Introduction of Evidential Breath Testing in Ireland

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Introduction

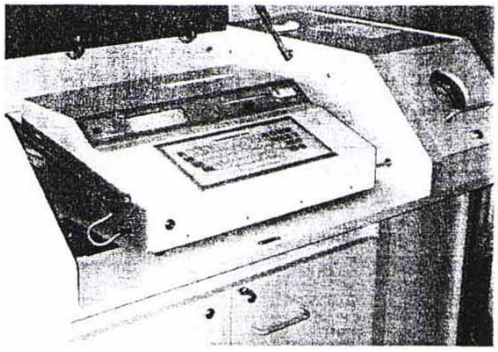
Evidential Breath Testing (EBT) is the term used to describe the determination of alcohol concentration in expired breath. Originally some jurisdictions reported the result of a breath test in terms of blood alcohol concentration; however, most EU countries now operate an EBT program with breath alcohol limits defined by statute. The limit in Ireland is prescribed in the 1994 Road Traffic Act at 35 µg/100ml, with more severe penalties for levels exceeding 44 and 66 µg/100ml.

Under section 6 of the above Act, the Medical Butrsu of Road Safely (the Bureau) has a statutory duty to arrange for the approval, supply and testing of apparatus for determining the concentration of alcohol in the breath. As part of the Government Strategy for Road Safety 1998-2002, the Bureau evaluated different types of instruments for this purpose from June 1999 to September 1999. two of these instruments were the lion intoxilyzer 6000IRI., manufactured by Lion Laboratories, Cardiff, and the INTOXIMETER EC/IR manufactured by Intoximeters UK Ltd., Devon. Both these instruments were already tested in the UK by the Home Office at their Forensic Science Laboratories and are in use by police forces throughout Britain.

The specifications against which the instruments were tested in the Bureau are based on those used by the Home Office[1] and the recommendations of the Organisation Internationale Métrologie Légale (OIML).[2]

Technology

GC and colorimetric methods have been used in the past for breath alcohol analysis with varying degrees of success.



Recently two technologies have emerged for providing a sound fundamental basis for EBT equipment. These are fuel cell and infra-red technology

Fuel Cell

The alcohol fuel cell as used in the INTOXIMETER EC/IR consists of a porous inert layer coated on both sides with platinum black. The porous layer is impregnated with an acidic electrolyte solution and platinum electrical connections are applied to the platinum black surfaces. A gas inlet is provided to allow a sample of breath alcohol to be introduced (Figure I). Oxidation of alcohol lakes place on the upper surface of the cell, producing H+ions that migrate towards the -ve electrode. Thus a current, whose magnitude is proportional to the amount of alcohol consumed by the cell, flows when the two electrodes are connected externally.

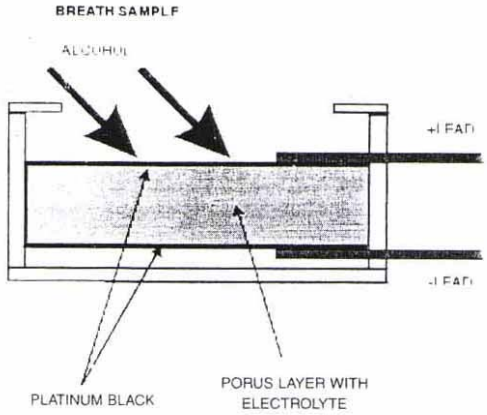


Figure 1

Infra-Red

The lion intoxilyzer 6000IRL uses the principle of infra -red absorption, A schematic diagram is shown in Figure 2.

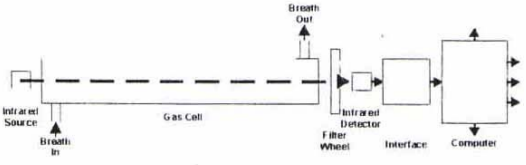


Figure 2

The greater the amount of alcohol in the gas chamber, the greater the amount of irradiation is absorbed, hence the detector output is reduced. The relationship between alcohol concentration and absorption is defined by Beer's law

Specificity is ensured by the use of four narrow band filters in the 3 micron range. If the ratio between the absorption at the four wavelengths is disturbed, the presence of an interfering substance is flagged.

Quality Control

One of the key elements in ensuring that EBT instruments produce reliable results is the external gas simulator. This takes the form of cylinder of compressed alcohol vapour in air and is supplied to the instrument for checking purposes only. If the analysed value of the check gas falls outside an allowed tolerance, the test will abort and will not analyse breath samples. Each cylinder is supplied by BOC and is certified to contain 35 µg/100ml +/-0.7 µg/100ml. During a normal subject test this gas is analysed twice, at the start and at the end of the test. Following the analysis of a breath specimen or check gas sample, the system is purged with ambient air and checked to ensure that the room air is free of alcohol. An example of the instrument printout is shown in Figure 3.

