



ASSESSMENT OF ERROR DUE TO ORIFICE DIAMETER MIS-MEASUREMENT AT YELVERTON

A Report for

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

PROJECT NO: NGR010

REPORT NO: 2010/286

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

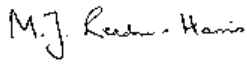
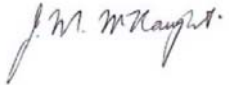
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Assessment of Error Due to Orifice Diameter Mis-Measurement at Yelverton

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 Yelverton a correction factor of 1.002280 should be applied during the period of mis-measurement.

Over the period 12/12/2006 to 10/07/2008 inclusive the flow was 865.88072 mscm and the corrected flow should be 867.85407 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 flows through Yelverton in the period of the error. The Joint Office Error Code is EA009.

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.

**TABLE 1
ORIFICE DIAMETERS**

Calibration Reference	Plate serial no	Declared certificate date	Orifice bore (mm)	Temperature	Value at 20 °C Orifice bore (mm)
OP4035	484-10	27/03/2004	263.748	21	263.7438
OP4244	484-4	11/01/2005	263.7625	21	263.7583
OP60077	484-10	16/11/2006	264.223	21	264.2188
OP80035	484-10	09/07/2008	264.478	20	264.4780
OP80070	484-11	13/10/2008	263.7505	20.4	263.7488
OP80083	484-10	21/11/2008	264.482	20.7	264.4790
OP90044	484-11	30/10/2009	263.744	20.6	263.7415

Figure 1 shows the data from Table 1 for the orifice bores at 20°C. This figure shows that after the work was carried out on plate 484-10 there is a low measurement of diameter followed by two high measurements of diameter. The deduction from this graph is that a plate was mis-measured.

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

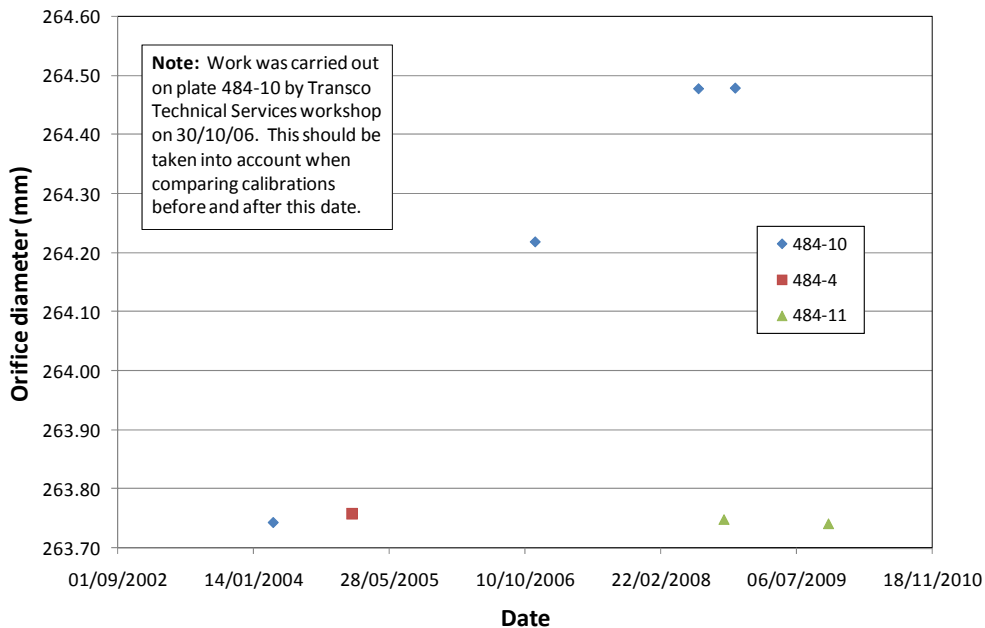


Figure 1 Orifice Diameters at 20 °C

The plates actually used in the meter tube are given in Table 2.

