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Stack Emissions Testing Report

Total Particulate Matter
Chlorides

Clarksteel Galvanising Limited

Yaxley

Galvanising Plant

Test Date	14th February 1997
Report by	Gareth Bond
Checked by	Caroline Charlton
Authorised by	Alastair Wolff

Job No ENV 690

Contents

Introduction

Clarksteel Galvanising Limited operate a Galvanising Process at Station Road, Yaxley which is subject to Local Authority Air Pollution Control under the Environmental Protection Act 1990.

Labtek Environmental Limited were commissioned by PCME Limited to carry out stack emissions testing to determine the releases of total particulate matter and chlorides from the following Plant under normal operating conditions.

This emissions test is part of the calibration service offered by PCME Limited in support of their continuous emissions monitor which is installed at the emissions point.

Company	Clarksteel Galvanising Limited
Site	Yaxley
Stack	Galvanising Plant
Test Date	14th February 1997
Time Sampling Started	10:59
Time Sampling Ended	13:05
Process	Hot Dip Galvanising Processes
Guidance Note	PG 2/2 (96)
Abatement Plant	Bag Filter
Materials Processed	Miscellaneous Steelwork
Operating Conditions	20 Tonnes per Day

Throughout sampling, the operating conditions were maintained as above.
Any deviations from BS 3405 : 1983 are noted in the conclusion.

Emissions Summary

Company	Clarksteel Galvanising Limited
Site	Yaxley
Date	14th February 1997
Time Sampling Started	10:59
Time Sampling Ended	13:05
Stack	Galvanising Plant

Parameter	Units	Result	Limit	Outcome
Total Particulate Matter	mg/m^3	5.72	15	Passed
Particulate Emission Rate	g/s	0.025	-	-
Chlorides	mg/m^3	1.16	30	Passed
Stack Gas Temperature	°C	23	-	-
Stack Gas Volumetric Flow Rate	m^3/hr	16220	-	-
Stack Gas Velocity	m/s	18.3	-	-

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

Written Summary

Total Particulate Matter	Passed

Two particulate tests were performed during continuous operating conditions. The mean sampling time was 28 minutes. The mean particulate concentration was 5.72 mg/m^3 at reference conditions. This value is below the emission limit of 15 mg/m^3 specified in PG 2/2 (96) The tests were performed in accordance with the main procedural requirements of BS 3405 : 1983 using a Ströhlein STE 4 isokinetic particulate sampling train.

Chlorides	Passed

Two tests were performed during continuous operating conditions. The mean sampling time was 30.5 minutes. The mean chlorides (as hydrogen chloride excluding particulate matter) concentration was 1.16 mg/m3 at reference conditions. This value is below the emission limit of 30 mg/m^3 specified in PG 2/2 (96) The tests were performed using a glass probe and impinger collection containing 0.1N NaOH solution with analysis by ion chromatography in a NAMAS accredited laboratory.

Total Particulate Matter Summary

Sample	Sampling Times	Concentration (mg/m^3)	Limit (mg/m^3)
Run 1	10:59 - 11:25	6.71	-
Run 2	12:30 - 13:05	4.73	-
Mean Particulate Concentration		5.72	15

Sample	Sampling Times	Emission Rate (g/s)	Ratio of Particulate Emission Rates
Run 1	10:59 - 11:25	0.030	-
Run 2	12:30 - 13:05	0.020	-
Mean Particulate Emission Rate		0.025	1.47 : 1

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

Chlorides Summary

HCl	Lab Result (ug)	Volume Sampled (m^3)	Concentration (mg/m^3)	Limit (mg/m^3)
Run 1	80	0.09	0.939	-
Run 2	75	0.05	1.386	-
Mean HCl Concentration		-	1.163	30

The chlorides concentrations are expressed as hydrogen chloride excluding particulate matter.

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

Calculations Run 1

1. Stack Gas Velocity

$V = 0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$

V = Velocity (m/s)
Cp = Pitot Tube Calibration Coefficient
ΔP = Mean Differential Pressure (Pa)
T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	18.65 m/s
Stack Diameter (D)	0.57 m
Stack Area (A)	0.26 m^2
Stack Temperature (T)	296.00 K
Atmospheric Pressure (P_A)	101.90 kPa
Static Pressure (P_{St})	-0.03 kPa
Standard Barometric Pressure (P_B)	101.30 kPa

$$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A \qquad Q_{(actual)} = V \times A$$

