Home Office

REPORT ON THE EVALUATION OF PURGE/BLANK CYCLE ON THE **INTOXIMETER EC/IR**

BY

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ON BEHALF OF

HOME OFFICE
PUBLIC ORDER UNIT

UKAS TESTING
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CONTENTS

1.0 INTRODUCTION

1.1 The Intoximeter EC/IR

The Intoximeter EC/IR is an Evidential Breath Alcohol Testing Instrument (EBTI) manufactured by Intoximeters Inc. (St. Louis, Missouri), supplied and serviced by Intoximeters UK Ltd. (Totnes, Devon). It was originally type approved in February 1998 for the purpose of performing evidential breath tests as laid out in the following legislation:

- Road Traffic Act 1988; and
- Transport and Works Act 1992.

In 2004, the Intoximeter EC/IR was further type approved so that it could also be used to perform evidential breath tests under the Railway and Transport Safety Act 2003.

All currently type approved EBTIs, including the Intoximeter EC/IR, follow a prescribed eight step measurement cycle defined in '*Evidential Breath Alcohol Testing Instruments: A Guide to Type Approval Procedures for Evidential Breath Alcohol Testing Instruments used for Road Traffic Law Enforcement in Great Britain'*, 1994, HMSO [hereinafter referred to as 'the Guide [1994]']. This measurement cycle is designed with a number of checks and balances to ensure that the result of the concentration of ethanol in end-expiratory breath can be relied upon in court. The measurement cycle is defined in Section 5.6 of the Guide [1994] as:

1. Purge and check zero
2. Verification of calibration by simulation
3. Purge and check zero
4. Take and analyse specimen 1
5. Purge and check zero
6. Take and analyse specimen 2
7. Purge and check zero
8. Verification of calibration by simulation.

The instrument shall then produce a print-out following completion of the measurement cycle. The print-out shall be in a particular format and the results and the associated time for each step shall be clearly identifiable.

It has been observed that the Intoximeter EC/IR on some occasions carries out an extended purge/blank cycle between the taking and analysis of Specimen 1 and the taking and analysis of Specimen 2. It has been claimed that because of this the Intoximeter EC/IR is either unreliable, or falls outside of the Type Approval specification.

The "purge and check zero" stage has two main purposes:

- The "purge" step is intended to clear the sampling chamber using ambient air, ensuring that there is no carry-over of sample between stages of the measuring cycle.

- The "check zero" step involves the instrument analysing the sample to confirm that there is no ethanol vapour in the analytical chamber. If the instrument detects ethanol vapour in the analytical chamber the test will automatically be aborted at this point, and the instrument will display an error message on the screen and on the printout for that test.

Intoximeters Inc. have advised that the extended purge cycle sometimes observed is part of the normal function of the instrument, and not because it is unreliable or outside type

approval specification. This is because the instrument was designed to carry out an extended purge/blank cycle after the first specimen of breath, if that breath specimen contained more than 50µg/100ml of ethanol. The limit at which the instrument carries out its extended purge/blank cycle is linked to the Statutory Option of replacing the result of a breath specimen with the result from a specimen of blood or urine. The Statutory Option was removed in April 2015.

Intoximeters Inc. have also advised CAST that there are other variables which affect the time taken to complete a purge blank cycle. The Intoximeter EC/IR will perform up to three purges in each purge/blank check cycle and each purge is followed by a base wait of up to 120 seconds before the blank check. The base wait is the time frame in which the Intoximeter EC/IR checks to ensure that the acceptable fuel cell sensor baseline has been reached prior to taking a sample for the blank check.

1.2 Evaluation

The evaluation presented herein consists of tests to establish in what situations the instrument performs an extended purge/blank check stage immediately after the first specimen of breath has been provided in order to test the information provided by Intoximeters Inc. These tests were undertaken in February 2015, according to a method which has been accredited by United Kingdom Accreditation Service (UKAS) to be compliant with the requirements of ISO/IEC 17025.

The Intoximeter EC/IR with a software version of v5.23 has been observed to operate with an extended purge/blank cycle after the first specimen where the analytical result of this specimen has a value of 50.2µg/100mL or greater.

The Intoximeter EC/IR displays and prints all results rounded down to the nearest integer value, therefore a reading of 50µg/100mL could be between 50.0µg/100mL and 50.9µg/100mL. Accordingly, a reading of 50µg/100mL for one specimen may give rise to an extended purge since the actual concentration could have been, for example, 50.9µg/100L, whilst a reading of 50µg/100mL in another specimen may not if the value of that specimen was 50.0 µg/100mL.