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

Configuration	omnL1026.cfg	omnL1212.cfg	omnM1101.cfg	omnN0131.cfg	omnN0710.cfg
	26/10/2006 23:01	13/12/2006 00:01	02/11/2007 00:01	01/02/2008 00:01	10/07/2008 23:01
Orifice plate bore diameter (mm)	263.7625	264.223	264.223	264.223	264.478
Expansion coefficient of the plate (°C)	0.000016	0.000016	0.000016	0.000016	0.000016
Orifice plate calibration temperature	21	21	21	21	20
Meter tube diameter (mm)	433.0637	433.0637	433.0637	433.0637	433.0637
Expansion coefficient of the meter tube (°C)	0.000011	0.000011	0.000011	0.000011	0.000011
Meter tube calibration temperature	20	20	20	20	20
Isonotropic Exponent	1.37	1.37	1.3664	1.3726	1.3726
Dynamic Viscosity (Pa.s)	0.0000122	0.0000122	0.0000123	0.0000122	0.0000122
Orifice plate certificate number	OP4244	OP60077	OP60077	OP60077	OP80035
Orifice plate serial number	484-4	484-10	484-10	484-10	484-10
Error in orifice diameter?	No	Yes	Yes	Yes	No

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 four-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:

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

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 66 bar a; the change in $q_{m,c}/q_{m,o}$ due to changing the static pressure by 10 bar is around 0.00002%.

Over the period from 12/12/2006 to 01/11/2007 the correction can be calculated as in Table 3; throughout this calculation the meter tube diameter is 433.0637 mm, the isentropic exponent is 1.37 and the dynamic viscosity 0.0000122 Pa s.

TABLE 3
THE CORRECTION FROM 12/12/2006 TO 01/11/2007

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=10$ mbar	264.2188	0.610115	0.999949	2959876	0.604195	
Corrected $\Delta p=10$ mbar	264.4785	0.610715	0.999949	2966628	0.604193	1.0022809
Original $\Delta p=500$ mbar	264.2188	0.610115	0.997465	20867548	0.603908	
Corrected $\Delta p=500$ mbar	264.4785	0.610715	0.997464	20915116	0.603905	1.0022795

So $q_{m,c}/q_{m,o}$ is 1.002280.

Over the period from 01/11/2007 to 31/01/2008 the correction can be calculated as in Table 4; throughout this calculation the meter tube diameter is 433.0637 mm, the isentropic exponent is 1.3664 and the dynamic viscosity 0.0000123 Pa s.

TABLE 4
THE CORRECTION FROM 01/11/2007 TO 31/01/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=10$ mbar	264.2188	0.610115	0.999949	2935823	0.604197	
Corrected $\Delta p=10$ mbar	264.4785	0.610715	0.999949	2942519	0.604195	1.0022809
Original $\Delta p=500$ mbar	264.2188	0.610115	0.997458	20697772	0.603908	
Corrected $\Delta p=500$ mbar	264.4785	0.610715	0.997457	20744953	0.603906	1.0022795

So $q_{m,c}/q_{m,o}$ is 1.002280.

Over the period from 31/01/2008 to 10/07/2008 the correction can be calculated as in Table 4; throughout this calculation the meter tube diameter is 433.0637 mm, the isentropic exponent is 1.3726 and the dynamic viscosity 0.0000122 Pa s.

TABLE 5

THE CORRECTION FROM 01/02/2008 TO 10/07/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=10$ mbar	264.2188	0.610115	0.999949	2959877	0.604195	
Corrected $\Delta p=10$ mbar	264.4785	0.610715	0.999949	2966628	0.604193	1.0022809
Original $\Delta p=500$ mbar	264.2188	0.610115	0.997469	20867648	0.603908	
Corrected $\Delta p=500$ mbar	264.4785	0.610715	0.997468	20915217	0.603905	1.0022795

So $q_{m,c}/q_{m,o}$ is 1.002280.

4 CORRECTIONS ON A DAILY BASIS

The volume flows for each day from 12/12/2006 to 10/07/2008 are given in Table B.1 of Appendix B together with the corrected values. It has been assumed that the plates were changed at 10:30 therefore 85.4% of the flow for 12/12/2006 has to be corrected but none of that for 10/07/2008 based on the flow before and after 10:30. Summing the data gives the figures in Table 6.

