



ASSESSMENT OF ERROR DUE TO ORIFICE DIAMETER MIS-MEASUREMENT AT WESTON POINT MTB

A Report for

**National Grid
Brick Kiln Street
HINCKLEY
Leicestershire
LE10 0NA**

PROJECT NO: NGR010

REPORT NO: 2010/287

DATE: 18 AUGUST 2010



This report is issued as part of the contract under which the work has been carried out for the client.

NOTES

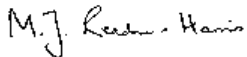
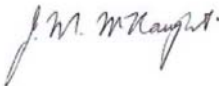
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A Report for

**National Grid
Brick Kiln Street
HINCKLEY
Leicestershire
LE10 0NA**

Prepared by: 	Approved by: 
Dr M J Reader-Harris	J M McNaught

for
Michael Valente
Managing Director

Date: 18 August 2010

EXECUTIVE SUMMARY

Owing to a mis-measurement of orifice diameters flows have been mis-measured at affected offtakes connected to the National Transmission System. This project has been undertaken to resolve these errors.

At Weston Point MTB a correction factor of 1.002371 should be applied during the period of mis-measurement.

Over the period 21/09/2007 to 26/09/2008 inclusive the flow was 112.13422 mscm and the corrected flow should be 112.39902 mscm.

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1 INTRODUCTION

Owing to a mis-measurement of orifice diameters flows have been mis-measured at affected offtakes connected to the National Transmission System. This project has been undertaken to resolve these errors. This report covers the flow through Weston Point MTB in the period of the error. The Joint Office Error Code is NW008.

2 ORIFICE DIAMETERS

The calibrations of the orifice plates in question gave the measured diameters shown in Table 1. The diameters at 20 °C have been calculated. The effective bores include the effect of a drain hole to BS ISO/TR 15377:1998.

**TABLE 1
ORIFICE DIAMETERS**

Calibration Reference	Plate serial no	Declared certificate date	Measured values			Values at 20 °C	
			Orifice bore (mm)	Effective bore (mm)	Temperature	Orifice bore (mm)	Effective bore (mm)
OP4171	216-3	10/01/05	161.967	162.1042	21	161.9644	162.1016
OP5061	216-4	08/04/05	162.265		21	162.2624	
OP60027	216-4	21/02/06	162.269		21	162.2664	
OP60060	216-3	11/10/06	161.9735	162.1111	20	161.9735	162.1111
OP70056	216-4	07/06/07	162.095		21	162.0924	
OP80008	216-2	03/03/08	161.9405	162.0795	20	161.9405	162.0795
OP80048	216-3	08/08/08	161.9765	162.1145	20	161.9765	162.1145
OP80071	216-4	29/10/08	162.2655	162.1042	20.4	162.2645	

Figure 1 shows the data from Table 1 for the orifice bores at 20°C. This figure shows that there is a reduction in measured diameter followed by a recovery. The deduction from this graph is that a plate was mis-measured.

The calibration certificates for the orifice plates are given as Appendix A.

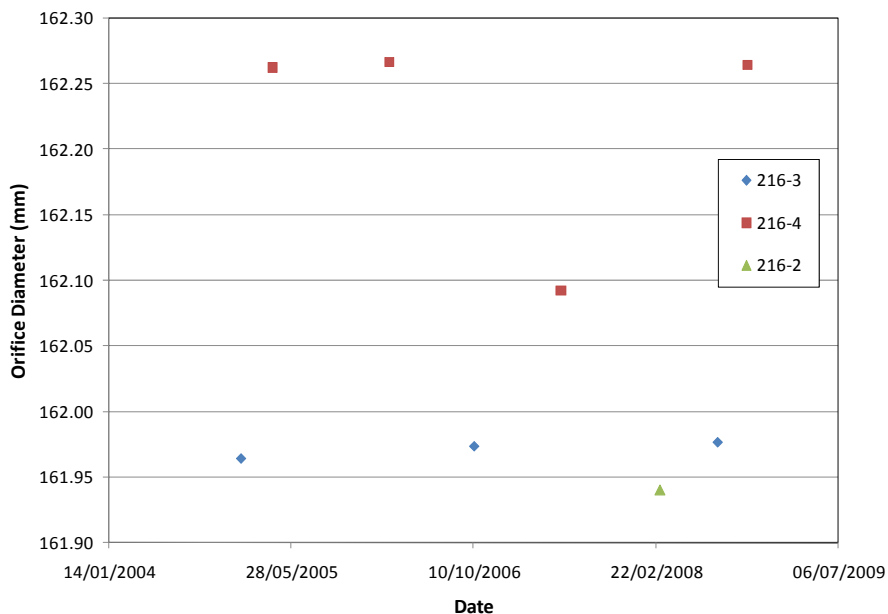


Figure 1 Orifice Diameters at 20 °C

The plates actually used in each of the two meter tubes are given in Table 2.