$Q_{(STP)}$ = 4.42 m^3/s **$Q_{(actual)}$ = 4.76 m^3/s**

3. Cumulative Sampling Mass Emission (M)

No. Sampling Points (n)	4
Duration at each point (s)	360 s
Nozzle area (a)	50.27 mm^2
Particulate Mass (m)	0.0084 gms
Stack Area (A)	0.26 m^2

$$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6 = 3.0E\text{-}02 \text{ g/s}$$

M = 0.030 g/s

4. Particulate Concentration (C) at 273K, 101.3kPa

$C = (M / Q) \times 1000$

C = 6.71 mg/m^3

Calculations Run 2

1. Stack Gas Velocity

$V = 0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$

V = Velocity (m/s)
Cp = Pitot Tube Calibration Coefficient
ΔP = Mean Differential Pressure (Pa)
T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	17.96 m/s
Stack Diameter (D)	0.57 m
Stack Area (A)	0.26 m^2
Stack Temperature (T)	296.00 K
Atmospheric Pressure (P_A)	101.90 kPa
Static Pressure (P_{St})	-0.03 kPa
Standard Barometric Pressure (P_B)	101.30 kPa

$$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St}) \times V \times A}{P_B} \qquad Q_{(actual)} = V \times A$$

$Q_{(STP)}$ = 4.25 m^3/s **$Q_{(actual)}$ = 4.58 m^3/s**

3. Cumulative Sampling Mass Emission (M)

No. Sampling Points (n)	4
Duration at each point (s)	480 s
Nozzle area (a)	50.27 mm^2
Particulate Mass (m)	0.0076 gms
Stack Area (A)	0.26 m^2

$$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6 = 2.0E\text{-}02 \text{ g/s}$$

M = 0.020 g/s

4. Particulate Concentration (C) at 273K, 101.3kPa

$C = (M / Q) \times 1000$

C = 4.73 mg/m^3

Total Particulate Matter Sampling Methodology

Checks Carried Out Before Arrival On Site

Filter Preparation

The particulate filter sleeves to be used are cleaned, dried and then packed with glass wool (or quartz wool for temperatures above 600 °C). The filters are then cooled in a desiccator and weighed as soon as is practical. They are weighed on a 4-figure balance (accurate to ± 0.1 mg).

The filters are placed in individual self-contained glass containers and are transported on site in a filter box. Spare filters are also prepared in case of accidents.

Isokinetic particulate measuring equipment

The STE4, isokinetic particulate measuring equipment, is cleaned and checked for any obvious flaws before use. The silicon and rubber tubing are checked for any damage and the filter head and nozzles are cleaned.

Pitot Tube and Gauge

The pitot tube is checked for any flaws, such as blockages and damaged heads. The gas velocity gauge is examined to check whether the inlet holes are blocked. The power supply of the gauge is checked and the instrument's zero point adjusted if necessary. The connection tubes from the pitot tube to the gauge are checked for any holes and are taped together to avoid any false reading due to differential temperatures.

Thermocouple

The temperature is measured using a K type thermocouple which is externally checked for any faults before use. The thermocouple and display unit are calibrated quarterly. The power supply is checked before use.

Sampling Procedure On Site

A stainless steel rod is used to measure the internal diameter of the stack. The diameter (D) is entered into a palmtop computer and the specific monitoring points are calculated using the following equations : 0.15 * D and 0.85 * D for circular stacks and 0.25 * D and 0.75 * D for square stacks, for 4 point sampling.

The pitot tube is used to carry out a preliminary survey of the stack. Dynamic pressure is measured at 10 points along the proposed sampling plane. If the highest to lowest dynamic pressure ratio exceeds 9:1 or if the gas velocity highest to lowest exceeds 3:1 another sampling plane should be used.

Temperature is measured at 10 points along the sampling plane and an average temperature calculated. If the temperature at any of the sampling points differs by more than 10% to that of the average temperature, then the point will not be used.

The pitot tube is blown down to remove any dust particles. The connection tubes are then fastened from the pitot tube to the gauge via non-return valves. Dynamic pressure, static pressure and temperature readings are taken at the appropriate sample points.

This information is entered into the palmtop computer, where local and average velocity calculations are made.

From the velocity calculation, the appropriate nozzle size and volumetric flow rate (suction) are determined to ensure true isokinetic sampling.

The nozzle is then attached to the STE4 and filter sleeve inserted. Before the first sampling run can be performed, a leak check is carried out.

The STE4`s sampling probe is then placed securely in the stack at a right angle to the direction of the gas flow and positioned at the first calculated monitoring point. The probe is left (without suction) for about 5 minutes to attain the stack temperature

With the air by-pass control valve fully open, the suction pump is switched on and the flow rate set to the required level for sampling. The time of sampling is recorded. The probe is moved to position 2 after a designated time interval.