This report is not intended as a definitive and restrictive list of the performance of the Intoximeter EC/IR against the full requirements of the Guide [1994] but is rather intended to establish the circumstances in which the extended purge can be observed.

2.0 EQUIPMENT AND TEST PROCEDURES

OBJECTIVE:

1. To investigate whether the Intoximeter EC/IR does carry out an extended purge/blank cycle at step five of the evidential test cycle.
2. If so, whether there was a specific ethanol concentration at which this extended purge/blank stage starts to occur.

MANUFACTURING DESCRIPTION:	Evidential breath alcohol testing instrument
MANUFACTURER:	Intoximeters Inc. 2081 Craig Road, St Louis, Missouri, 63146, United States of America
INSTRUMENT NAME:	Intoximeter EC/IR
SOFTWARE VERSION:	V5.23
MANUFACTURER HANDBOOK:	Intoximeter EC/IR Administrator/Operator Manual United Kingdom
TESTING REQUIREMENTS:	A Guide to Type Approval Procedures For Evidential Breath Alcohol Testing Instruments Used For Road Traffic Law Enforcement In Great Britain [1994]
NUMBER OF DEVICES TESTED:	One
SERIAL NUMBERS:	01708
SECURITY CLASSIFICATION OF INSTRUMENT UNDER TEST:	None
START OF TEST:	3 February 2015
FINISH OF TEST:	4 February 2015

3.0 TEST REQUIREMENTS AND STANDARDS

The Intoximeter EC/IR serial number 01708 with software version 5.23 is an exemplar of the type approved instrument hardware and firmware. A specific testing requirement was established to explore the extended purge/blank cycle. Although the particular test reported here was tailored to explore a single step in the measurement cycle, CAST performed testing according to methods accredited to ISO/IEC 17025.

Tests were carried out on Intoximeter EC/IR serial number 01708, which was used during the original Type Approval testing (which finished in 1998). The instrument has been held on behalf of the Home Office since that date. The instrument was initially held by the Forensic Science Service, Lambeth laboratory until February 2012 and at the Home Office Centre for Applied Science and Technology (CAST), Sandridge laboratory since then.

Before testing, a calibration and service was undertaken by an Intoximeters (UK) Field Service Engineer.

3.1 Test method

Intoximeters Inc. and Intoximeters (UK) Limited state that the Intoximeter EC/IR is designed to carry out a longer purge/blank cycle after the first breath specimen in an evidential breath testing cycle, if that breath specimen has an ethanol concentration of more than 50µg/100mL.

In operational use, all type approved EBTIs display and print the result of each stage of the measurement cycle and rounded down to the nearest integer values. In this report, the instrument under test was set into "metrological mode" for testing which displays and prints the result of each stage of the test cycle to a greater precision of 0.1µg/100mL. This was done to enable investigation into the specific ethanol concentration at which the longer purge/blank cycle was triggered.

Testing was carried out with solutions having a nominal ethanol vapour concentration of 50µg/100mL at 34°C.

3.2 Key Equipment Used

Equipment	CAST Asset Number	Serial Number
Guth 34C Liquid Simulators	18367, 18370, 18364	G13097, G13095, G13091

3.3 Ethanol Vapour Samples

Aqueous ethanol solutions were made up to produce vapour samples from a liquid simulator at a nominal concentration of 50µg/100mL.

- Solutions were produced and certified in accordance with methods accredited to ISO/IEC 17025.
- Humid ethanol and air vapour samples were produced from a liquid simulator using the standard method accredited to ISO/IEC 17025.

3.4 Gas Standards

An ethanol/air mixture, prepared by The BOC Group Ltd. and certified by the National Physical Laboratory, was connected directly to the Intoximeter EC/IR *via* pneumatic tubing for use at stages 2 and 8 in the proscribed test sequence above. The nominal concentration of this gas standard was 35µg/100mL.

4.0 RESULTS AND OBSERVATIONS OF THE EVALUATION

A set of typical tests have been extracted from the large data set shown in Appendix A and presented in Table 1 below.