TABLE 2
PLATES USED IN EACH LINE AS CONFIGURED BY FLOW COMPUTER

Configuration data	omnM0918.cfg	omnM0921.cfg	omnN0922.cfg	omnN0926.cfg
MTB	18/09/2007 23:01	21/09/2007 23:01	22/09/2008 23:01	26/09/2008 23:01
Orifice plate bore diameter (mm)	161.9735	162.095	162.095	162.0795
Expansion coefficient of the plate (°C)	0.000016	0.000016	0.000016	0.000016
Orifice plate calibration temperature	20	21	21	20
Meter tube diameter (mm)	288.7663	288.7663	288.7663	288.7663
Expansion coefficient of the meter tube (°C)	0.000011	0.000011	0.000011	0.000011
Meter tube calibration temperature	20	20	20	20
Isentropic Exponent	1.339	1.339	1.3417	1.3417
Dynamic Viscosity (Pa.s)	0.000012	0.000012	0.000012	0.000012
Orifice plate certificate number	OP60060	OP70056	OP70056	OP80008
Orifice plate serial number	216-3	216-4	216-4	216-2
Error in orifice diameter?	No	Yes	Yes	No

On 18/09/2007 the orifice diameter in the flow computer did not include the effect of the drain hole; however, the calculations given here give the correction due to mis-measurement of the orifice diameter alone.

3 CORRECTING THE FLOWRATE

To correct the measured flowrate by replacing an incorrect diameter with the correct diameter might appear to be fairly straightforward. However, the data supplied only give time to the nearest minute and at eight-minute intervals. This is inadequate for very accurate calculation. It is possible to calculate the flow over each time interval and to add the values over a day; this method can be used to check that the calculations are being done correctly, but the differences between the summed figures and the ones already given in the spreadsheet are too large to enable the correction to be calculated in this way. An alternative method has therefore been used.

The mass flowrate q_m is given by

$$q_m = \frac{\pi d^2 C \varepsilon \sqrt{2 \rho \Delta p}}{4 \sqrt{1 - \beta^4}}$$

where d is the orifice diameter, C is the discharge coefficient, ε is the expansibility, ρ is the density, Δp is the differential pressure, and β is the diameter ratio.

If the corrected and original data are described with subscripts c and o , then the following correction factor is obtained:

$$\frac{q_{m,c}}{q_{m,o}} = \left(\frac{d_c}{d_o} \right)^2 \frac{C_c \varepsilon_c}{C_o \varepsilon_o} \sqrt{\frac{1 - \beta_o^4}{1 - \beta_c^4}}$$

The correct effective diameter is taken as the average of the measurements shown in Table 1 for that plate excluding the erroneous measurement. It is then necessary to calculate C and ε in each case, and they were determined from the equations in ISO 5167-1:1991. C is

a function of β and Re_D ; so there is a change in C due to β , but the change varies with Reynolds number. Throughout the calculations the upstream pressure p_1 is taken as 56 bar a; the change in $q_{m,c}/q_{m,o}$ due to changing the static pressure by 10 bar is around 0.00002% at maximum.

Over the period from 21/09/2007 to 22/09/2008 the correction can be calculated as in Table 3. Throughout this calculation the meter tube diameter is 288.7663 mm, the isentropic exponent is 1.339 and the dynamic viscosity is 0.000012 Pa s.

TABLE 3
THE CORRECTION FROM 21/09/2007 TO 22/09/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=10$ mbar	162.0924	0.561327	0.999941	1550310	0.604207	
Corrected $\Delta p=10$ mbar	162.2644	0.561923	0.999941	1553987	0.604215	1.0023719
Original $\Delta p=500$ mbar	162.0924	0.561327	0.997034	10923624	0.603828	
Corrected $\Delta p=500$ mbar	162.2644	0.561923	0.997033	10949517	0.603836	1.0023704

So $q_{m,c}/q_{m,o}$ is 1.002371.

Over the period from 22/09/2008 to 26/09/2008 the correction can be calculated as in Table 4. Throughout this calculation the meter tube diameter is 288.7663 mm, the isentropic exponent is 1.3417 and the dynamic viscosity is 0.000012 Pa s.

TABLE 4
THE CORRECTION FROM 22/09/2008 TO 26/09/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=10$ mbar	162.0924	0.561327	0.999941	1550310	0.604207	
Corrected $\Delta p=10$ mbar	162.2644	0.561923	0.999941	1553987	0.604215	1.0023719
Original $\Delta p=500$ mbar	162.0924	0.561327	0.997040	10923689	0.603828	
Corrected $\Delta p=500$ mbar	162.2644	0.561923	0.997039	10949583	0.603836	1.0023704

So $q_{m,c}/q_{m,o}$ is 1.002371.

4 CORRECTIONS ON A DAILY BASIS

The volume flows for each day from 21/09/2007 to 26/09/2008 are given in Table B.1 of Appendix B together with the corrected values. It has been assumed that the plates were changed at 11:00; therefore 79.8% of the flow for 21/09/2007 has to be corrected and 20.9% of that for 26/09/2008 have to be corrected based on the flow before and after 11:00. Summing the data gives the figures in Table 5.