TABLE 6

THE FLOW OVER THE PERIOD 12/12/2006 TO 10/07/2008 INCLUSIVE

Flow (mscm)	865.88072
Correction (mscm)	1.97335
Corrected flow (mscm)	867.85407
% Change	0.2279

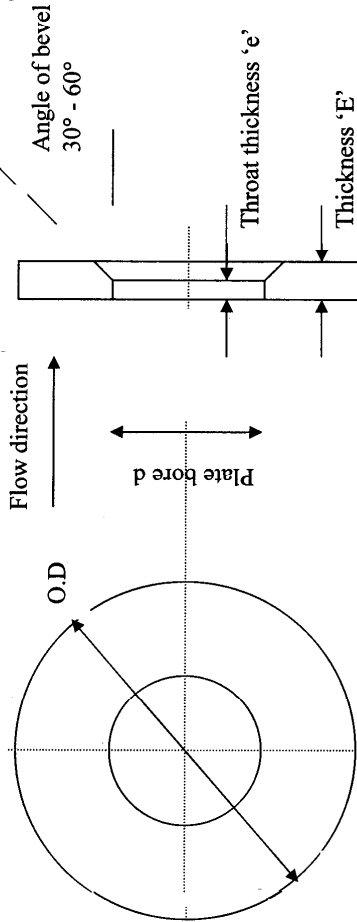
5 CONCLUSIONS

A correction factor of 1.002280 should be applied during the period of mis-measurement.

APPENDIX A
ORIFICE PLATE CALIBRATION CERTIFICATES

DRAWING NUMBER TRANSCO/TS/PK96

NATIONAL GRID



Units	mm
Bore	A/S
Outside diameter	A/S
Thickness 'E'	A/S
Thickness 'e'	A/S

	Bore size		Tolerance
	in	mm	
1 to 2.999		25 to 74.999	±0.025
3 to 3.999		75 to 99.999	±0.038
4 to 5.999		100 to 149.999	±0.05
6 to 7.999		150 to 199.999	±0.075
8 and above		200 and above	±0.1

- Material – Stainless steel
- The bore shall be circular at the upstream face to within ±0.0005d
- The upstream edge shall be square and free from burrs wire edges or peculiarities. It may be regarded as square if its radius of curvature does not exceed 0.0004d
- The upstream face shall be smooth to 1.2 microns Ra
- If bevel required then cut on downstream edge, Integral plates rubber seal on downstream face
- The upstream face shall be flat to 0.1%

STATION NAME: YELVERTON
 PLATE SERIAL: 484/10
 QUANTITY: 1 OFF
 BLANK SUPPLIED: YES
 DATE REQUESTED: 30-10-06
 DELIVERY DATE: ASAP

Please quote your estimated charge and indicate whether our required delivery can be achieved

Special requirements: Please tidy upstream face.

TRANSCO, TECHNICAL SERVICES WORKSHOP
 TEL: 01455 892102 FAX: 01455 892067



TRANSCO ORIFICE PLATE CALIBRATION

DATE: 27-03-04
REF NO: OP4035
TEMPERATURE: 21 degsC
MEASURED ORIFICE BORE: 263.748mm

PLATE DETAILS

PLATE SERIAL. 484-10 PLATE O.D 507.979mm
 MANUFACTURER: PIPE I.D: 432.892mm SITE: YELVERTON
 MATERIAL CERT.No DESIGN BORE: 263.773mm FLOW: 7.2 x 10e6 M³/day

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 3858 NEXT CAL DUE:- 17/10/04

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	2	3	4	5	6	7	8
FLATNESS %	0.035	0.117	0.153	0.039	0.026	0.102	0.054
	9.399	9.408	9.408	9.413	9.413	9.412	9.406
mm	3.142	3.165	3.167	3.207	3.218	3.152	3.201
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125

CONCENTRICITY 0.075mm

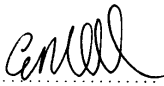
SURFACE FINISH (Ra) 12 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.020mm TAPER: 0 degs

BEVEL ANGLE: 44DEGS

COMMENTS:

INSPECTED BY  G.WARDLE

VERIFIED BY  P.KENNERSON

TRANSCO ORIFICE PLATE CALIBRATION

DATE: 11-01-05
REF NO: OP4244
TEMPERATURE: 21 degsC
MEASURED ORIFICE BORE: 263.7625mm

PLATE DETAILS

PLATE SERIAL.	484-4	PLATE O.D	507.967mm	SITE:	YELVERTON
MANUFACTURER:		PIPE I.D:	432.892mm	FLOW:	7200000 M ³ /day
MATERIAL CERT.No.		DESIGN BORE:	263.773mm		

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	4	5	6	7	8
PLATNESS %	0.128	0.136	0.130	0.143	0.134	0.114	0.162	0.131
'E' mm	9.387	9.395	9.392	9.371	9.355	9.346	9.319	9.345
'e' mm	8.503	8.490	8.470	8.439	8.421	8.433	8.469	8.495
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:	44 DEGS							
CONCENTRICITY	0.049mm							
SURFACE FINISH (Ra)	1.7 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS	0.019mm	TAPER:	0 degs					

COMMENTS:

INSPECTED BY:  G. WARDLE
 VERIFIED BY:  P. KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 16-11-06
 REF NO: OP60077
 TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 264.223mm

PLATE DETAILS

PLATE SERIAL. 484-10 PLATE O.D 507.577mm
 MANUFACTURER: PIPE I.D: 432.892mm SITE: YELVERTON
 MATERIAL CERT.No. DESIGN BORE: 263.773mm FLOW: 7.2X10E06 M³/DAY

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:-	1	2	3	4	5	6	7	8
FLATNESS μ	0.110	0.111	0.117	0.111	0.096	0.109	0.098	0.104
'E' mm	8.110	8.050	8.043	8.108	8.106	8.030	8.026	8.114
'e' mm	2.609	2.530	2.562	2.714	2.775	2.727	2.722	2.705
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:	44 DEGS							
CONCENTRICITY	0.264mm							
SURFACE FINISH (Ra)	1.2 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS :	0.258mm	TAPER: 0 degs						

COMMENTS:

INSPECTED BY:  P. KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 9-JULY-2008

REF NO: OP80035

TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 264.478mm

PLATE DETAILS

PLATE SERIAL: 484-10 PLATE O.D: 507.991mm
 MANUFACTURER: HEBCO PIPE I.D: 432.892mm SITE: YELVERTON
 MATERIAL CERT.No W1540 DESIGN BORE: 263.773mm FLOW: 7.2X10E06 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)

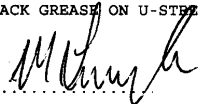
STATIONS:-	1	2	3	4	5	6	7	8
FLATNESS %	0.156	0.188	0.112	0.091	0.093	0.131	0.105	0.103
'E' mm	8.059	8.064	8.060	8.054	8.047	8.052	8.041	8.045
mm	2.560	2.539	2.564	2.636	2.726	2.746	2.722	2.701
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:	44 DEGS							
CONCENTRICITY	0.282mm							
SURFACE FINISH (Ra)	0.8 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.012mm TAPER: 0 degs

DRAINHOLE PRESENT ? (YES/NO): No

COMMENTS: BLACK GREASE ON U-STREAM

INSPECTED BY:  M Livingstone.

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 13-OCT-2008
REF NO: OP80070
TEMPERATURE: 20.4 degsC
MEASURED ORIFICE BORE: 263.7505mm

PLATE DETAILS

PLATE SERIAL: 484-11 PLATE O.D: 507.987mm
 MANUFACTURER: ANT IND PIPE I.D: 432.892mm SITE: YELVERTON
 MATERIAL CERT.No. ANT21731 DESIGN BORE: 263.773mm FLOW: 7.2X10E06 M³/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:-	1	2	3	4	5	6	7	8
FLATNESS μ	0.060	0.078	0.028	0.007	0.054	0.077	0.070	0.039
	8.218	8.197	8.217	8.216	8.218	8.233	8.221	8.219
Le mm	2.887	2.862	2.867	2.837	2.816	3.006	2.943	2.904
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.025	0.0125	0.0125	0.025	0.0125
BEVEL ANGLE:	47 DEGS							
CONCENTRICITY	0.073mm							
SURFACE FINISH (Ra)	1.4 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.010mm TAPER: 0 degs

