



# **ASSESSMENT OF ERROR DUE TO ORIFICE DIAMETER MIS-MEASUREMENT AT HORNDON B**

**A Report for**

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

**PROJECT NO: NGR010**

**REPORT NO: 2010/251**

**DATE: 16 JUNE 2010**



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

## **NOTES**

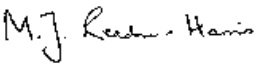
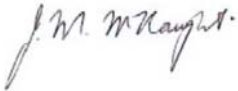
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## Assessment of Error Due to Orifice Diameter Mis-Measurement at Horndon B

A Report for

National Grid  
Brick Kiln Street  
HINCKLEY  
Leicestershire  
LE10 0NA

<b>Prepared by:</b>  	<b>Approved by:</b>  
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for  
Michael Valente  
Managing Director

Date: 16 June 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 Horndon B although plate 590-R was mis-measured on 07/08/2007, it was correctly measured on 14/12/2007 and not installed in the line until 27/02/2008. Therefore no error occurred at Horndon B due to the mis-measured orifice plate.

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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 Horndon B in the period of the error. The Joint Office Error Code is NT001.

## 2 ORIFICE DIAMETERS

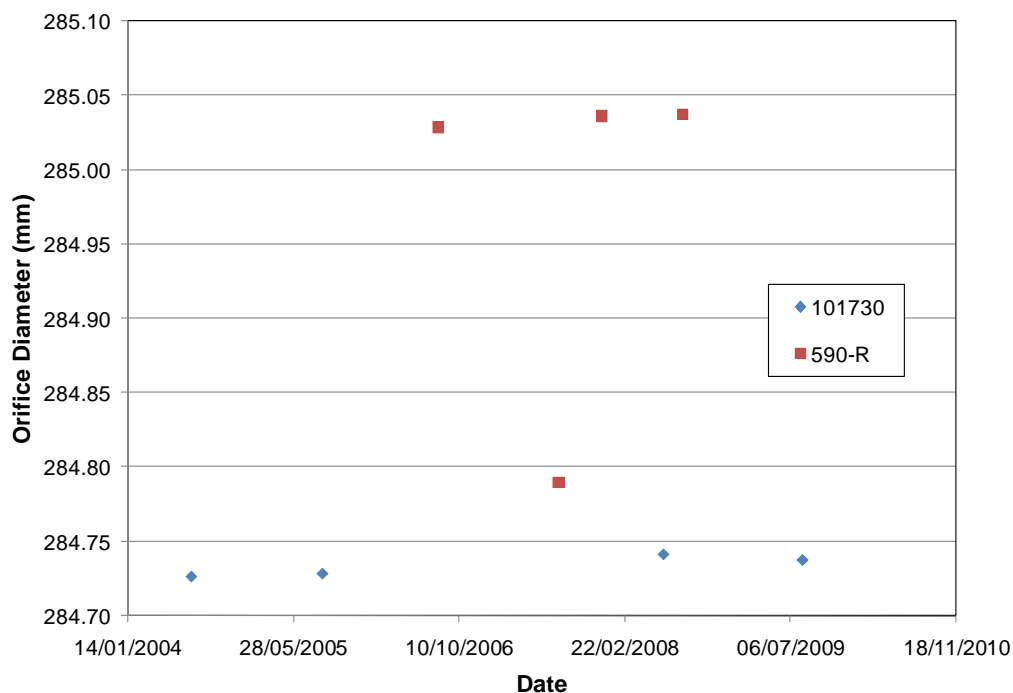
The calibrations of the orifice plates in question gave the measured diameters shown in Table 1. The diameters at 20 °C have been calculated.