TABLE 5

THE FLOW OVER THE PERIOD 21/09/2007 TO 26/09/2008 INCLUSIVE

Flow (mscm)	112.13422
Correction (mscm)	0.26480
Corrected flow (mscm)	112.39902
% Change	0.2361

5 CONCLUSIONS

A correction factor of 1.002371 should be applied during the period of mis-measurement.

APPENDIX A
ORIFICE PLATE CALIBRATION CERTIFICATES

TRANSCO ORIFICE PLATE CALIBRATION

DATE: 10-01-05

REF NO: OP4171

TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 161.967mm

PLATE DETAILS

PLATE SERIAL. 216-3 PLATE O.D 319.787mm
 MANUFACTURER: PIPE I.D: mm SITE: WESTON POINT
 MATERIAL CERT.No DESIGN BORE mm FLOW:

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 15/10/05

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS	1	2	3				
PLATNESS %	0.172	0.038	0.076	0.036	0.008	0.034	0.061
E mm	6.428	6.408	6.430	6.437	6.433	6.433	6.434
mm	5.008	5.032	5.003	4.905	4.884		
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125		
BEVEL ANGLE	37 DEGS						
CONCENTRICITY	0.035mm						
SURFACE FINISH (Ra)	3.0 microns						
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS						
ROUNDNESS 0.005mm	TAPER 0 degs						

DRAIN HOLE BORE 6.357mm

CENTRE DISTANCE

COMMENTS

INSPECTED BY



G. WARDLE

TRANSCO ORIFICE PLATE CALIBRATION

DATE: 08-04-05
REF NO: OP5061
TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 162.265mm

PLATE DETAILS

PLATE SERIAL:	216-4	PLATE O.D	319.604mm	SITE	WESTON POINT
MANUFACTURER:		PIPE I.D:	mm	FLOW	
MATERIAL CERT.No	E84730	DESIGN BORE	mm		

TEST EQUIPMENT

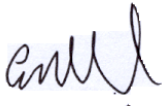
MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 15/10/05

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:	2	4	6	7	8	
FLATNESS μ	0.007	0.021	0.000	0.003	0.009	0.001
E' mm	5.664	5.646	5.588	5.610	5.641	5.665
mm	4.314	4.301		4.317	4.315	4.322
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE	44 DEGS					
CONCENTRICITY	0.056mm					
SURFACE FINISH (Ra)	1.5 microns					
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS					
ROUNDNESS	0.007mm	TAPER	0 degs			

COMMENTS

INSPECTED BY



G. WARDLE

VERIFIED BY



P. KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 21-02-06
 REF NO: OP60027
 TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 162.269mm

PLATE DETAILS

PLATE SERIAL: 216-4 PLATE O.D 319.614mm
 MANUFACTURER: PIPE I.D: mm SITE WESTON POINT
 MATERIAL CERT.No. E84730 DESIGN BORE mm FLOW

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 14/10/06

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS	1	2	3	4	5	6	7
FLATNESS μ	0.002	0.027	0.003	0.033	0.006	0.002	0.008
E mm	5.65	5.636	5.612	5.582	5.585	5.617	5.646
mm	4.314	4.305	4.308	4.311	4.295	4.311	4.307
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE	44 DEGS						
CONCENTRICITY	0.070mm						
SURFACE FINISH (Ra)	1.5 microns						
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS						
ROUNDNESS	0.005mm	TAPER	0 degs				

COMMENTS

INSPECTED BY  P. KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 11-10-06
 REF NO: OP60060
 TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 161.9735mm

PLATE DETAILS

PLATE SERIAL. 216-3 PLATE O.D. 319.800mm
 MANUFACTURER: PIPE I.D.: mm SITE: WESTERN POINT
 MATERIAL CERT.No. DESIGN BORE: mm FLOW:

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 14/10/06

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5	6		
FLATNESS μ	0.118	0.092	0.077	0.039	0.010	0.021	0.062	0.125
RE mm	6.423	6.410	6.438	6.439	6.433	6.433	6.430	6.444
RE mm	5.008	5.022	4.974	4.947	4.941	5.000	5.071	5.081
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	SQUARE
BEVEL ANGLE	37 DEGS							
CONCENTRICITY	0.041mm							
SURFACE FINISH (Ra)	3.1 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS	0.007mm	TAPER:		0 degs				
DRAIN HOLE BORE	6.365mm				CENTRE DISTANCE		141.404mm	

COMMENTS

INSPECTED BY..  P. KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 07-06-07
REF NO: OP70056
TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 162.095mm

PLATE DETAILS

PLATE SERIAL. 216-4 PLATE O.D 319.389mm
 MANUFACTURER: PIPE I.D: mm SITE WESTERN POINT
 MATERIAL CERT.No DESIGN BORE mm FLOW