DRAINHOLE PRESENT ? (YES/NO) No

COMMENTS

INSPECTED BY  M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 21-NOV-2008

REF NO: OP80083

TEMPERATURE: 20.7 degsC

MEASURED ORIFICE BORE: 264.482mm

PLATE DETAILS

PLATE SERIAL. 484-10 PLATE O.D 507.990mm
 MANUFACTURER: PIPE I.D: 433.0637mm SITE: YELVERTON
 MATERIAL CERT.No. DESIGN BORE: 263.773mm FLOW: 7.2X10E06 M³/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:-	1	2	3	4	5	6	7	8
FLATNESS %	0.123	0.137	0.096	0.095	0.104	0.106	0.095	0.112
'E' mm	8.067	8.067	8.063	8.054	8.052	8.056	8.041	8.051
			2.567	2.662	2.736	2.732	2.725	2.667
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.025	0.0125	0.0125
BEVEL ANGLE:	44 DEGS							
CONCENTRICITY	0.276mm							
SURFACE FINISH (Ra)	1.2 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS	0.013mm	TAPER:		0 degs				

DRAINHOLE PRESENT ? (YES/NO) No

COMMENTS: BROWN DUST-GREASE TO UPSTREAM

INSPECTED BY:  M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 30-OCT-2009
 REF NO: OP90044
 TEMPERATURE: 20.6 degsC
 MEASURED ORIFICE BORE: 263.744mm

PLATE DETAILS

PLATE SERIAL. 484-11 PLATE O.D 507.979mm
 MANUFACTURER: ANI INDUSTRIES PIPE I.D: 433.0637mm SITE: YELVERTON
 MATERIAL CERT.No. ANT21709 DESIGN BORE: 263.733mm FLOW: 7.2 X 10E06 M^3/DAY

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, UKAS TRACEABLE CERT:- 7325. NEXT CAL DUE:- 02-OCTOBER-2010

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:	1	2	4	5	6	7	8	
FLATNESS %	0.067	0.058	0.041	0.010	0.059	0.106	0.052	0.044
E' mm	8.215	8.204	8.221	8.224	8.223	8.238	8.232	8.220
e' mm	2.907	2.894	2.898	2.899	2.903	2.902	2.894	2.909
EDGE SHARPNESS mm	0.0125	0.025	0.025	0.0125	0.0125	0.0125	0.025	0.0125
BEVEL ANGLE:	47 DEGS							
CONCENTRICITY	0.070mm							
SURFACE FINISH (Ra)	1.28 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS							
ROUNDNESS	0.014mm	TAPER:		0 degs				