Uncertainty of Measurement

From the above printout it can be seen that the result used for the purposes of the relevant section of the Road Traffic Act 1961 is significantly lower than either breath specimen 1 or 2. In fact, 17.5% is subtracted from the lower of the two results and this resultant figure is used for prosecution purposes. Such a subtraction is a forensic scientific prerequisite to allow for analytical variation, the maximum permissible tolerances of the instrument and the presumption of innocence in favour of an accused in Irish jurisprudence. The value of 17.5% was calculated in consultation with the National Metrology Laboratory and the Legal Metrology Service.

Laboratory Evaluation

Two lion intoxilyzer 6000IRL and two INTOXIMETER EC/IR instruments were tested under the following headings: Accuracy, precision, specificity, clock accuracy and barometer accuracy.

Accuracy

Alcohol vapours were generated at 0, 35, 44, 66 and 200 µg/100ml using two Guth C34 simulators heated to 34ºC, connected in tandem and charged with ethanol solutions at know concentrations. These solutions were prepared in the Bureau and are traceable to LGC standard. Vapours thus generated were analysed (n=10) by the test instruments on a weekly basis over an extended period. The deviations of the reported results from the target values at the 35

Road Traffic Act 1994, section 17-statement
APPARATUS: lion intoxilyzer 6000IRL
SERIAL NUMBER: B0406

GARDA SIOCHÁNA STATION: ANYTOWN GARDA STATION

TEST NUMBER: B0406/0001
DATE OF START OF TEST: 1ST APRIL 2000

PERSON WHO PROVIDED SPECIMENS:
NAME: AN OTHER
ADDRESS: ANY ROAD
ANY TOWN

ANALYSIS

	TEST	µg/100ml	TIME
BLANK	000	15:15	
SIMULATOR CHECK 1	035		15:15
BLANK	000	15:16	
BREATH SPECIMEN 1		070	15:17
BLANK	000	15:17	
BREATH SPECIMEN 2		071	15:18
BLANK	000	15:18	
SIMULATOR CHECK 2		035	15:19

The specimen to be taken into account for the purposes of section 19(i) of the Road Traffic Act 1961 is specimen 1 above. The concentration of alcohol in the breath for the purposes of that section is 057 microgrammes of alcohol per 100 millilitres of breath.

Member of an Garda Siochana

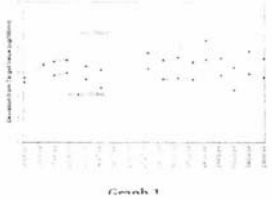
NAME:
NUMBER
SIGNATURE……..…

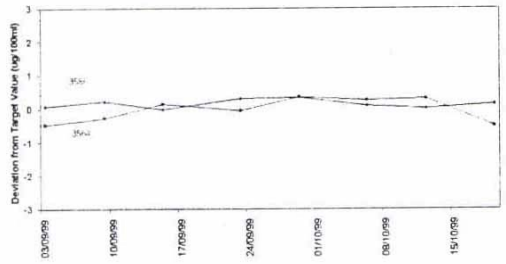
I, the undersigned, hereby acknowledge the receipt of this statement.

……
Signature of person who provided specimens of breath.

Figure 3

µg/100ml level for both lion intoxilyzer 6000IRL instruments are shown in Graph 1. Similar results for the INTOXIMETER EC/IR are shown in Graph 2. The maximum permissible error allowed by OIML at this level is ± 3 µg/100ml.

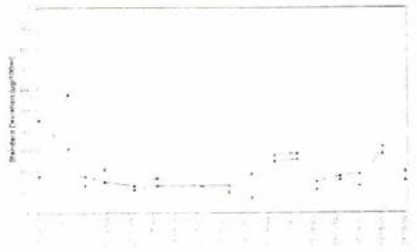




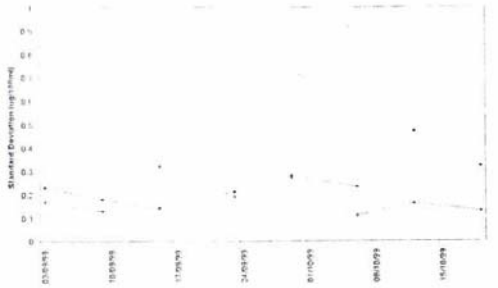
Graph 2

Precision

The within day standard deviation (n=10) was calculated for cacti instrument once a week. The results at the 35 µg/100ml level are shown in Graphs 3 and 4.



Graph 3



Graph 4

The maximum permissible within day standard deviation allowed by OIML at this level is 1.0 µg/100ml

Specificity

Certified compressed gases containing 35 ug/10ml ethanol plus 15 u.g/100ml acetone and 35 µg/100ml ethanol plus 5 µg/100ml methanol were used for this purpose.