Measurement Cycle Stage	Time elapsed following 50.2µg/100mL (test no# 150203243)	Time elapsed following 50.0µg/100mL (test no# 150203244)	Time elapsed following 49.9µg/100mL (test no# 150203254)
Time to Purge	01:02	01:10	01:11
Purge	00:35	00:34	00:31
Blank Check	00:24	00:26	00:31
Specimen 1	00:30	00:30	00:33
Purge	01:35	00:32	00:35
Blank Check	00:26	00:25	00:30
Specimen 2	00:31	00:31	00:34
Purge	00:32	00:31	00:36
Blank Check	00:25	00:28	00:33
Sim Check 2	00:36	00:35	00:40
Purge	00:15	00:17	00:15

Table 1: Typical test times following different breath alcohol concentrations being presented to the Intoximeter EC/IR

Key findings from these data are:

- The Intoximeter EC/IR will carry out a purge of approximately 30 seconds followed by a blank check after the first specimen where the analytical result of this specimen has a value of up to, and including, 50.0µg/100mL.
- The Intoximeter EC/IR will carry out an extended purge time of approximately 130 seconds followed by a blank check after the first specimen where the analytical result of this specimen has a value of 50.2µg/100mL or greater. Extensive testing was carried out with the aim of ensuring 50.1µg/100mL was tested however it did not prove possible to deliver a specimen with this precise value.
- **The Intoximeter EC/IR displays and prints all results rounding down to the nearest integer value, therefore a reported value of 50µg/100mL could be anywhere between 50.0µg/100mL and 50.9µg/100mL. Accordingly, a reading for specimen 1 of 50µg/100mL in one instance may give rise to an extended purge, whilst another reading for specimen 1 of 50µg/100mL in another instance may not.** The Intoximeter EC/IR will carry out a standard purge of approximately 30 seconds followed by a blank check after the second specimen irrespective of the analytical result for this specimen.

The results of the tests demonstrate that the Intoximeter EC/IR operates with a longer purge cycle after the first specimen where the analytical result of this specimen has a value of 50.2µg/100mL or greater. This result is consistent with the statement from the manufacturer that the extended purge cycle is to be expected after the first specimen of breath, if that breath specimen contained more than 50µg/100ml of ethanol.

These tests were conducted on the instrument which was used for the original Type Approval testing, and therefore this longer purge/blank cycle formed part of the original type approved instrument. Any operational instrument which carries out this long purge during an evidential test cycle is therefore behaving as expected.

Appendix A – Results of Analytical Testing

Data points missing have been marked with *XXX*. Reasons for the missing data could be various and not linked to the instruments functionality.

Test #	150203230		150203231		150203232		150203233		150203234		150203235		150203236		150203240		150203241		150203242		150203243		150203244	
	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time
Time to Purge						01:05		00:59		01:05		01:06		01:05		01:08		01:01		01:05		01:02		01:10
Purge						00:33		00:35		00:33		00:32		00:35		00:31		00:33		00:34		00:35		00:34
Blank Check						00:25		00:24		00:25		00:26		00:25		00:24		00:23		00:22		00:24		00:26
Specimen 1	52.2		52.2		48.8	00:25	51.4	00:34	52.1	00:28	52.5	00:27	52.9	00:28	50.3	00:34:04	49.8	00:31	48.4	00:30	50.2	00:30	50.0	00:30
Purge						00:35		01:27		01:34		01:33		01:34		01:36		00:34		00:37		01:35		00:32
Blank Check						00:29		00:25		00:22		00:23		00:22		00:21		00:25		00:22		00:26		00:25
Specimen 2	51.7		52.7		47.9	00:26	52.1	00:28	52.7	00:24	52.6	00:26	53.5	00:28	50.5	00:30	XXX		50.1	00:31	50.4	00:31	49.6	00:31
Purge						00:35		00:37		00:40		00:33		00:34		00:33				00:33		00:32		00:31
Blank Check						00:23		00:22		00:21		00:26		00:24		00:22				00:25		00:25		00:28
Sim Check 2						00:31.5		00:31		00:30		00:33		00:34		00:30				00:35		00:36		00:35
Purge						00:15		00:15		00:15		00:15		00:21		00:15				00:14		00:15		00:17