Once sampling is completed, the filter sleeve is removed from the filter head and placed in it's glass filter container. The dynamic pressure and temperature at each of the sampling points are then measured.

A new filter is placed within the filter head and the sampling procedure is repeated as above in order to collect a second sample.

On Site Isokinetic Data Sheet

Preliminary Stack Survey		Sampling Line A		Sampling Line B	
Traverse Point	Distance in Stack (m)	Dynamic ressure (Pa	Temperature (°C)	Dynamic ressure (Pa	Temperature (°C)
1	0.05	162	23	201	23
2	0.10	205	23	262	23
3	0.16	246	23	277	23
4	0.21	250	23	275	23
5	0.26	258	23	279	23
6	0.31	311	23	297	23
7	0.36	337	23	331	23
8	0.41	370	23	350	23
9	0.47	378	23	357	23
10	0.52	344	23	320	23

Lowest Dynamic Pressure (any line) 162 Ratio of Above 2.3 : 1

Highest Dynamic Pressure (any line) 378 (Highest permitted ratio 9:1)

Temperature Range permitted for any point is betwe -7 to 53 °C.

Run 1		Sampling Time (mins)		24	Nozzle size used (mm)		8
Sampling Point	Dynamic Initial (Pa)	Pressure Final (Pa)	Temp Initial (°C)	Temp Final (°C)	Velocity Initial (m/s)	Velocity Final (m/s)	Flowmeter set at (%)
1	205	201	23	23	15.52	15.37	69
2	378	340	23	23	21.07	19.99	93
3	262	238	23	23	17.54	16.72	77
4	357	332	23	23	20.48	19.75	90
Average	301	278	23	23	18.65	17.96	82

Difference between Initial Velocity and Final Velocity -3.89 % (Limit permitted is + 5%)

Start Filter Weight = 1.0257 g Sample Weight = 0.0084 g

End Filter Weight = 1.0341 g Sample as % of Filter Weight = 0.819 %

Run 2		Sampling Time (mins)		32	Nozzle size used (mm)		8
Sampling Point	Dynamic Initial (Pa)	Pressure Final (Pa)	Temp Initial (°C)	Temp Final (°C)	Velocity Initial (m/s)	Velocity Final (m/s)	Flowmeter set at (%)
1	201	210	23	23	15.37	15.71	68
2	340	354	23	23	19.99	20.39	88
3	238	247	23	23	16.72	17.03	74
4	332	349	23	23	19.75	20.25	87
Average	278	290	23	23	17.96	18.35	79

Difference between Initial Velocity and Final Velocity 2.13 % (Limit permitted is + 5%)

Start Filter Weight = 0.9556 g Sample Weight = 0.0076 g

End Filter Weight = 0.9632 g Sample as % of Filter Weight = 0.795 %

Chlorides Sampling Methodology

The concentration of chlorides (as hydrogen chloride excluding particulate matter) in the stack gas is determined using a wet chemistry technique.

The sampling train used consists of the following:

- An in stack glass wool filter with a particulate efficiency of > 20 microns.

- A series of 3 mini glass impingers with ball and socket joints which are made fully airtight with silicon grease.

- The first impinger is left empty for condensate the second two contain 0.1N NaOH (prepared at a NAMAS accredited laboratory).

- A dry gas meter to record the volume of air sampled. The air temperature entering the meter and the vacuum pressure of the meter are measured and used to correct the volume sampled to standard conditions. The vacuum pressure gauge used has a NAMAS accredited calibration certificate and the thermocouple is tested regularly against a NAMAS accredited calibrated thermometer.

- A 110 volt pump sucking at a rate of 3 m^3 per hour which is set to the required flow rate by a control valve, as determined by site conditions.

At Labtek all equipment is checked and cleaned prior to arrival on site. The impingers are cleaned with de-ionised water and the samples placed in sterile containers which are provided by a NAMAS accredited laboratory.

Two samples are taken along with an additional sample of solution which is used to determine the blank value of the solution. These are analysed in a NAMAS accredited laboratory by ion chromatography.