DRAINHOLE PRESENT ? (YES/NO) No

COMMENTS: BROWN DEPOSIT TO UPSTREAM FACE

INSPECTED BY:  M Livingstone

**APPENDIX B
CORRECTED DAILY VOLUME FLOWS**

TABLE B.1

FLOWS AT YELVERTON DURING THE PERIOD OF THE MIS-MEASUREMENT

	Original Values (total)	Corrected values (total)	% increase
Date	Volume (mscm)	Volume (mscm)	Volume (mscm)
12/12/2006	2.58990	2.59494	0.1947
13/12/2006	1.62540	1.62911	0.2280
14/12/2006	1.62820	1.63191	0.2280
15/12/2006	2.27630	2.28149	0.2280
16/12/2006	2.61940	2.62537	0.2280
17/12/2006	2.58590	2.59180	0.2280
18/12/2006	3.18480	3.19206	0.2280
19/12/2006	3.56200	3.57012	0.2280
20/12/2006	3.90140	3.91030	0.2280
21/12/2006	4.25870	4.26841	0.2280
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16/01/2008	2.38320	2.38863	0.2280
17/01/2008	2.57360	2.57947	0.2280
18/01/2008	2.16450	2.16944	0.2280
19/01/2008	1.91820	1.92257	0.2280
20/01/2008	1.99960	2.00416	0.2280
21/01/2008	2.35380	2.35917	0.2280
22/01/2008	2.90480	2.91142	0.2280
23/01/2008	2.60100	2.60693	0.2280
24/01/2008	2.42460	2.43013	0.2280
25/01/2008	2.52330	2.52905	0.2280
26/01/2008	2.50710	2.51282	0.2280
27/01/2008	2.51070	2.51642	0.2280
28/01/2008	2.88800	2.89458	0.2280
29/01/2008	2.45710	2.46270	0.2280
30/01/2008	2.98270	2.98950	0.2280
31/01/2008	2.54370	2.54950	0.2280
01/02/2008	2.99380	3.00063	0.2280
02/02/2008	3.51000	3.51800	0.2280
03/02/2008	3.24740	3.25480	0.2280
04/02/2008	3.31870	3.32627	0.2280
05/02/2008	2.96600	2.97276	0.2280
06/02/2008	2.77810	2.78443	0.2280
07/02/2008	2.54060	2.54639	0.2280
08/02/2008	2.28650	2.29171	0.2280
09/02/2008	2.61680	2.62277	0.2280
10/02/2008	2.38940	2.39485	0.2280
11/02/2008	2.43950	2.44506	0.2280
12/02/2008	2.42590	2.43143	0.2280
13/02/2008	2.26810	2.27327	0.2280
14/02/2008	2.77540	2.78173	0.2280
15/02/2008	2.61340	2.61936	0.2280
16/02/2008	2.78100	2.78734	0.2280

17/02/2008	2.83560	2.84207	0.2280
18/02/2008	3.25710	3.26453	0.2280
19/02/2008	3.35090	3.35854	0.2280
20/02/2008	3.54120	3.54927	0.2280
21/02/2008	2.85730	2.86381	0.2280
22/02/2008	2.75160	2.75787	0.2280
23/02/2008	2.58630	2.59220	0.2280
24/02/2008	2.15910	2.16402	0.2280
25/02/2008	2.62680	2.63279	0.2280
26/02/2008	2.17740	2.18236	0.2280
27/02/2008	1.90160	1.90594	0.2280
28/02/2008	2.13120	2.13606	0.2280
29/02/2008	2.57350	2.57937	0.2280
01/03/2008	2.25550	2.26064	0.2280
02/03/2008	1.96290	1.96738	0.2280
03/03/2008	2.34300	2.34834	0.2280
04/03/2008	2.50940	2.51512	0.2280
05/03/2008	2.64410	2.65013	0.2280
06/03/2008	2.02160	2.02621	0.2280
07/03/2008	1.99330	1.99784	0.2280
08/03/2008	2.35920	2.36458	0.2280
09/03/2008	2.51520	2.52093	0.2280
10/03/2008	2.83950	2.84597	0.2280
11/03/2008	2.15840	2.16332	0.2280
12/03/2008	2.60230	2.60823	0.2280
13/03/2008	2.19630	2.20131	0.2280
14/03/2008	2.23380	2.23889	0.2280
15/03/2008	2.01250	2.01709	0.2280
16/03/2008	2.59850	2.60442	0.2280
17/03/2008	2.92290	2.92956	0.2280
18/03/2008	2.58210	2.58799	0.2280
19/03/2008	2.46370	2.46932	0.2280
20/03/2008	2.55330	2.55912	0.2280
21/03/2008	3.38451	3.39223	0.2280
22/03/2008	3.51990	3.52793	0.2280
23/03/2008	3.53960	3.54767	0.2280
24/03/2008	3.48320	3.49114	0.2280
25/03/2008	3.22010	3.22744	0.2280
26/03/2008	2.78011	2.78645	0.2280
27/03/2008	3.08310	3.09013	0.2280
28/03/2008	3.12130	3.12842	0.2280
29/03/2008	2.28970	2.29492	0.2280
30/03/2008	2.13390	2.13877	0.2280
31/03/2008	2.54730	2.55311	0.2280
01/04/2008	2.07680	2.08154	0.2280
02/04/2008	2.08820	2.09296	0.2280
03/04/2008	1.99410	1.99865	0.2280
04/04/2008	1.81640	1.82054	0.2280
05/04/2008	2.99840	3.00524	0.2280