**TABLE 1**  
**ORIFICE DIAMETERS**

Calibration Reference	Plate serial no	Declared certificate date	Orifice bore (mm)	Temperature	Value at 20 °C Orifice bore (mm)
OP4065	101730	23/07/2004	284.7310	21	284.7264
OP50110	101730	23/08/2005	284.7330	21	284.7284
OP60130	590-R	09/08/2006	285.0330	21	285.0284
OP70080	590-R	07/08/2007	284.7900	20	284.7900
OP70094	590-R	14/12/2007	285.0360	20	285.0360
OP80028	101730	18/06/2008	284.7415	20	284.7415
OP80049	590-R	13/08/2008	285.0370	20	285.0370
OP90031	101730	12/08/2009	284.7395	20.4	284.7377

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 the meter tube are given in Table 2. It can be seen that plate 590-R was not installed in the tube with a mis-measured diameter. Therefore there was no error in measurements taken at Horndon B, and no correction is necessary.

TABLE 2

## PLATES USED IN EACH LINE AS CONFIGURED BY THE FLOW COMPUTER

Configuration	omnM0924.cfg	omnN0226.cfg	omnN0603.cfg	omnN0704.cfg
	24/09/2007 23:01	27/02/2008 00:01	03/06/2008 23:01	04/07/2008 23:01
Orifice plate bore diameter (mm)	284.733	285.036	285.036	284.7415
Expansion coefficient of the plate (/°C)	0.000016	0.000016	0.000016	0.000016
Orifice plate calibration temperature	21	20	20	20
Meter tube diameter (mm)	432.0318	432.0318	432.0318	432.0318
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	1.3483	1.3483	1.3482	1.3482
Dynamic Viscosity (Pa.s)	0.000012	0.000012	0.0000119	0.0000119
Orifice plate certificate number	OP50110	OP70094	OP70094	OP80028
Orifice plate serial number	101730	590-R	590-R	101730
Error in orifice diameter?	No	No	No	No

### 3 CONCLUSIONS

Although plate 590-R was mis-measured on 07/08/2007, it was correctly measured on 14/12/2007 and not installed in the line until 27/02/2008. Therefore no error occurred at Horndon B due to the mismeasurement of the orifice plate.

**APPENDIX A  
ORIFICE PLATE CALIBRATION CERTIFICATES**

**TRANSCO ORIFICE PLATE CALIBRATION**

**DATE:** 23-07-04  
**REF NO:** OP4065  
**TEMPERATURE:** 21 degsC

**MEASURED ORIFICE BORE:** 284.731mm

**PLATE DETAILS**

PLATE SERIAL.	101730	PLATE O.D	471.443mm	SITE:	HORDON AGI
MANUFACTURER:	DANIEL	PIPE I.D:	mm	FLOW:	
MATERIAL CERT.No	K01085	DESIGN BORE:	mm		

**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:-	1	2	3	4	5	6	7	8
FLATNESS $\mu$	0.026	0.058	0.050	0.086	0.128	0.027	0.041	0.007
'E' mm	8.424	8.342	8.360	8.440	8.389	8.328	8.284	8.380
'e' mm	6.355	6.401	6.348	6.268	6.259	6.271	6.350	6.366
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125

CONCENTRICITY 0.213mm

SURFACE FINISH (Ra) 0.7 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.026mm TAPER: 0 degs

BEVEL ANGLE: 44DEGS

**COMMENTS**

INSPECTED BY  G. WARDLE  
 VERIFIED BY  P. KENNERSON



NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 23-08-05  
 REF NO: OP50110  
 TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 284.733mm

PLATE DETAILS

PLATE SERIAL. 101730 PLATE O.D 471.398mm  
 MANUFACTURER: DANIEL PIPE I.D: mm SITE: HORNDON AGI  
 MATERIAL CERT.No K01085 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	4	5	6	7	8
FLATNESS %	0.023	0.057	0.061	0.082	0.248	0.012	0.031	0.026
'E' mm		8.365	8.359	8.457	8.382	8.360	8.295	8.374
'e' mm	6.364	6.397	6.365	6.275	6.254	6.270	6.359	6.346
EDGE SHARPNESS mm	SQUARE	SQUARE	SQUARE	SQUARE	0.0125	SQUARE	0.0125	SQUARE
BEVEL ANGLE	44 DEGS							
CONCENTRICITY	0.207mm							
SURFACE FINISH (Ra)	1.7 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS : 0.009mm TAPER: 0 degs