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 13/10/07

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS	2		4		8			
FLATNESS %	0.004	0.015	0.009	0.033	0.000	0.006	0.004	0.005
E mm	5.704	5.630	5.589	5.646	5.649	5.582	5.620	5.700
mm	4.346	4.300	4.290	4.353	4.347	4.275	4.285	4.348
EDGE SHARPNESS mm	0.0125	SQ	SQ	0.0125	SQ	SQ	0.0125	0.0125
BEVEL ANGLE	44 DEGS							
CONCENTRICITY	0.032mm							
SURFACE FINISH (Ra)								
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS							
ROUNDNESS 0.144mm	TAPER		0 degs					

COMMENTS

INSPECTED BY

 P. KENNERSON /  J. CHANMAN

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 03-MAR-2008

REF NO: OP80008

TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 161.9405mm

PLATE DETAILS

PLATE SERIAL. 216-2 PLATE O.D. 319.770mm
 MANUFACTURER: PIPE I.D.: 288.7663mm SITE: WESTON POINT
 MATERIAL CERT.No. DESIGN BORE: mm FLOW: M³/DAY

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 6292 NEXT CAL DUE:- 05-OCTOBER-2008

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	6	7	8	
PLATNESS %	0.089	0.080	0.186	0.059	0.158	0.150	0.132	0.159
'E' mm	6.357	6.364	6.350	6.355	6.336	6.343	6.372	6.386
			4.753	4.851	4.833	4.819	4.713	4.663
EDGE SHARPNESS mm	0.025	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:	37 DEGS							
CONCENTRICITY	0.030mm							
SURFACE FINISH (Ra)	0.5 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS	0.008mm	TAPER:		0 degs				
DRAIN HOLE BORE	6.398mm			CENTRE DISTANCE			141.338mm	

COMMENTS: CLEAN PLATE

INSPECTED BY:  M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 08-AUG-2008

REF NO: OP80048

TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 161.9765mm

PLATE DETAILS

PLATE SERIAL.	216-3	PLATE O.D	319.783mm	SITE:	WESTON POINT
MANUFACTURER:		PIPE I.D:	288.7663mm	DESIGN BORE:	mm
MATERIAL CERT.No.				FLOW:	M ³ /DAY

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, UKAS CERT:- 6292. NEXT CAL DUE:- 05-OCTOBER-2008

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5	6	7	8
FLATNESS %	0.184	0.050	0.090	0.039	0.002	0.050	0.039	0.083
'E' mm	6.417	6.414	6.436	6.424	6.426	6.441	6.437	6.429
'e' mm	5.031	5.035	4.971	4.883	4.913	5.046	5.065	5.057
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	SQUARE	0.0125	0.025	0.025	0.0125
BEVEL ANGLE:	37 DEGS							
CONCENTRICITY	0.045mm							
SURFACE FINISH (Ra)	3.0 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS : 0.006mm TAPER: 0 degs

DRAIN HOLE BORE 6.375mm CENTRE DISTANCE 141.410mm

DRAINHOLE PRESENT ? (YES/NO): Yes

COMMENTS: CLEAN PLATE.

INSPECTED BY:  M Livingstone.

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 29-OCT-2008

REF NO: OP80071

TEMPERATURE: 20.4 degsC

MEASURED ORIFICE BORE: 162.2655mm

PLATE DETAILS

PLATE SERIAL.	216-4	PLATE O.D.	319.618mm	SITE:	WESTON POINT
MANUFACTURER:		PIPE I.D:	288.7663mm	DESIGN BORE:	mm
MATERIAL CERT.No	B84730			FLOW:	M ³ /DAY

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, UKAS CERT:- 6822. NEXT CAL DUE:- 03-OCTOBER-2009

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-		3	4	5	7	8		
FLATNESS %	0.003	0.017	0.004	0.025	0.016	0.007	0.018	0.017
'E' mm	5.632	5.653	5.624	5.570	5.577	5.609	5.641	5.628
'e' mm	4.303	4.312	4.319	4.312	4.307	4.298	4.322	
EDGE SHARPNESS mm	0.0125	SQUARE	SQUARE	0.0125	0.0125	0.025	0.0125	
BEVEL ANGLE:	44 DEGS							
CONCENTRICITY	0.063mm							
SURFACE FINISH (Ra)	0.5 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS							
ROUNDNESS	0.005mm	TAPER:	0 degs					