All instruments were tested weekly and it was noted that the instruments either flagged "Interfering Substance" or the results were within the allowed OIML tolerance as shown below.

Permitted Tolerances:

Methanol: 4 µg/100ml

Acetone: 3 µg/100ml

Real Time Clock and Internal Barometer Accuracy

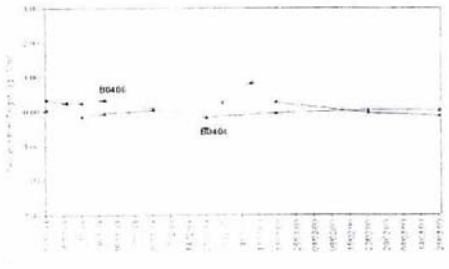
All instruments tested performed within the specification claimed by the manufacturer and allowed by the UK Home Office.

Field Tests

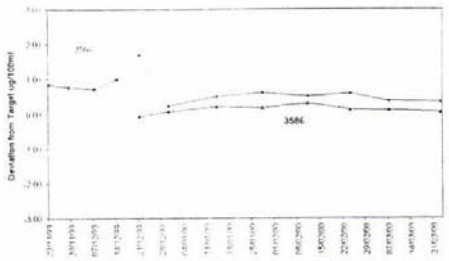
All four approved instruments were installed in selected Garda Stations in October and November 1999. To evaluate their performance in the field, Bureau staff tested the instruments on a weekly basis for the first four weeks, followed by monthly tests for the next six months. The format of the tests in the field followed the same pattern as already described in the laboratory. It is intended to eventually increase the testing interval to six months.

Accuracy

Graph 5 shows the lion intoxilyzer 6000IRL response to an alcohol vapour generated at the 35 ug/100ml level using tandem simulator[1]. Field results for the INTOXIMETER EC/IR instruments are shown in Graph 6. On even' occasion the instruments performed well within their allowed tolerance of± 3 µg/100ml.



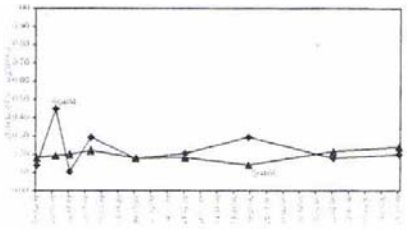
Graph 5



Graph 6

Precision

The absolute standard deviation was determined (n=10) at 35,44,66 and 200 µg/100ml for each instrument periodically. All instruments complied with the O.I.M.L specification in this regard. Graphs 7 (lion intoxilyzer 6000IRL) and 8 (INTOX1METER EC/IR) show the calculated standard deviation from week to week.



Graph 7

Graph 8

Specificity

The response to certified' gases containing known amounts of volatiles dm could occur in a subjects expired breath was examined for each instrument in the field. In the case of INTOXIMETER EC/IR instruments, there was a tendency to underestimate a result if acetone was present at a concentration of 15 µg/100ml. The presence of methanol caused the instrument to flag "Interfering Substance' and abort the test. Lion intoxilyzer 6000IRL instruments tend to respond to both interfering substances by flagging "Interfering Substance" and aborting the test.

Real Time Clock and Barometer Accuracy

The accuracy of the internal clock was checked against the Eircom "Talking Clock", in all cases the difference between the indicated time and the reference time was within the acceptable tolerance of ± 3mins. The accuracy of the internal barometer, which is used to adjust [he result of the external simulator gas for atmospheric pressure variations, was assessed against a reference barometer. On one occasion the barometer in an INTOXIMETER EC/IR instrument was shown to he reading incorrectly and the instrument was replaced, in ail other instances, the variations were within the allowed tolerance of ± 1.0 kPa.

Traceability

All equipment used for this work is properly calibrated and traceable to recognized International Standards.

Operator Training

A joint Garda College/Bureau training scheme is in proper scientific standard. The training course is of two days' duration and operators undergo a written and practical examination before they may operate the instruments to "driving under the influence" cases.

Conclusions

The four instruments tested by the Bureau in the laboratory comply with the Bureau requirements and are suitable for evidential breath alcohol testing. On-going field tests show that these approved instruments continue to operate within their permitted tolerances and are under statistical control.

Additional instruments will be introduced into selected Garda Stations nationwide on a phased basis over the next three years.❑

References

1 A Guide to Type Approval Procedures for Evidential Health Alcohol Testing Instruments. HMSO Publications, Home Office and Forensic Science Service, Oct. 1994.

2. International Recommendation OIML R 126 Edition 1998(E) 11, rue Turgot – 75009 Paris - France

Presented at the International Conference on Forensic Science, Dublin, 2000.