Test #	150203245		150203246		150203247		150203248		150203249		150203250		150203251		150203252		150203253		150203254		150203255		150203256	
	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time
Time to Purge		01:02		01:09		01:10		01:29		01:06		01:06		01:11		01:03		01:36		01:11		01:12		01:23
Purge		00:34		00:35		00:32		00:32		00:32		00:31		00:33		00:32		00:32		00:31		00:31		00:32
Blank Check		00:24		00:26		00:24		00:28		00:29		00:33		00:24		00:32		00:31		00:31		00:30		00:25
Specimen 1	49.1	00:32	47.3	00:29	51.2	00:30	48.8	00:31	49.6	00:32	50.2	00:32	50.7	00:31	50.2	00:32	49.6	00:32	49.9	00:33	49.8	00:31	49.8	00:35
Purge		00:32		00:31		01:36		00:33		00:34		01:34		01:37		01:36		00:33		00:35		00:37		00:37
Blank Check		00:25		00:22		00:22		00:25		00:24		00:23		00:22		00:22		00:27		00:30		00:36		00:38
Specimen 2	49.4	00:31	49.5	00:31	51.2	00:31	48.6	00:30	50.3	00:31	51.0	00:34	50.8	00:33	50.5	00:32	50.3	00:34	50.5	00:34	49.8	00:34	50.2	00:34
Purge		00:32		00:37		00:33		00:31		00:32		00:32		00:32		00:31		00:34		00:36		00:36		00:35
Blank Check		00:23		00:23		00:24		00:24		00:25		00:26		00:25		00:25		00:30		00:33		00:34		00:34
Sim Check 2		00:35		00:32		00:33		00:32		00:38		00:38		00:42		00:38		00:40		00:40		00:42		00:40
Purge		00:15		00:15		00:15		00:15		00:15		00:15		00:16		00:15		00:15		00:15		00:15		00:15

Test #	150204257		150204258		150204259		150204260		150204261		150204262		150204263		150204264		150204265		150204266		150204267		150204268	
	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time
Time to Purge		01:10				01:08		01:12				01:18		01:15		01:23		01:03		01:08		01:07		01:18
Purge		00:31				00:31		00:31				00:31		00:31		00:33		00:32		00:31		00:31		00:33
Blank Check		00:22				00:21		00:26				00:21		00:22		00:23		00:22		00:22		00:22		00:23
Specimen 1	50.2	00:27	-		49.7	00:32	49.5	00:29	49.3		49.0	00:26	49.6	00:32	50.8	00:32	51.8	00:33	49.0	00:34	49.8	00:35	50.4	00:34
Purge		01:35				00:31		00:32				00:32		00:34		01:39		01:36		00:32		00:32		01:34
Blank Check		00:22				00:23		00:23				00:24		00:22		00:21		00:21		00:22		00:26		00:24
Specimen 2	49.8	00:31	-		49.4	00:31	49.5	00:33	XXX		49.0	00:32	50.7	00:32	51.5	00:34	50.3	00:31	50.6	00:33	51.4	00:35	51.3	00:35
Purge		00:35				00:33		00:31				00:32		00:31		00:32		00:35		00:32		00:32		00:31
Blank Check		00:25				00:26		00:24				00:25		00:24		00:23		00:22		00:25		00:28		00:22
Sim Check 2		00:31				00:33		00:36				00:34		00:36		00:28		00:38		00:40		00:40		00:41
Purge		00:15				00:15		00:15				00:15		00:15		01:16		00:15		00:15		00:15		00:16

Test #	150204268		150204269		150204270		150204271		150204272		150204273		150204274		150204275		150204276		150204277		150204278		150204279	
	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time	BrAc	Time
Time to Purge		01:09		01:19		01:11		01:25		01:25		01:07		01:13		01:09		01:09		01:14		01:25		01:13
Purge		00:32		00:33		00:34		00:32		00:32		00:31		00:33		00:35		00:31		00:31		00:31		00:30
Blank Check		00:22		00:24		00:23		00:22		00:22		00:23		00:28		00:21		00:25		00:25		00:22		00:26
Specimen 1	50.4	00:36	49.5	00:37	49.5	00:28	48.9	00:34	49.4	00:34	49.5	00:30	49.5	00:35	50.4	00:35	50.0	00:39	48.9	00:37	49.1	00:33	49.4	00:37
Purge		00:32		00:34		00:33		00:35		00:35		00:32		00:33		01:35		00:35		00:37		00:36		00:32
Blank Check		00:26		0.15		00:31		00:32		00:32		00:24		00:28		00:22		00:29		00:23		00:31		00:35
Specimen 2	51.3	00:35	50.1	00:35	50.1	00:36	50.5	00:35	50.3	00:35	50.4	00:33	50.0	00:35	50.5	00:38	50.7	00:36	49.4	00:37	48.9	00:37	49.7	00:37
Purge		00:31		00:32		00:31		00:32		00:32		00:34		00:31		00:32		00:31		00:37		00:32		00:32
Blank Check		00:29		00:29		00:33		00:33		00:33		00:24		00:28		00:23		00:29		00:34		00:38		00:41
Sim Check 2		00:41		00:41		00:44		00:45		00:45		00:31		00:35		00:39		00:43		00:44		00:45		00:45
Purge		00:16		00:15		00:16		00:15		00:15		00:15		00:15		00:15		00:15		00:15		00:15		00:16