DRAINHOLE PRESENT ? (YES/NO): No

COMMENTS: CLEAN PLATE

INSPECTED BY:  M Livingstone

**APPENDIX B
CORRECTED DAILY VOLUME FLOWS**

TABLE B.1

FLOWS AT WESTON POINT MTB DURING THE PERIOD OF THE MIS-MEASUREMENT

	Original Values (total)	Corrected values (total)	% increase
Date	Volume (mscm)	Volume (mscm)	Volume (mscm)
21/9/2007	0.95328	0.95508	0.1893
22/9/2007	0.3224	0.32316	0.2371
23/9/2007	0.3203	0.32106	0.2371
24/9/2007	0.3228	0.32357	0.2371
25/9/2007	0.326	0.32677	0.2371
26/9/2007	0.331	0.33178	0.2371
27/9/2007	0.3325	0.33329	0.2371
28/9/2007	0.3369	0.33770	0.2371
29/9/2007	0.3289	0.32968	0.2371
30/9/2007	0.3294	0.33018	0.2371
1/10/2007	0.3265	0.32727	0.2371
2/10/2007	0.3154	0.31615	0.2371
3/10/2007	0.3109	0.31164	0.2371
4/10/2007	0.3168	0.31755	0.2371
5/10/2007	0.3199	0.32066	0.2371
6/10/2007	0.3223	0.32306	0.2371
7/10/2007	0.3205	0.32126	0.2371
8/10/2007	0.3288	0.32958	0.2371
9/10/2007	0.322	0.32276	0.2371
10/10/2007	0.3292	0.32998	0.2371
11/10/2007	0.3229	0.32367	0.2371
12/10/2007	0.3148	0.31555	0.2371
13/10/2007	0.312	0.31274	0.2371
14/10/2007	0.1858	0.18624	0.2371
15/10/2007	0	0.00000	0
16/10/2007	0	0.00000	0
17/10/2007	0.0279	0.02797	0.2371
18/10/2007	0.1014	0.10164	0.2371
19/10/2007	0.2729	0.27355	0.2371
20/10/2007	0.3308	0.33158	0.2371
21/10/2007	0.3279	0.32868	0.2371
22/10/2007	0.3269	0.32768	0.2371
23/10/2007	0.3312	0.33199	0.2371
24/10/2007	0.3295	0.33028	0.2371
25/10/2007	0.3292	0.32998	0.2371
26/10/2007	0.3378	0.33860	0.2371
27/10/2007	0.3405	0.34131	0.2371
28/10/2007	0.3203	0.32106	0.2371
29/10/2007	0.321	0.32176	0.2371
30/10/2007	0.3196	0.32036	0.2371
31/10/2007	0.3181	0.31885	0.2371
1/11/2007	0.2921	0.29279	0.2371
2/11/2007	0.3282	0.32898	0.2371
3/11/2007	0.3358	0.33660	0.2371
4/11/2007	0.3369	0.33770	0.2371
5/11/2007	0.3363	0.33710	0.2371

6/11/2007	0.3281	0.32888	0.2371
7/11/2007	0.3184	0.31915	0.2371
8/11/2007	0.332	0.33279	0.2371
9/11/2007	0.3384	0.33920	0.2371
10/11/2007	0.3237	0.32447	0.2371
11/11/2007	0.3323	0.33309	0.2371
12/11/2007	0.3424	0.34321	0.2371
13/11/2007	0.3272	0.32798	0.2371
14/11/2007	0.3303	0.33108	0.2371
15/11/2007	0.3307	0.33148	0.2371
16/11/2007	0.3292	0.32998	0.2371
17/11/2007	0.3242	0.32497	0.2371
18/11/2007	0.3257	0.32647	0.2371
19/11/2007	0.3219	0.32266	0.2371
20/11/2007	0.3195	0.32026	0.2371
21/11/2007	0.3288	0.32958	0.2371
22/11/2007	0.3312	0.33199	0.2371
23/11/2007	0.5058	0.50700	0.2371
24/11/2007	0.377	0.37789	0.2371
25/11/2007	0.4452	0.44626	0.2371
26/11/2007	0.4426	0.44365	0.2371
27/11/2007	0.4503	0.45137	0.2371
28/11/2007	0.4108	0.41177	0.2371
29/11/2007	0.4713	0.47242	0.2371
30/11/2007	0.3285	0.32928	0.2371
1/12/2007	0.3292	0.32998	0.2371
2/12/2007	0.3174	0.31815	0.2371
3/12/2007	0.2953	0.29600	0.2371
4/12/2007	0	0.00000	0
5/12/2007	0.1027	0.10294	0.2371
6/12/2007	0.2462	0.24678	0.2371
7/12/2007	0.3567	0.35755	0.2371
8/12/2007	0.352	0.35283	0.2371
9/12/2007	0.362	0.36286	0.2371
10/12/2007	0.6086	0.61004	0.2371
11/12/2007	0.4646	0.46570	0.2371
12/12/2007	0.4532	0.45427	0.2371
13/12/2007	0.4427	0.44375	0.2371
14/12/2007	0.7873	0.78917	0.2371
15/12/2007	0.5857	0.58709	0.2371
16/12/2007	0.5923	0.59370	0.2371
17/12/2007	0.4278	0.42881	0.2371
18/12/2007	0.5876	0.58899	0.2371
19/12/2007	0.4393	0.44034	0.2371
20/12/2007	0.5443	0.54559	0.2371
21/12/2007	0.4713	0.47242	0.2371
22/12/2007	0.4554	0.45648	0.2371
23/12/2007	0.3258	0.32657	0.2371
24/12/2007	0.3611	0.36196	0.2371
25/12/2007	0.3136	0.31434	0.2371
26/12/2007	0.4793	0.48044	0.2371
27/12/2007	0.4074	0.40837	0.2371
28/12/2007	0.3654	0.36627	0.2371
29/12/2007	0.4601	0.46119	0.2371
30/12/2007	0.3188	0.31956	0.2371
31/12/2007	0.3625	0.36336	0.2371
1/1/2008	0.3186	0.31936	0.2371