COMMENTS:

INSPECTED BY



P. KENNERSON

**NATIONAL GRID ORIFICE PLATE CALIBRATION**

**DATE:** 09-08-06  
**REF NO:** OP60130  
**TEMPERATURE:** 21 degsC

**MEASURED ORIFICE BORE:** 285.033mm

**PLATE DETAILS**

PLATE SERIAL.	590-R	PLATE O.D	471.226mm		
MANUFACTURER:	DANIEL	PIPE I.D:	mm	SITE:	HORNDON
MATERIAL CERT.No.	DUK7291	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				
FLATNESS $\mu$	0.158	0.146	0.259	0.160	0.102	0.118	0.159	0.244	
'E' mm	5.589	5.552	5.543	5.542	5.460	5.603	5.532	5.576	
'e' mm									
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	SQUARE	0.0125	SQUARE	0.0125	
BEVEL ANGLE:	DEGS								
CONCENTRICITY	0.168mm								
SURFACE FINISH (Ra)	0.7 microns								
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS								
ROUNDNESS	0.014mm	TAPER:		0 degs					

COMMENTS

INSPECTED BY:  P. KENNERSON /  J. CHAUHAN

**NATIONAL GRID ORIFICE PLATE CALIBRATION**

**DATE:** 07-AUG-2007

**REF NO:** OP70080

**TEMPERATURE:** 20 degsC

**MEASURED ORIFICE BORE:** 284.79mm

**PLATE DETAILS**

PLATE SERIAL.	590 R	PLATE O.D	470.891mm	SITE:	HORNDON
MANUFACTURER:	DANIEL DVS	PIPE I.D:	mm	FLOW:	
MATERIAL CERT.No.		DESIGN BORE	mm		

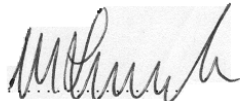
**TEST EQUIPMENT**

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

**UPSTREAM FACE INSPECTION RESULTS (ISO 5167)**

STATIONS:-	1	2	3	4	5	7	8	
FLATNESS %	0.220	0.148	0.239	0.150	0.133	0.094	0.122	0.250
'E' mm	5.617	5.593	5.543	5.603	5.646	5.615	5.531	5.531
mm								
EDGE SHARPNESS mm	0.125	0.125	SQUARE	0.125	0.125	SQUARE	0.125	SQUARE
BEVEL ANGLE								
CONCENTRICITY	0.053mm							
SURFACE FINISH (Ra)	0.68 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :-	PASS							
ROUNDNESS	0.248mm	TAPER:	0 degs					

**COMMENTS**

INSPECTED BY  M Livingstone

**NATIONAL GRID ORIFICE PLATE CALIBRATION**

**DATE:** 14-DEC-2007

**REF NO:** OP70094

**TEMPERATURE:** 20 degsC

**MEASURED ORIFICE BORE:** 285.036mm

PLATE DETAILS

PLATE SERIAL:	590-R	PLATE O.D	471.275mm		
MANUFACTURER:	DANIEL	PIPE I.D:	mm	SITE	HORNDON
MATERIAL CERT.No.	DUK7291	DESIGN BORE	mm	FLOW	M <sup>3</sup> /DA

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 %	0.043	0.039	0.035	0.060	0.013	0.020	0.008	0.030
	5.375	5.394	5.399	5.398	5.342	5.386	5.377	5.356
mm								
EDGE SHARPNESS mm	SQUARE	SQUARE	SQUARE	SQUARE	SQUARE	SQUARE	SQUARE	SQUARE
BEVEL ANGLE:	DEGS							
CONCENTRICITY	0.029mm							
SURFACE FINISH (Ra)	0.7 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS							
ROUNDNESS	0.012mm	TAPER:	0 degs					