06/04/2008	3.63980	3.64810	0.2280
07/04/2008	4.13350	4.14292	0.2280
08/04/2008	3.52670	3.53474	0.2280
09/04/2008	3.31000	3.31755	0.2280
10/04/2008	2.95190	2.95863	0.2280
11/04/2008	3.10840	3.11549	0.2280
12/04/2008	2.60660	2.61254	0.2280
13/04/2008	3.10580	3.11288	0.2280
14/04/2008	4.18450	4.19404	0.2280
15/04/2008	3.86250	3.87131	0.2280
16/04/2008	3.13830	3.14546	0.2280
17/04/2008	2.81810	2.82453	0.2280
18/04/2008	3.47940	3.48733	0.2280
19/04/2008	3.20071	3.20801	0.2280
20/04/2008	2.45150	2.45709	0.2280
21/04/2008	2.28329	2.28850	0.2280
22/04/2008	2.02320	2.02781	0.2280
23/04/2008	2.39460	2.40006	0.2280
24/04/2008	2.25370	2.25884	0.2280
25/04/2008	1.99380	1.99835	0.2280
26/04/2008	1.59560	1.59924	0.2280
27/04/2008	1.60210	1.60575	0.2280
28/04/2008	1.67191	1.67572	0.2280
29/04/2008	1.92139	1.92577	0.2280
30/04/2008	2.31640	2.32168	0.2280
01/05/2008	2.03091	2.03554	0.2280
02/05/2008	1.75240	1.75640	0.2280
03/05/2008	1.59340	1.59703	0.2280
04/05/2008	0.18930	0.18973	0.2280
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06/05/2008	0.00000	0.00000	0.0000
07/05/2008	0.00000	0.00000	0.0000
08/05/2008	0.00000	0.00000	0.0000
09/05/2008	0.00000	0.00000	0.0000
10/05/2008	0.00000	0.00000	0.0000
11/05/2008	0.00000	0.00000	0.0000
12/05/2008	0.00000	0.00000	0.0000
13/05/2008	0.00000	0.00000	0.0000
14/05/2008	0.00000	0.00000	0.0000
15/05/2008	0.00000	0.00000	0.0000
16/05/2008	0.00000	0.00000	0.0000
17/05/2008	0.00000	0.00000	0.0000
18/05/2008	0.00000	0.00000	0.0000
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22/05/2008	0.00000	0.00000	0.0000
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24/05/2008	0.00000	0.00000	0.0000

25/05/2008	0.00000	0.00000	0.0000
26/05/2008	0.00000	0.00000	0.0000
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01/06/2008	0.00000	0.00000	0.0000
02/06/2008	0.00000	0.00000	0.0000
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14/06/2008	0.00000	0.00000	0.0000
15/06/2008	0.00000	0.00000	0.0000
16/06/2008	0.00000	0.00000	0.0000
17/06/2008	0.00000	0.00000	0.0000
18/06/2008	1.61630	1.61999	0.2280
19/06/2008	2.54360	2.54940	0.2280
20/06/2008	3.09270	3.09975	0.2280
21/06/2008	3.05790	3.06487	0.2280
22/06/2008	2.82260	2.82904	0.2280
23/06/2008	0.22740	0.22792	0.2280
24/06/2008	0.00000	0.00000	0.0000
25/06/2008	0.37370	0.37455	0.2280
26/06/2008	0.40640	0.40733	0.2280
27/06/2008	0.00000	0.00000	0.0000
28/06/2008	0.00000	0.00000	0.0000
29/06/2008	0.00000	0.00000	0.0000
30/06/2008	0.00000	0.00000	0.0000
01/07/2008	0.00000	0.00000	0.0000
02/07/2008	0.00000	0.00000	0.0000
03/07/2008	0.00000	0.00000	0.0000
04/07/2008	0.00000	0.00000	0.0000
05/07/2008	0.00000	0.00000	0.0000
06/07/2008	0.00000	0.00000	0.0000
07/07/2008	0.00000	0.00000	0.0000
08/07/2008	0.00000	0.00000	0.0000
09/07/2008	0.00000	0.00000	0.0000
10/07/2008	0.00000	0.00000	0.0000