2/1/2008	0.5188	0.52003	0.2371
3/1/2008	0.4449	0.44595	0.2371
4/1/2008	0.5849	0.58629	0.2371
5/1/2008	0.3159	0.31665	0.2371
6/1/2008	0.4561	0.45718	0.2371
7/1/2008	0.3949	0.39584	0.2371
8/1/2008	0.3182	0.31895	0.2371
9/1/2008	0.4249	0.42591	0.2371
10/1/2008	0.3625	0.36336	0.2371
11/1/2008	0.4214	0.42240	0.2371
12/1/2008	0.4282	0.42922	0.2371
13/1/2008	0.3196	0.32036	0.2371
14/1/2008	0.2957	0.29640	0.2371
15/1/2008	0.2214	0.22192	0.2371
16/1/2008	0.4491	0.45016	0.2371
17/1/2008	0.3409	0.34171	0.2371
18/1/2008	0.3271	0.32788	0.2371
19/1/2008	0.4629	0.46400	0.2371
20/1/2008	0.3885	0.38942	0.2371
21/1/2008	0.4826	0.48374	0.2371
22/1/2008	0.3467	0.34752	0.2371
23/1/2008	0.3364	0.33720	0.2371
24/1/2008	0.6656	0.66718	0.2371
25/1/2008	0.3251	0.32587	0.2371
26/1/2008	0.3564	0.35725	0.2371
27/1/2008	0.3786	0.37950	0.2371
28/1/2008	0.3527	0.35354	0.2371
29/1/2008	0.644	0.64553	0.2371
30/1/2008	0.3733	0.37419	0.2371
31/1/2008	0.5259	0.52715	0.2371
1/2/2008	0.326	0.32677	0.2371
2/2/2008	0.0004	0.00040	0.2371
3/2/2008	0.109	0.10926	0.2371
4/2/2008	0.0119	0.01193	0.2371
5/2/2008	0.4183	0.41929	0.2371
6/2/2008	0.3269	0.32768	0.2371
7/2/2008	0.3254	0.32617	0.2371
8/2/2008	0.329	0.32978	0.2371
9/2/2008	0.4337	0.43473	0.2371
10/2/2008	0.3448	0.34562	0.2371
11/2/2008	0.4155	0.41649	0.2371
12/2/2008	0.3572	0.35805	0.2371
13/2/2008	0.4429	0.44395	0.2371
14/2/2008	0.4078	0.40877	0.2371
15/2/2008	0.4441	0.44515	0.2371
16/2/2008	0.3921	0.39303	0.2371
17/2/2008	0.3953	0.39624	0.2371
18/2/2008	0.3645	0.36536	0.2371
19/2/2008	0.7203	0.72201	0.2371
20/2/2008	0.735	0.73674	0.2371
21/2/2008	0.32	0.32076	0.2371
22/2/2008	0.4708	0.47192	0.2371
23/2/2008	0.4688	0.46991	0.2371
24/2/2008	0.3577	0.35855	0.2371
25/2/2008	0.4832	0.48435	0.2371
26/2/2008	0.3786	0.37950	0.2371
27/2/2008	0.3307	0.33148	0.2371

28/2/2008	0.393	0.39393	0.2371
29/2/2008	0.3475	0.34832	0.2371
1/3/2008	0.3871	0.38802	0.2371
2/3/2008	0.3465	0.34732	0.2371
3/3/2008	0.4663	0.46741	0.2371
4/3/2008	0.3996	0.40055	0.2371
5/3/2008	0.586	0.58739	0.2371
6/3/2008	0.3218	0.32256	0.2371
7/3/2008	0.3202	0.32096	0.2371
8/3/2008	0.3309	0.33168	0.2371
9/3/2008	0.4256	0.42661	0.2371
10/3/2008	0.5183	0.51953	0.2371
11/3/2008	0.461	0.46209	0.2371
12/3/2008	0.4917	0.49287	0.2371
13/3/2008	0.3139	0.31464	0.2371
14/3/2008	0.3469	0.34772	0.2371
15/3/2008	0.5318	0.53306	0.2371
16/3/2008	0.495	0.49617	0.2371
17/3/2008	0.3709	0.37178	0.2371
18/3/2008	0.3249	0.32567	0.2371
19/3/2008	0.4692	0.47031	0.2371
20/3/2008	0.6042	0.60563	0.2371
21/3/2008	0.3837	0.38461	0.2371
22/3/2008	0.3279	0.32868	0.2371
23/3/2008	0.3414	0.34221	0.2371
24/3/2008	0.4562	0.45728	0.2371
25/3/2008	0.6702	0.67179	0.2371
26/3/2008	0.33791	0.33871	0.2371
27/3/2008	0.5161	0.51732	0.2371
28/3/2008	0.5075	0.50870	0.2371
29/3/2008	0.3146	0.31535	0.2371
30/3/2008	0.3722	0.37308	0.2371
31/3/2008	0.3347	0.33549	0.2371
1/4/2008	0.3174	0.31815	0.2371
2/4/2008	0.3361	0.33690	0.2371
3/4/2008	0.4058	0.40676	0.2371
4/4/2008	0.316	0.31675	0.2371
5/4/2008	0.4468	0.44786	0.2371
6/4/2008	0.4521	0.45317	0.2371
7/4/2008	0	0.00000	0
8/4/2008	0	0.00000	0
9/4/2008	0.01	0.01002	0.2371
10/4/2008	0.0659	0.06606	0.2371
11/4/2008	0.0075	0.00752	0.2371
12/4/2008	0.0691	0.06926	0.2371
13/4/2008	0.20361	0.20409	0.2371
14/4/2008	0.1748	0.17521	0.2371
15/4/2008	0.1952	0.19566	0.2371
16/4/2008	0.2279	0.22844	0.2371
17/4/2008	0.2093	0.20980	0.2371
18/4/2008	0.3077	0.30843	0.2371
19/4/2008	0.2543	0.25490	0.2371
20/4/2008	0.25301	0.25361	0.2371
21/4/2008	0.1595	0.15988	0.2371
22/4/2008	0.1928	0.19326	0.2371
23/4/2008	0.1533	0.15366	0.2371
24/4/2008	0.1628	0.16319	0.2371

