Tool; SEC/ MFA Workshop
1997	FMEA to Design – Out Problems MFA / Ad – Qual Workshop
1997	Practical Application of Personal Protective Equipment – MFA / Racal Workshop

1997	Solid Wastes – A Finisher's Perspective; MFA
1997	Oven Temperature Control using Radio Telemetry; Grant Instruments
1997	Introduction to Air Sampling; SKC Ltd
1997	Profitability and the Monitoring and Control of Energy and Water; Marquis Associates
1996	European Perspectives on Environmental Best Practice; ERM
1996	Regulatory Developments in the UK WM Hazardous Waste Unit
1996	Thermal Sand Reclamation – Economic Drivers Towards Installation, Landfill Tax and its Consequences; Thermofire
1996	Metal Screen Filters as a Candidate for Best Practice; Air Filters
1996	Ceramic Filters and Secondary Metal Processing; Withers Metals
1996	Environmental Technology Best Practice Programme; ETSU
1996	Accounting for Environmental Performance; MRC
1996	Principle and Practice of Waste Management; Wedge Holdings
1996	The Waste Minimisation Agenda; UOW Workshop
1995	Air Pollution Standing Conference; NEC
1994	Eurosafe - Personal Protective Equipment; Assessing Needs and Choice
1994	GEC A Practical Approach to Health and Safety Management
1994	MOHS – Health Surveillance
1994	Government Policy Towards Business and the Environment – MFA Conference
1994	Engineering Industry and Environmental Pressure – MFA Conference /EEF
1994	Is BS 7750 Relevant to Metal Finishing; MFA Workshop
1994	EPA and the Metal Finishing Sector; MFA Workshop
1994	Environmental Management; Practical Implementation and Action; Business Link
1993	Environmental Education - WALCAT Workshop
1991	Clean Air Engineering: Environmental Source Monitoring
1991	Clean Air Engineering: Isokinetic Emission Monitoring
1991	SGS - Sports Ground Services – Introduction to Barrier Testing
1991	SGS - Hillsborough Barrier Enquiry – Measurement and Reporting
1991	SGS "Green Dove - EMS Sales Strategy"

1990	SGS "Principles of International Trade"
1990	SGS "Sales and Marketing - Value Added Strategies"
1990	SGS Yarsley "TQM Principles and Practices"
1990	SGS “Principles of Environmental Auditing ”module 1”
1990	SGS “BS 5750 Auditing Protocols”
1990	SGS “Introduction to the Green Dove Strategy”
1990	SGS "BS 5750 Management Systems; Planned strategy"
1990	SGS Principles of Environmental Auditing “module 2”
1990	SGS CoSHH LEV Regulation 9.2 Inspection and Testing
1990	SGS -Statutory Inspection and Testing of LEVs (In house course)
1990	SGS - Principles of Cargo Full Out Turn Guarantee (FOG)
1990	SGS - Analysis of Fragrances and Perfumes
1990	SGS - Perfumes; Olfactory Odour Analysis
1989	SGS/Polymer Laboratories - Method derivation for the analysis of perfume samples
1989	SGS/Dyson - Method derivation for the analysis of perfume samples
1989	SGS - Method derivation for the olfactory analysis of perfume and fragrance samples
1989	SGS - Method derivation for the reporting of olfactory assessment of perfume and fragrance samples
1990	SGS - Analysis of Precious and Semi - Precious Metals (London Metals Exchange)
1990	SGS - Analysis of Gold and its alloys (London Metals Exchange)
1990	SGS - Analysis of Heavy Metals (Toy Testing Division)
1990	SGS - Analysis of Heavy Metals (Soil Testing)
1990	SGS - Analysis of Water Samples (Soil and Groundwater Testing)
1990	SGS - Litigation and International Liability - Perfume Fraud Investigations
1990	SGS - Analysis of Fuels (Aviation and Automotive)
1990	SGS - Vehicle Repair Centres; EPA Support and Monitoring
1990	SGS - Analysis of Cements and Concrete Testing
1990	SGS - Principles of Calibration and Metrology
1989	BASF - Source Testing

1989	BASF International Analytical Conference
1989	BASF - Principles of LIMS
1989	BASF - Selective Ion Electrode Analytical Methods
1989	BASF - HPLC Analytical Methods
1989	BASF - Gas Chromatography Analytical Methods; Column Selection
1989	BASF - Gas Chromatography Analytical Methods; Calibration
1989	BASF - Gas Chromatography Analytical Methods; Detector Selection
1989	BASF - Gas Chromatography Analytical Methods; Principles of Integration
1989	BASF - Infra Red Spectroscopy Analytical Methods
1989	BASF - Measurement of Molecular Weight Distribution by HPLC
1989	BASF/Polymer Laboratories – Method derivation for the analysis of acrylic resins; column selection and analytical methodology
1989	BASF/polymer laboratories – Knauer Instrumentation familiarisation
1989	BASF/Casella Environmental Monitoring Methods; Selection of Absorption Media
1989	BASF/Casella Environmental Monitoring Methods; Pumped and Passive sampling
1989	BASF/Casella – Field sampling of Acrylate Monomers
1989	BASF/Casella – Method derivation for the analysis of airborne Acrylate Monomers and Pre-polymers
1989	BASF/Casella – Method derivation for the analysis of airborne solvents
1989	BASF/Casella – Method derivation for the analysis of airborne Isocyanate Monomers and Pre-polymers
1989	BASF/Casella – Method derivation for the analysis of airborne Urethane Monomers and Pre-polymers
1989	BASF - Method derivation for the analysis of Polysiloxane Pre-polymers
1989	BASF - Method derivation for the analysis of Rolls Royce Paint and subsequent solvent adjustments
1989	BASF - Method derivation for the analysis of Vauxhall Motors Paint and subsequent solvent adjustments
1989	BASF - Method derivation for the analysis of Ford Motor Company Paint and subsequent solvent adjustments
1989	BASF - Method derivation for the analysis of Can Coating solvent / odour emissions
1989	BASF - Method derivation for the analysis of electrophoretic oven emissions