COMMENTS

INSPECTED BY:



M LIVINGSTONE

**NATIONAL GRID ORIFICE PLATE CALIBRATION**

**DATE:** 18-JUNE-2008

**REF NO:** OP80028

**TEMPERATURE:** 20 degsC

**MEASURED ORIFICE BORE:** 284.7415mm

PLATE DETAILS

PLATE SERIAL.	101730	PLATE O.D	471.430mm	SITE:	HORNDON
MANUFACTURER:	DANIEL	PIPE I.D:	432.0318mm	FLOW:	M <sup>3</sup> /DAY
MATERIAL CERT.No.	K01085	DESIGN BORE:	mm		

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 %	0.020	0.053	0.073	0.081	0.048	0.037	0.033	0.003
'E' mm	8.407	8.358	8.361	8.451	8.381	8.367	8.290	8.365
'e' mm	6.343	6.378	6.347	6.255	6.249	6.288	6.355	6.354
EDGE SHARPNESS mm	0.0125	SQUARE	SQUARE	SQUARE	0.0125	SQUARE	SQUARE	SQUARE
BEVEL ANGLE:	44 DEGS							
CONCENTRICITY	0.221mm							
SURFACE FINISH (Ra)	0.9 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS :	0.012mm	TAPER:	0 degs					

DRAINHOLE PRESENT ? (YES/NO): No

COMMENTS: CLEAN PLATE

INSPECTED BY  M Livingston

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 13-AUG-2008

REF NO: OP80049

TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 285.037mm

PLATE DETAILS

PLATE SERIAL. 590-R PLATE O.D 471.315mm  
 MANUFACTURER: DANIEL PIPE I.D: 432.0318mm SITE: HORNDON  
 MATERIAL CERT.No DUK7291 DESIGN BORE: mm FLOW: M<sup>3</sup>/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			
FLATNESS %	0.093	0.052	0.016	0.030	0.012	0.013	0.034	0.019
'E' mm	5.408	5.407	5.340	5.392	5.392	5.359	5.375	5.392
'e' mm								
EDGE SHARPNESS mm	0.0125	0.0125	SQUARE	SQUARE	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:	DEGS							
CONCENTRICITY	0.050mm							
SURFACE FINISH (Ra)	0.7 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.007mm TAPER: 0 degs

DRAINHOLE PRESENT ? (YES/NO) No

COMMENTS: CLEAN PLATE.

INSPECTED BY:  M Livingstone

**NATIONAL GRID ORIFICE PLATE CALIBRATION**

**DATE:** 12-AUG-2009  
**REF NO:** OP90031  
**TEMPERATURE:** 20.4 degsC

**MEASURED ORIFICE BORE:** 284.7395mm

**PLATE DETAILS**

PLATE SERIAL. 101730 PLATE O.D 471.418mm  
 MANUFACTURER: DANIEL PIPE I.D: 432.0318mm SITE: HORNDON  
 MATERIAL CERT.No. HTK01085 DESIGN BORE: mm FLOW: M<sup>3</sup>/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)**

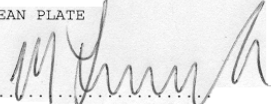
STATIONS:-	1	2	3	4	5	6	7	8
FLATNESS $\mu$	0.036	0.063	0.064	0.066	0.025	0.048	0.044	0.03
RE mm	8.409	8.359	8.354	8.450	8.384	8.369	8.290	8.362
le mm	6.360	6.385	6.360	6.272	6.223	6.284	6.354	6.358
EDGE SHARPNESS mm	SQUARE	SQUARE	SQUARE	SQUARE	0.0125	0.0125	0.0125	SQUARE
BEVEL ANGLE	44 DEGS							
CONCENTRICITY	0.208mm							
SURFACE FINISH (Ra)	0.75 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.017mm TAPER: 0 degs

DRAINHOLE PRESENT ? (YES/NO): No

COMMENTS: CLEAN PLATE

INSPECTED BY: 

M Livingstone.