25/4/2008	0.1835	0.18394	0.2371
26/4/2008	0.1599	0.16028	0.2371
27/4/2008	0.1512	0.15156	0.2371
28/4/2008	0.0342	0.03428	0.2371
29/4/2008	0.0308	0.03087	0.2371
30/4/2008	0.0702	0.07037	0.2371
1/5/2008	0.0542	0.05433	0.2371
2/5/2008	0.0614	0.06155	0.2371
3/5/2008	0.1351	0.13542	0.2371
4/5/2008	0.1575	0.15787	0.2371
5/5/2008	0.1573	0.15767	0.2371
6/5/2008	0.1585	0.15888	0.2371
7/5/2008	0.1592	0.15958	0.2371
8/5/2008	0.1576	0.15797	0.2371
9/5/2008	0.1474	0.14775	0.2371
10/5/2008	0.1138	0.11407	0.2371
11/5/2008	0.063	0.06315	0.2371
12/5/2008	0.0629	0.06305	0.2371
13/5/2008	0.0654	0.06556	0.2371
14/5/2008	0.0661	0.06626	0.2371
15/5/2008	0.0655	0.06566	0.2371
16/5/2008	0.0659	0.06606	0.2371
17/5/2008	0.0672	0.06736	0.2371
18/5/2008	0.0652	0.06535	0.2371
19/5/2008	0.0631	0.06325	0.2371
20/5/2008	0	0.00000	0
21/5/2008	0.0498	0.04992	0.2371
22/5/2008	0.064	0.06415	0.2371
23/5/2008	0.0381	0.03819	0.2371
24/5/2008	0.067	0.06716	0.2371
25/5/2008	0.0724	0.07257	0.2371
26/5/2008	0.0813	0.08149	0.2371
27/5/2008	0.1529	0.15326	0.2371
28/5/2008	0.0803	0.08049	0.2371
29/5/2008	0.0825	0.08270	0.2371
30/5/2008	0.0809	0.08109	0.2371
31/5/2008	0.0944	0.09462	0.2371
1/6/2008	0.0842	0.08440	0.2371
2/6/2008	0.0766	0.07678	0.2371
3/6/2008	0.078	0.07818	0.2371
4/6/2008	0.0776	0.07778	0.2371
5/6/2008	0.1233	0.12359	0.2371
6/6/2008	0.1582	0.15858	0.2371
7/6/2008	0.1556	0.15597	0.2371
8/6/2008	0.1573	0.15767	0.2371
9/6/2008	0.1228	0.12309	0.2371
10/6/2008	0.0299	0.02997	0.2371
11/6/2008	0.0871	0.08731	0.2371
12/6/2008	0.1588	0.15918	0.2371
13/6/2008	0.1614	0.16178	0.2371
14/6/2008	0.2142	0.21471	0.2371
15/6/2008	0.17271	0.17312	0.2371
16/6/2008	0.2697	0.27034	0.2371
17/6/2008	0.3418	0.34261	0.2371
18/6/2008	0.3349	0.33569	0.2371
19/6/2008	0.3233	0.32407	0.2371
20/6/2008	0.3279	0.32868	0.2371