1989	BASF - Method derivation for the analysis of DETA/TETA electrophoretic solvent analysis and subsequent solvent adjustments
1989	BASF/Casella - Method derivation for the analysis of BL paints – site based
1989	BASF/Casella - Reporting of Environmental Emissions
1989	BASF/Perkin Elmer – GC/FID/ECD systems familarisation
1988	Qualified First Aider CPR Procedures
1986	Management and Motivation
1980	BASF/ Paint Research Association: Paint Formulation
1980	Wilkins and Mitchell/PPJ – Paint Management and Process Optimisation
1980	Wilkins and Mitchell/ICI VDU Management and Process Optimisation
1980	Wilkins and Mitchell/Tecalamit – Paint Management and Process Optimisation
1979	Wolverhampton Polytechnic: Advanced Analytical Procedures

Recent Awards, Presentations And Publications

2012	Alwin Metals ISO 14001 and 9001 – 2008 support
2010	Sealine International ISO 14001 support
2009	Coram Showers ISO 14001 support
2009	Kaby Engineers Ltd ISO 14001 support
2008	Road Show Speaker – West Bromwich Albion; REACH and its Implications
2007	Williams Alloys and Residues – support to ISO 14001
2006 – 2009	Monthly contributor to Corporate Times
2006	SEA meeting; House of Lords
2006	PCME Road Show Speaker – Ricoh Stadium
2005	Tonge & Taylor ISO 14001
2003	Calcast Limited ISO 14001
2003	C E Marshall (Wolverhampton) Ltd ISO 14001
2003	PCME Road Show Speaker; Celtic SFC
2002	Speaker – Cortec Seminar, University of Coventry – An Introduction to IPPC
2002	PCME Road Show Speaker; Manchester United FC
2002	Kings Triplex Holdings – ISO 14001

2001/4	PCME Road Show – Monitoring of Particulates – Workplace and Environment
2001	Lanstar ISO 14001
2001	Lanstar ; Introduction to the Principles of Gas Chromatography
2001	Yale Security Products UK Ltd – ISO 14001
2001	Oldbury Aluminium Alloys Ltd. – ISO 14001
1998	World Metals Congress - Budapest. First 10 ISO 14001 foundries - Consultancy support to Transtec Group.
1998	Transtec Group - ISO 14001 - Birmingham, Droitwich, Llanidloes.
1998	Johnson Controls - ISO 14001 - Silloth and Wednesbury.
1998	MPL- Key Group - 1st Plastic Moulder to ISO14001 - Tamworth.
1998	MFA - Waste management and minimisation seminar.
1998	ISO 14001 -The Environmental Standard - BLB.
1997	JRI Technologies - 1st. Foam producer to ISO 14001.
1995	BS 7750 - A practical guide to compliance. Various industrial sites.
1995	"Environmental by Design" - fundamentals of design strategy seminars
1995	“Design for Disassembly” - fundamentals of product recycling and reuse.
1995	“Product Finite Life Analysis - Environmental Aspects” - GEC Group.
1995	Wolverhampton Centre of Engineering Excellence: "Safe usage, storage, handling and disposal of industrial liquids" seminars.
1995	Wolverhampton Centre of Engineering Excellence: EPA "Directors in the Dock" seminars.
1994	Wolverhampton Centre of Engineering Excellence: EPA Awareness workshop training.
1994	BLB: Practical Environmental Management.
1994	Birmingham Chamber of Commerce: EHS Management.
1994	Speaker - MPS “Environmental Awareness” Seminars.
1994	Inst. Elec. Engineers: EPA Evening presentation.
1994	Inst. Met. Finishing: Instrumentation and Capability.
1992	Metal Finishing Association: EPA Awareness Seminars.
1994	Transactions on the Inst. Met. Finishing: EHS legislation, effects on the M F Industry - Annual Technical Conference article.

1992 Ceramic Industries International: "Not Entailing Excessive Cost" EPA article.

Career Resume

Tim Growcott is the Senior Partner in Halcyon Environmental, a UK based consultancy, which specialises in Environmental Consulting Services. The consultancy works with around 500 company customers, from engineering to chemical specialists, foam and plastic users, MOD and RAF site's and specialist operators.

Trained formally as an Industrial Chemist, he has worked with companies including Mander Brothers in paints, BL Heavy Vehicles Division at Guy Motors in heavy vehicle manufacturing and Wilkins & Mitchell in domestic appliance manufacturing.

Latterly he worked with the Inmont Corporation and BASF in automotive and printing industry coatings development, and SGS in specialist environmental roles, undertaking diverse environmental issues including sales, marketing, site investigation work, litigation and liability, the development of environmental systems including EN ISO 14001.

Halcyon has undertaken specific and broad spectrum environmental issues with regard to environmental compliance, forward business environmental planning, and cradle to grave strategies that include environmental significance in product design and manufacturing, product finite life analysis, design for disassembly and renewable and recyclable resources.

Halcyon was recognised by the World Metal Congress, held in Budapest in achieving EN ISO 14001 with one of its customers as one of the world's first 10 foundries to achieve the standard.

Halcyon personnel have supported the recent transfer of business from the mainland UK to Bulgaria and are developing business in Portugal.