Actual Volume Sampled:

Measured Volume Sampled (m^3) • Standard Temperature (273 K) / Temperature at the Gas Meter (K) • Absolute Pressure (kPa) / Standard Pressure (kPa)

Quality Assurance Check List

Velocity Measurements:

Water droplets were not present. ✓

Direction of gas flow within ± 20° of stack axis. ✓

Total Particulate Matter:

Sampling plane correctly positioned. ✓

Sampling from centres of equal areas. ✓

Sampling at each point not less than 3 minutes. ✓

Constant 'as' during cumulative sampling. ✓

Direction of gas flow within ± 20° of stack axis. ✓

Isokinetic flow maintained during sampling. ✓

Leak check performed after each run and passed. ✓

Sample Handling:

Samples achieved stable weights. ✓

Sample weights > 0.3% of filter weights. ✓

Particulate samples stored for 3 months ✓

QA Procedures:

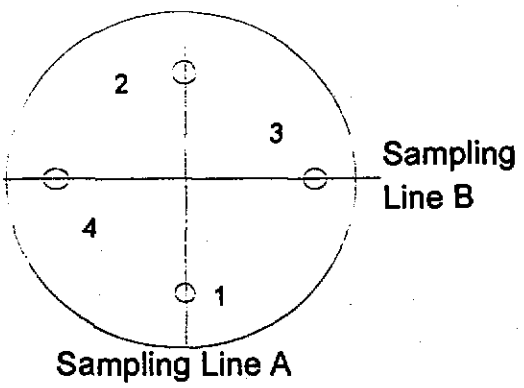
File saved to disk. ✓

Hard copy made. ✓

Isokinetic data sheet filed. ✓

Signed Gareth Bond
Team Leader

Stack Diagram

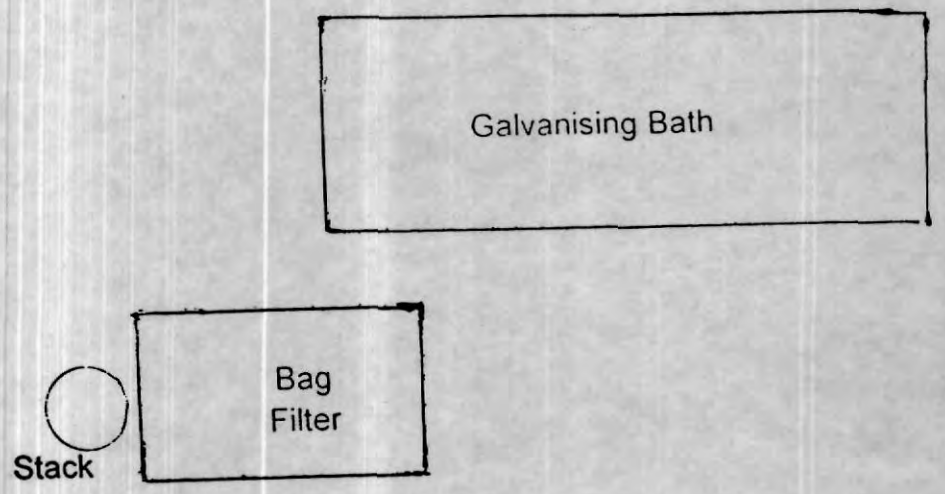


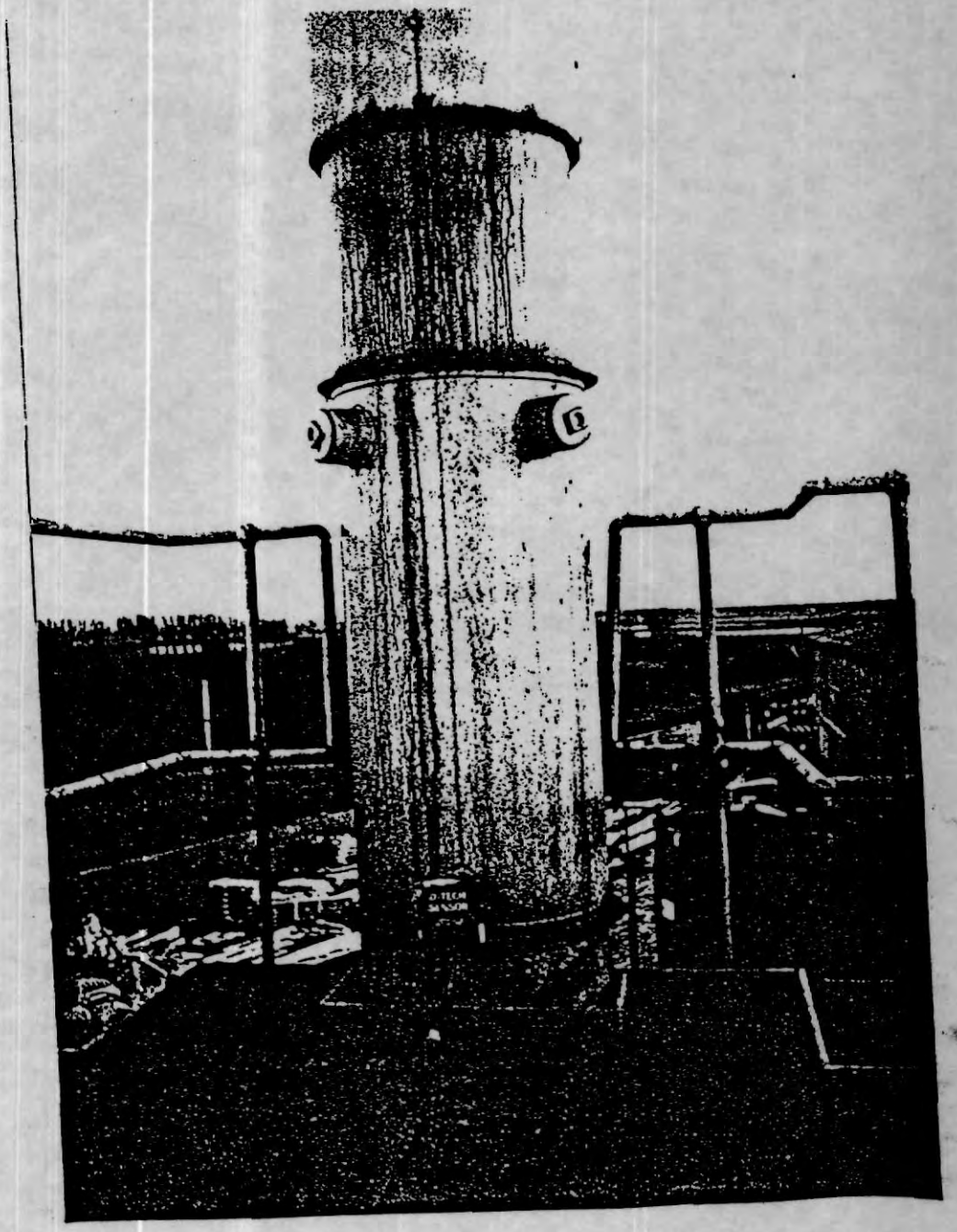
Stack Diameter (D) = 0.57 m

Stack Area = 0.26 m^2

Sampling Point	Distance as % of d	Distance in m
1	15	0.09
2	85	0.48
3	15	0.09
4	85	0.48

Plant Layout





Environmental Monitoring Team

Environmental Team Leader	Gareth Bond BSc. (Hons.) Applied Geology AEA Technology - Level 2 Isokinetic Sampling Engineer
Environmental Technician	Adam Crowe BSc. (Hons.) Environmental Biology Msc. Aquatic Resource Management

Report by Gareth Bond Signed

Checked by Caroline Charlton Signed

Authorised by Alastair Wolff Signed

Conclusion