21/6/2008	0.3283	0.32908	0.2371
22/6/2008	0.3241	0.32487	0.2371
23/6/2008	0.3285	0.32928	0.2371
24/6/2008	0.3224	0.32316	0.2371
25/6/2008	0.2898	0.29049	0.2371
26/6/2008	0.0974	0.09763	0.2371
27/6/2008	0.3086	0.30933	0.2371
28/6/2008	0.3224	0.32316	0.2371
29/6/2008	0.3257	0.32647	0.2371
30/6/2008	0.3241	0.32487	0.2371
1/7/2008	0.3191	0.31986	0.2371
2/7/2008	0.31731	0.31806	0.2371
3/7/2008	0.31789	0.31864	0.2371
4/7/2008	0.3163	0.31705	0.2371
5/7/2008	0.3123	0.31304	0.2371
6/7/2008	0.3094	0.31013	0.2371
7/7/2008	0.3094	0.31013	0.2371
8/7/2008	0.3405	0.34131	0.2371
9/7/2008	0.3141	0.31484	0.2371
10/7/2008	0.33701	0.33781	0.2371
11/7/2008	0.31609	0.31684	0.2371
12/7/2008	0.31641	0.31716	0.2371
13/7/2008	0.3177	0.31845	0.2371
14/7/2008	0.3137	0.31444	0.2371
15/7/2008	0.3136	0.31434	0.2371
16/7/2008	0.3154	0.31615	0.2371
17/7/2008	0.3132	0.31394	0.2371
18/7/2008	0.24709	0.24768	0.2371
19/7/2008	0.1928	0.19326	0.2371
20/7/2008	0.1786	0.17902	0.2371
21/7/2008	0.2067	0.20719	0.2371
22/7/2008	0.2103	0.21080	0.2371
23/7/2008	0.29279	0.29348	0.2371
24/7/2008	0.3074	0.30813	0.2371
25/7/2008	0.3049	0.30562	0.2371
26/7/2008	0.3083	0.30903	0.2371
27/7/2008	0.23341	0.23396	0.2371
28/7/2008	0.1051	0.10535	0.2371
29/7/2008	0.1807	0.18113	0.2371
30/7/2008	0.1784	0.17882	0.2371
31/7/2008	0.179	0.17942	0.2371
1/8/2008	0.181	0.18143	0.2371
2/8/2008	0.2611	0.26172	0.2371
3/8/2008	0.3132	0.31394	0.2371
4/8/2008	0.3135	0.31424	0.2371
5/8/2008	0.3128	0.31354	0.2371
6/8/2008	0.3127	0.31344	0.2371
7/8/2008	0.3145	0.31525	0.2371
8/8/2008	0.3144	0.31515	0.2371
9/8/2008	0.3128	0.31354	0.2371
10/8/2008	0.3129	0.31364	0.2371
11/8/2008	0.3134	0.31414	0.2371
12/8/2008	0.3121	0.31284	0.2371
13/8/2008	0.3132	0.31394	0.2371
14/8/2008	0.3156	0.31635	0.2371
15/8/2008	0.3175	0.31825	0.2371
16/8/2008	0.3185	0.31926	0.2371

17/8/2008	0.317	0.31775	0.2371
18/8/2008	0.315	0.31575	0.2371
19/8/2008	0.3147	0.31545	0.2371
20/8/2008	0.3072	0.30793	0.2371
21/8/2008	0.3148	0.31555	0.2371
22/8/2008	0.3174	0.31815	0.2371
23/8/2008	0.3167	0.31745	0.2371
24/8/2008	0.3124	0.31314	0.2371
25/8/2008	0.311	0.31174	0.2371
26/8/2008	0.1763	0.17672	0.2371
27/8/2008	0.0047	0.00471	0.2371
28/8/2008	0.1586	0.15898	0.2371
29/8/2008	0.2565	0.25711	0.2371
30/8/2008	0.3139	0.31464	0.2371
31/8/2008	0.3183	0.31905	0.2371
1/9/2008	0.3187	0.31946	0.2371
2/9/2008	0.3202	0.32096	0.2371
3/9/2008	0.3204	0.32116	0.2371
4/9/2008	0.3239	0.32467	0.2371
5/9/2008	0.3179	0.31865	0.2371
6/9/2008	0.3114	0.31214	0.2371
7/9/2008	0.3145	0.31525	0.2371
8/9/2008	0.3188	0.31956	0.2371
9/9/2008	0.3177	0.31845	0.2371
10/9/2008	0.3118	0.31254	0.2371
11/9/2008	0.3123	0.31304	0.2371
12/9/2008	0.3209	0.32166	0.2371
13/9/2008	0.3171	0.31785	0.2371
14/9/2008	0.3189	0.31966	0.2371
15/9/2008	0.1274	0.12770	0.2371
16/9/2008	0	0.00000	0
17/9/2008	0.1318	0.13211	0.2371
18/9/2008	0.3299	0.33068	0.2371
19/9/2008	0.3209	0.32166	0.2371
20/9/2008	0.322	0.32276	0.2371
21/9/2008	0.3231	0.32387	0.2371
22/9/2008	0.3259	0.32667	0.2371
23/9/2008	0.335	0.33579	0.2371
24/9/2008	0.324	0.32477	0.2371
25/9/2008	0.3239	0.32467	0.2371
26/9/2008	0.3269	0.32706	0.0497