The results of these tests demonstrate that under normal operating conditions, this Plant is being operated in full compliance with both the total particulate matter and chlorides emission limits specified in its Local Authority 'Part B' Process Authorisation.

Testing was fully in accordance with the main procedural requirements of BS 3405 : 1983.

Good housekeeping and maintenance of the ducting and abatement plant should be maintained to continue this level of Plant performance.

A regular programme of stack emissions testing in accordance with the Process Authorisation will be required to demonstrate continued compliance.

INSTRUMENT CALIBRATION REPORT

Company CLARKSTEEL GALVANISING LTD Date of Sampling 14th FEBRUARY
Site Address: YAXLEY Job Number:

Plant Identification: GALVANISING PLANT Disc/File Reference:
Test Carried Out By: GB / AC

Instrument Settings During Sample Instrument: DT 160 Channel #:

DT-770/SC-600

Instrument Checks: PASS / FAIL
Correct Time:
Sensitivity:
Old Cal factor:
in use during sampling:
Flow Compensation: ON / OFF
O2 Compensation: ON / OFF

DT-200

Coarse Gain Position:
Fine Gain Display:
Filter Position:
Coarse Gain:
Fine Gain:

Instrument Results

Run	Start Time	Finish Time	Duration (mins)	Instrument Average (Y)	Instrument Max	Dust Cone mg/m³ (X)
1	10:59	11:25	24			6.71
2	12:30	13:05	32			4.73
3						
4						
Time Weighted Average	———	———	———		———	5.72

Calibration Calculations

X (from Iso test) =
Y (Inst response) =

Scaling factor = $\frac{X}{Y}$ = ——— =

Gain New Cal Factor = scaling factor x Gain Old Cal Factor

=

Instrument Settings for Calibration

DT-770/SC-600

Cal Factor:

DT-200

CG Position:
FG Display:
Coarse Gain:
Fine Gain: