## Intoximeters Fuel Cell
## Integration Fuel Cells

- Integration – Fuel Cell construction design improvements
  - Open-faced fuel cell case. There are no obstructions so the sample has unimpeded access to the catalyst to promote quicker contact and reaction time in the conversion of alcohol to acetic acid.
  - **Case Material –**
    - Originally this was ABS plastic – this has a degree of permeability to water that allowed the Relative humidity to affect the electrolyte.
  - **Now using an engineered plastic material –**
    - The integral fuel cell uses a less permeable plastic case material –
    - This retards the water depletion in the electrolyte and extends the calibration stability and fuel cell life expectancy

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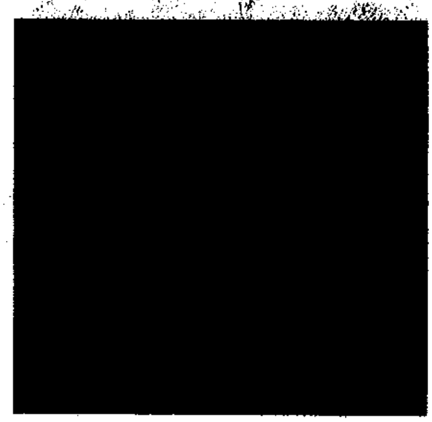
## Intoximeters
## Integration Fuel Cells

*Open Faced Cell*



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## Intoximeters Fuel Cell
## Integration Fuel Cells

- **Improved Platinum Wire Electrodes –**
  - **Original electrodes**
    - **were point contact only – resulting in poor and erratic contact between the electrode and surface of the fuel cell.**
  - **New electrodes**
    - **Are shaped to ensure optimum contact between the electrode and fuel cell surface**
    - **This improves the stability of the fuel cell signal and makes the fuel cell less susceptible to shock and vibration**

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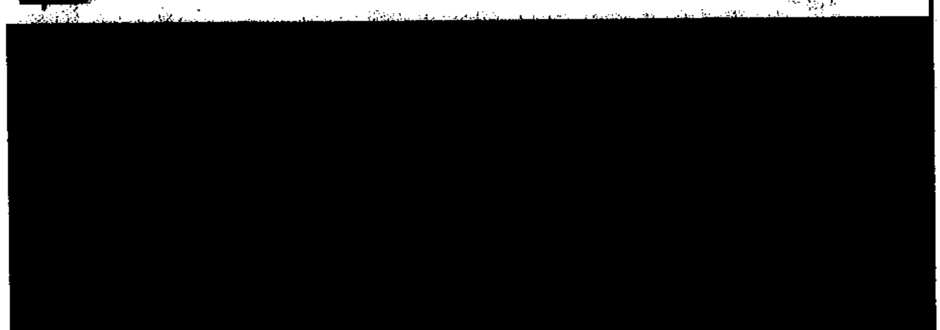
## Intoximeters Fuel Cell
## Original electrodes – Peak Cells



- **Point contact only**
- **Resulting in poor and erratic contact between the electrode and surface of the fuel cell.**
- **Calibration stability of fuel cell could be affected by any shock or vibration**

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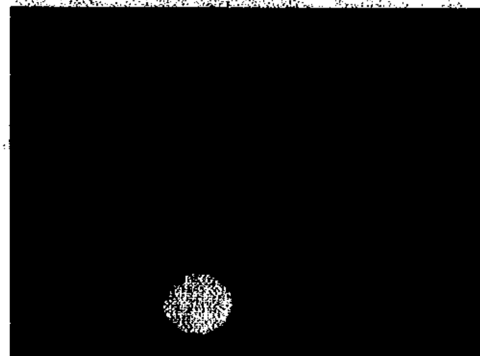
## Intoximeters Integration Fuel Cell
## **Improved Platinum Wire Electrodes**



**•New electrodes are shaped to ensure optimum contact between the electrode and fuel cell surface**
**•This improves the stability of the fuel cell signal and makes the fuel cell less susceptible to shock and vibration**

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## Intoximeters Fuel Cell
## Integration Fuel Cells

- Sampling mechanism redesign
  - **Improved consistency of sample size**
    - The pump piston is operated between two fixed mechanical stops to maximize the repeat accuracy of the pump stroke.
    - Reduces variations in readings due to variation in volume.
  - **Reduced the stroke of the pump to 2mm = half of that on prior designs – used on Peak Height analysis.**
    - This minimizes the volume of the gas sample, so that a thin layer of the alcohol sample will reach the catalytic surface sooner.
  - **Reduced power requirements for sampling**
    - The sample system pump is spring activated, so that only a small amount of electrical energy is required to release the pump and draw a sample.

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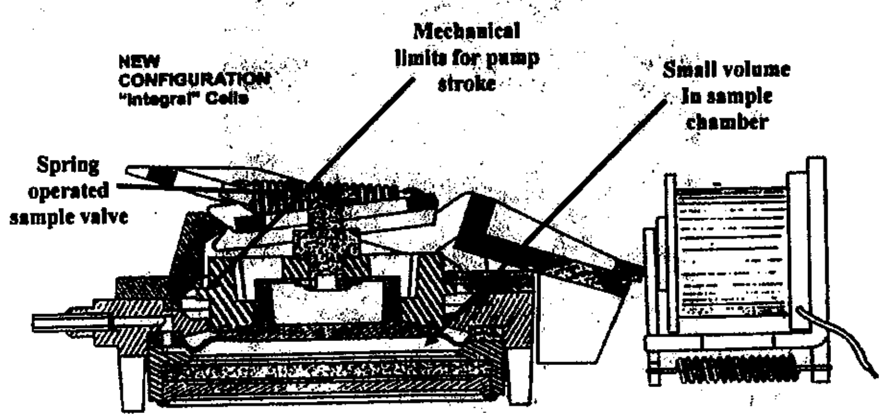
## Intoximeters Fuel Cell Integration Fuel Cells

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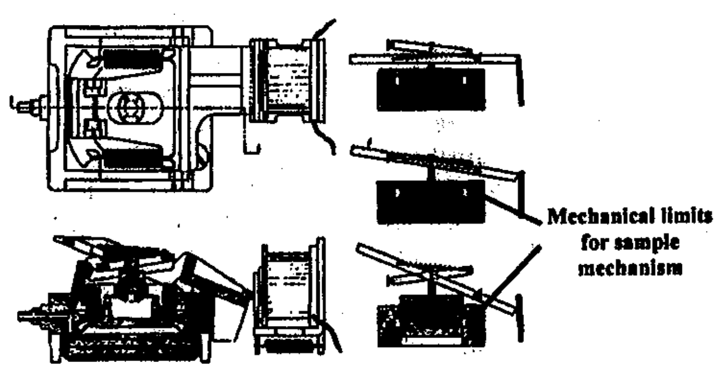
## Intoximeters Fuel Cell Integration Fuel Cells

- New Sampling System

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## Intoximeters
## Integration Fuel Cells

EC/IR Fuel Cell Sampling Assembly

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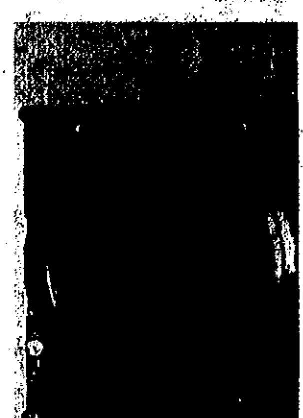
## Intoximeters
## Integration Fuel Cells Mounting

•Fuel cell Mounted on Sample Valve

•'O' Ring seal and silicon tube insert

*Diaphragm and Retainer*



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## Intoximeters Fuel Cell Integration Fuel Cells

- **Testing of integration fuel cells**
  - **100% of all integration fuel cells are tested**
  - **This testing is done by an automatic test bench**
  - **The results are used to screen the fuel cells for their applications**
  - **Data for all tested fuel cells are printed and kept on record**
  - **A copy of this data accompanies the fuel cell**

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## Intoximeters Fuel Cell Integration Fuel Cells

Integration Fuel Cell

Production Test Facility

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## Intoximeters Fuel Cell
## Integration Fuel Cells

### Test Data Printout

| [illegible] | [illegible] | [illegible] | Temp.: | 22 | %chg | T1/2: | 3.61 | | pos: | 7 | - | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Test # | BKG | JHS | pk | tpk | Int2 | t2 | Int4 | t4 | Int8 | t8 | Int16 | t16 | FACT |
| 1 | 0.02694 | 0.1009 | 0.1286 | 1.77 | 0.1009 | [illegible] | 0.1000 | 5.71 | 0.1009 | 6.56 | 0.1009 | 8.00 | 0.1009 |
| 2 | 0.02792 | 0.1000 | 0.1277 | 1.82 | 0.1010 | 3.83 | 0.1009 | 5.21 | 0.1000 | 6.60 | 0.1008 | 8.12 | 0.1007 |
| 3 | 0.02788 | 0.1000 | 0.1269 | 1.82 | 0.1011 | 3.86 | 0.1000 | 5.24 | 0.1009 | 6.64 | 0.1008 | 8.16 | 0.1004 |
| 4 | 0.02785 | 0.0998 | 0.1261 | 1.83 | 0.1012 | 3.89 | 0.1009 | 5.27 | 0.1009 | 6.68 | 0.1008 | 8.20 | 0.1004 |
| 5 | 0.02814 | 0.0994 | 0.1256 | 1.85 | 0.1012 | 3.91 | 0.1000 | 5.29 | 0.1008 | 6.70 | 0.1008 | 8.23 | 0.1002 |
| 6 | 0.02753 | 0.0990 | 0.1249 | 1.86 | 0.1013 | 3.93 | 0.1010 | 5.32 | 0.1010 | 6.75 | 0.1008 | 8.29 | 0.1004 |
| 7 | 0.02785 | 0.0995 | 0.1245 | 1.88 | 0.1014 | 3.95 | 0.1011 | 5.34 | 0.1010 | 6.77 | 0.1008 | 8.30 | 0.1003 |
| 8 | 0.02805 | 0.0993 | 0.1238 | 1.88 | 0.1013 | 3.97 | 0.1010 | 5.34 | 0.1009 | 6.79 | 0.1007 | 8.33 | 0.1002 |
| 9 | 0.02797 | 0.0994 | 0.1233 | 1.89 | 0.1013 | 3.98 | 0.1010 | 5.39 | 0.1009 | 6.82 | 0.1007 | 8.35 | 0.1002 |
| 10 | 0.02798 | 0.0990 | 0.1228 | 1.88 | 0.1014 | 4.00 | 0.1010 | 5.41 | 0.1009 | 6.84 | 0.1007 | 8.38 | 0.1009 |

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## Intoximeters Fuel Cell
## Integration Fuel Cells

- **FACT – analysis method**
  - **The original integration method was the peak/16 method.**
  - **After several years experience with this data a new improved integration method was developed**
  - **Combining the partial integral from sample to a point on the signal with a partial integral that looks at the slope of the curve coming down, we end up with a different algorithm that we have named FACT.**
  - **This compensates for the slight drop off in repeatability using P/16 over extended time periods of 6 or more months**

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## Intoximeters Fuel Cell Integration Fuel Cells

- **FACT – analysis method**
  - **This algorithm provides excellent repeatability (as good as peak/16) but with the added feature that it maintains its calibration accuracy better over time.**
  - **Using this proprietary system we know that calibration, for all intents and purposes, is stable for more than six months.**
  - **A further improvement has been introduced where weighting has been applied to the two partial integrals used for the calculation of the fuel cell result.**
  - **This improvement further improves the calibration stability of the fuel cell over more than 6 months.**
  - **FACT produces an accurate and repeatable reading on a new cell within 5 seconds.**

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## Intoximeters Fuel Cell Integration Fuel Cells

- **Further characteristics of Integral Fuel cell systems**
  - ***Linearity* - linear in its response to alcohol up to a sample value of 0.400 as long as it is properly calibrated and samples are taken at the same temperature (typically 25°C).**
  - ***Fatigue* - By using the integration method, the slump in readings from test to test is insignificant.**
  - **A 0.400 simulator solution, 10 tests 3 minutes apart run on an integral fuel cell will drop in reading less than 5%.**

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# Intoximeters EC/IR II
## DOT Evaluation Table

| Manufacturer: | INTOXIMETERS INC. EC/IR 2 sn200004 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Test | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Mean | SD | SE | Pass |
| (Target BAC indicated in brackets) | | | | | | | | | | | | | | |
| 1. Precision and Accuracy | | | | | | | | | | | | | | |
| (0.020) | 0.021 | 0.022 | 0.021 | 0.021 | 0.021 | 0.021 | 0.021 | 0.021 | 0.021 | 0.021 | 0.021 | [illegible] | 0.001 | |
| (0.040) | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | [illegible] | 0.001 | |
| (0.080) | 0.083 | 0.083 | 0.082 | 0.082 | 0.082 | 0.082 | 0.081 | 0.082 | 0.081 | 0.081 | 0.082 | [illegible] | 0.002 | |
| (0.100) | 0.102 | 0.101 | 0.101 | 0.101 | 0.101 | 0.101 | 0.100 | 0.101 | 0.100 | 0.100 | 0.101 | [illegible] | 0.001 | YES |
| (0.300) | 0.306 | 0.307 | 0.306 | 0.307 | 0.306 | 0.306 | 0.302 | 0.301 | 0.306 | 0.306 | 0.304 | 0.0031 | 0.004 | *** |
| 2. Acetone Interference | No testing required - Fuel cell | | | | | | | | | | | | | |
| low acetone (0.080) | | | | | | | | | | | | | | |
| high acetone (0.020) | | | | | | | | | | | | | | |
| 3. Blank Reading (0.000) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | YES |
| 4. Breath Sampling (0.080) | | | | | | | | | | | | | | |
| 0.2 Liters/sec. | 0.083 | 0.084 | 0.083 | 0.084 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.0003 | 0.003 | |
| 0.3 Liters/sec. | 0.082 | 0.083 | 0.082 | 0.082 | 0.082 | 0.082 | 0.081 | 0.081 | 0.081 | 0.081 | 0.082 | 0.0006 | 0.002 | |
| 0.5 Liters/sec. | 0.080 | 0.080 | 0.080 | 0.080 | 0.079 | 0.079 | 0.078 | 0.078 | 0.078 | 0.078 | 0.079 | 0.0007 | -0.001 | YES |
| 5. Power (0.080) | | | | | | | | | | | | | | |
| 108 Volts AC | 0.084 | 0.084 | 0.086 | 0.084 | 0.084 | 0.083 | 0.083 | 0.082 | 0.082 | 0.082 | 0.083 | 0.0012 | 0.003 | |
| 123 Volts AC | 0.083 | 0.082 | 0.082 | 0.081 | 0.081 | 0.082 | 0.080 | 0.080 | 0.080 | 0.080 | 0.081 | 0.0010 | 0.001 | YES |
| 6. Temperature (0.080) | | | | | | | | | | | | | | |
| 20 deg. C | 0.081 | 0.081 | 0.078 | 0.080 | 0.080 | 0.079 | 0.078 | 0.078 | 0.078 | 0.078 | 0.079 | 0.0011 | -0.001 | |
| 30 deg. C | 0.083 | 0.084 | 0.084 | 0.084 | 0.083 | 0.084 | 0.083 | 0.082 | 0.082 | 0.082 | 0.083 | 0.0007 | 0.003 | YES |
| 7. Post Vibration (0.080) | 0.085 | 0.084 | 0.084 | 0.083 | 0.083 | 0.083 | 0.082 | 0.083 | 0.082 | 0.082 | 0.083 | 0.0010 | 0.003 | YES |
| 8. Electrical Safety Insp. | | | | | | | | | | | | | | YES |
| Units | | Acetone-in-air Concentration | | | | Requirements | | | | | | | | |
| BAC: gm/210L Air | | low: 0.3 mg/L | | | | SD: 0.0042 or less | | | | | | | | |
| SD: Standard Deviation | | high: 0.5 mg/L | | | | SE: plus or minus 0.005 BAC or 5 % whichever is greater | | | | | | | | |
| SE: Syst. Error, Mean -target BAC | | | | | | *No single result greater than 0.005 BAC | | | | | | | | |
| | | | | | | **No requirement (information only for hand-held devices) | | | | | | | | |
| Date: January 2002 | | | | | | ***No requirement (information only) | | | | | | | | |

# Intoximeters EC/IR II
## DOT Evaluation Table

Intoximeters Test results – Linearity and Repeatability

| | | | | | | |
|---|---|---|---|---|---|---|
| 10381 | Mean 10 Tests g/210L | 0.4340 | 0.2146 | 0.1080 | 0.0540 | 0.0270 |
| | | | | | | |
| 10387 | Mean 10 Tests g/210L | 0.4382 | 0.2153 | 0.1080 | 0.0540 | 0.0268 |
| | | | | | | |
| 10384 | Mean 10 Tests g/210L | 0.4316 | 0.2151 | 0.1071 | 0.0540 | 0.0270 |
| | | | | | | |
| 10383 | Mean 10 Tests g/210L | 0.4333 | 0.2136 | 0.1080 | 0.0540 | 0.0270 |
| | | | | | | |
| 10386 | Mean 10 Tests g/210L | 0.4286 | 0.2124 | 0.1073 | 0.0530 | 0.0260 |
| | | | | | | |

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## Intoximeters Fuel Cell Integration Fuel Cells

- **Further characteristics of Integral Fuel cell systems**
  - **Heated Fuel cells – In the EC/IR I, EC/IR II and the AMCC instruments the fuel cell is heated to remove the temperature coefficient.**
  - **This heating also speeds up the rate of analysis**
  - **In the AS-IV – the fuel cell is unheated and an automated three point temperature compensation procedure is used.**

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## Intoximeters Fuel Cell Integration Fuel Cells

- Interfering Substances
  - One of the major benefits of fuel cells is their lack of cross-sensitivity to substances other than alcohol.
  - Samples containing any compound on the following list do not evoke any reading on a fuel cell.
  - The fuel cell will react to low molecular weight alcohols. Once up to Butanol, which has 4 carbons (higher molecular weight), the fuel cell has no significant sensitivity, and there is virtually no sensitivity to even higher molecular weight alcohols.

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## Intoximeters Fuel Cell
## Integration Fuel Cells

- Interfering Substances
  - The fuel cell simply does not react or see these Interfering Substances at these values.
  - This is not to say that if you put in 1000 times these concentrations, that something wouldn't happen in the cell, but these levels will not be found in a living subject.

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## Fuel Cell – Interfering Substance Sensitivity

Table 1 – Interfering Substances

| | Substance | Vapor Concentration | AlcoSensor III Response | AlcoSensor IV Response |
|---|---|---|---|---|
| | | (mg/l) | (mg/l) | (mg/l) |
| 1 | Acetaldehyde | 0.100 | 0.002 | 0.002 |
| 2 | Acetone | 0.100 | 0.000 | 0.000 |
| 3 | Acetonitrile | 0.100 | 0.000 | 0.000 |
| 4 | Benzene | 0.050 | 0.000 | 0.000 |
| 5 | 2-Butanol | 0.100 | 0.001 | 0.002 |
| 6 | Carbon Monoxide | 0.050 | 0.000 | 0.000 |
| 7 | Contact Cement | 0.060 | 0.000 | 0.000 |
| 8 | Cyclohexane | 0.100 | 0.000 | 0.000 |
| 9 | Diethylether | 0.100 | 0.000 | 0.000 |
| 10 | Ethylacetate | 0.060 | 0.000 | 0.000 |
| 11 | Gasoline | 0.100 | 0.000 | 0.000 |
| 12 | Isoprene | 0.100 | 0.002 | 0.002 |

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# Fuel Cell – Interfering Substance Sensitivity

**Table 2 – Interfering Substances - continued**

| | Substance | Vapor Concentration | AlcoSensor III Response | AlcoSensor IV Response |
|---|---|---|---|---|
| | | (mg/l) | (gm/dl) | (gm/dl) |
| 13 | Isopropanol | 0.060 | 0.006 | 0.005 |
| 14 | Lacquer Thinner* | 0.100 | 0.002 | 0.002 |
| 15 | Methane | 0.100 | 0.000 | 0.000 |
| 16 | Methanol | 0.040 | 0.009 | 0.008 |
| 17 | MEK | 0.060 | 0.000 | 0.000 |
| 18 | n-Pentane | 0.100 | 0.000 | 0.000 |
| 19 | n-Hexane | 0.100 | 0.000 | 0.000 |
| 20 | n-Heptane | 0.100 | 0.000 | 0.000 |
| 21 | n-Octane | 0.100 | 0.000 | 0.000 |
| 22 | Mineral Spirits | 0.100 | 0.000 | 0.000 |
| 23 | Tetrachloroethylene | 0.050 | 0.000 | 0.000 |
| 24 | Toluene | 0.050 | 0.000 | 0.000 |
| 25 | 111-Trichlorethane | 0.100 | 0.000 | 0.000 |
| 26 | Trichlorethylene | 0.100 | 0.000 | 0.000 |
| 27 | Xylene | 0.100 | 0.000 | 0.000 |

*Some lacquer thinners contain alcohol

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# Committee on Alcohol and other drugs National Safety Council report on Interfering Substances

- From a 1999 paper by Patrick Harding and Dr Kurt Dubowski for the National Safety Council which reviewed the available scientific articles on the affects of non-ethanol substances that may "falsely elevate breath alcohol results".
- "In order for a non-ethanol substance to produce a significant response on any breath alcohol testing instrument it must:
  - ***1. Be a volatile organic compound capable of appearing in the breath of a living, conscious human being.***
  - ***2. Be present in sufficiently high concentration to be measured by the instrument after a 15 to 20 minute pretest observation period.***
  - ***3. Be able to produce a response on the instrument that is indistinguishable from ethanol."***

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## Committee on Alcohol and other drugs National Safety Council report on Interfering Substances

- The conclusions of this report were:
  1. "The literature, and practical experience, indicate that endogenous (naturally occurring) compounds in human breath do not significantly affect breath alcohol testing instruments. With the exception of acetone, these compounds do not appear in sufficient concentrations to be considered potential interferents. Breath acetone concentrations, although potentially elevated in diabetic and fasting individuals, have no deleterious effect on current alcohol testing instruments."

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## End of Fuel Cell Technology presentation

Thank you

John Evans

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## Intoximeters EC/IR II IR Sampling system and flow sensor

Design and operation of the InfaRed and flow sensors used on the EC/IR II





## Intoximeters EC/IR II Infrared Sensor

**Basic Theory - Lambert-Beer's law - summary**

- *Lambert – Beers Law* - $I/I_0 = 10^{-A}$ is a non-linear relationship between signals and the concentration of the gas absorbing the infrared energy.
  - $I$ is the intensity of the beam after it passes through the sample, $I_0$ is the intensity of the beam incident on the sample, A is the absorbance.
  - A = e c l, where l is the length of the beam's path, c is the concentration of the sample in the solution , e is a constant of the sample, dependent on wavelength.
- You can measure the infrared absorption of a gas (ethanol) by directing infrared light through a sample of the gas and measuring the incident light falling on a detecting device.
- The instrument can process these signals to produce an output indicating the concentration of one or more of the constituents of the gas being analyzed.





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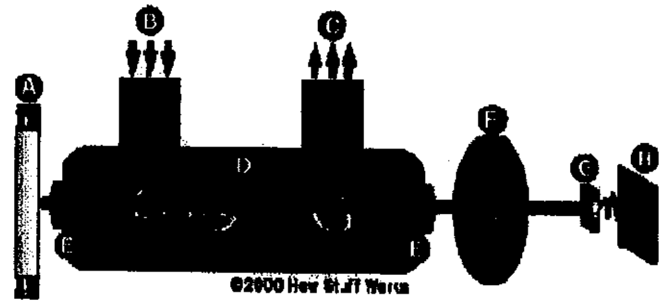
## Intoximeters EC/IR II
## Infrared Sensor
## Evidential IR analyzer -schematic




- A – IR Source Quartz Lamp, B – Breath Inlet, C – Breath Outlet
- D – IR Chamber, E – Quartz Lens, F – Filter Wheel, G – Photo detector
- H – Microprocessor

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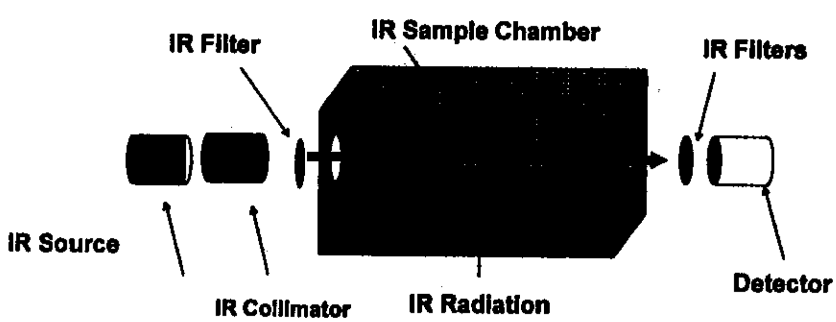
## Intoximeters EC/IR II
## Infrared Sensor
## Basic Theory - Summary

•**Basic IR Detector Layout – showing major components**

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## Intoximeters EC/IR II
## Infrared Sensor – Characteristics

- **Infrared sensors - non-linear analytical devices – requiring complex calibration procedures at multiple alcohol levels.**
- **Infrared sensors - inherently cross-sensitive to several breath constituents.**
- **Infrared sensors – temperature sensitive.**
- **Infrared sensors - able to continuously monitor alcohol concentration.**
- **This continuous monitoring is a capability that the fuel cell sensor does not possess.**





## Intoximeters EC/IR II
## InfraRed Sampling Assembly

- **The prime application of the InfraRed sample system in the EC/IR II is for Mouth Alcohol detection by continuous monitoring of the breath sample.**
- **This; with data from the flow sensor; determines the point at which to capture a sample of the breath and analyze its alcohol content using the fuel cell sensor.**
- ***The IR sampling assembly designed in the EC/IR II specifically for this application.***
- ***In the following section we will review the design, major sub-assemblies and operation of the IR sampling system in the EC/IR II instrument.***





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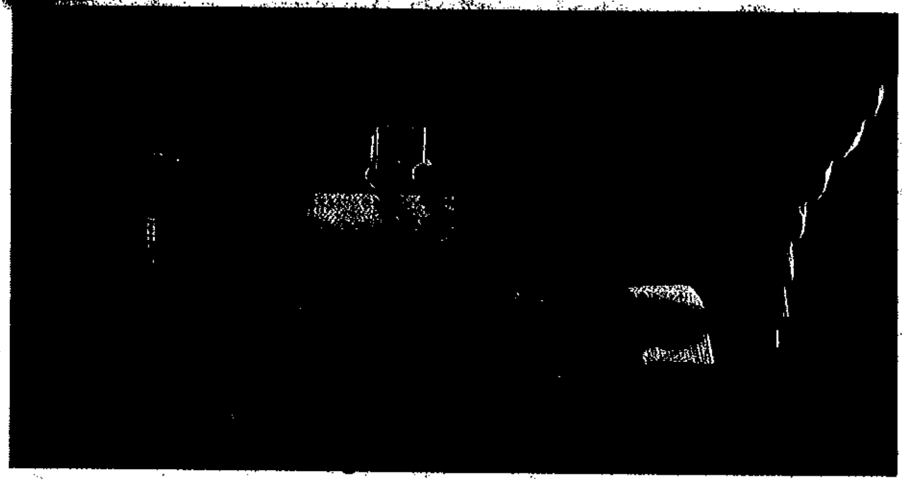
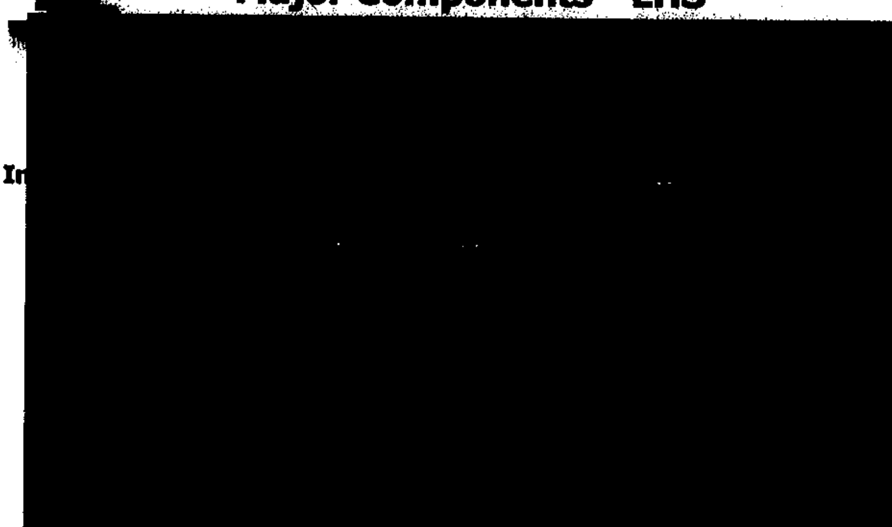
## Intoximeters EC/IR II
## IR Analyzer Assembly
## Major Components - RHS






## Intoximeters EC/IR II
## IR Analyzer Assembly
## Major Components - LHS



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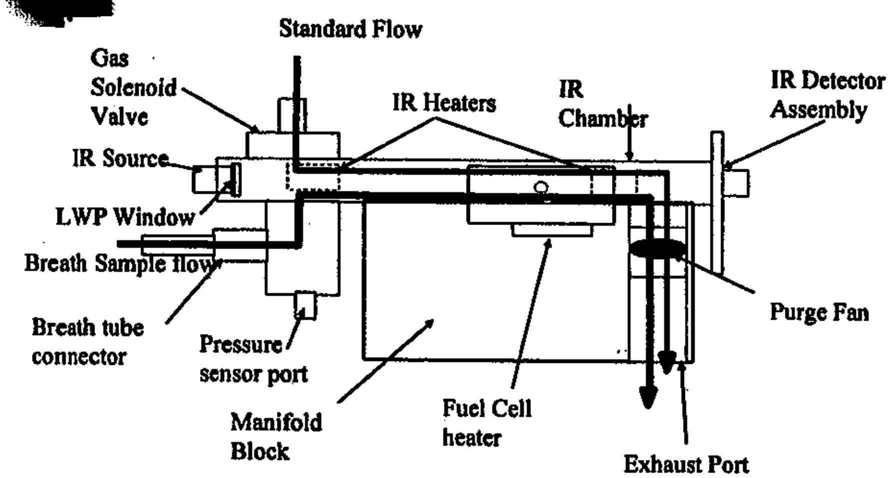
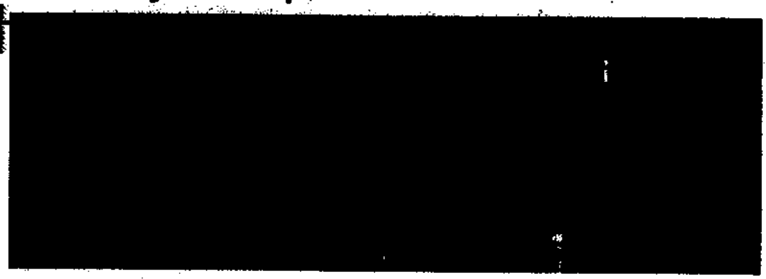
## Intoximeters EC/IR II
## Infrared Sensor
## IR Analyzer -Schematic








## Intoximeters EC/IR II
## IR Analyzer Assembly
## Major Components-IR Chamber



- IR Chamber – 5" (12.5cm) Long, 0.375" (0.95cm) Diameter
  - Approximately 9cc volume -
  - Aluminum - Plated surface to prevent absorption
  - Heated to 40°C +/- 1°C – by 2 heaters – for stability
  - Insulated for temperature stability





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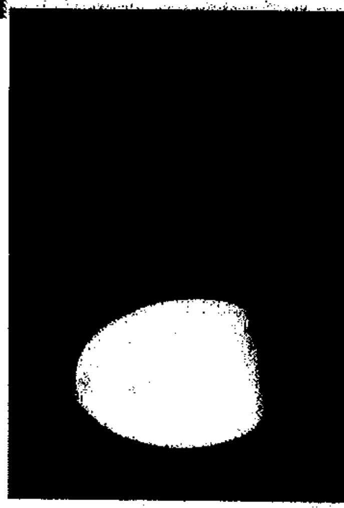
## Intoximeters EC/IR II
## IR Analyzer Assembly
## Major Components-IR Source



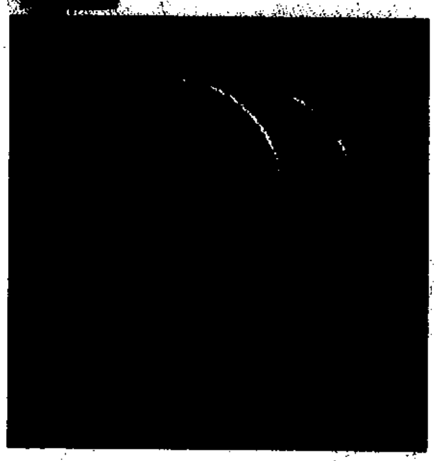
- IR Source – Thermopile Source –
  - broad spectrum IR source
  - Mounted in parabolic reflector
  - 18,000 hour life at full power – used at low power
  - Reduced Stand by voltage extends life
  - Plated Quartz Window at source reduces water sensitivity

Lens Coating Up

Lens Coating Down




## Intoximeters EC/IR II
## IR Analyzer Assembly
## Major Components-IR Detector



- IR Detector – Thermopile IR Detector
- 3 electrically identical channels
  - 2 Optical filters at 3.46 microns for ethanol
  - 1 Optical filter at 4.25 microns for Carbon Dioxide $CO^2$
  - Dual Thermopiles for each optical filter provides temperature compensation

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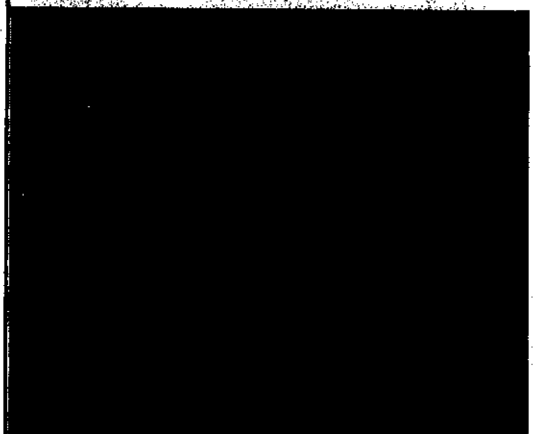
## Intoximeters EC/IR II
## IR Analyzer Assembly
## Major Components-IR Detector Assembly



- Signal Amplifier and 12 bit A/D conversion on circuit board at signal source
  - D/A on circuit board – allowing automatic calibration of IR channels.
  - Circuit designed for RFI/EMC immunity
  - Metal Can enhances RFI/EMC protection
  - Tight temperature control and insulation to ensure stable IR detector temperature




## Intoximeters EC/IR II
## IR Analyzer Assembly
## Major Components-IR Heater Assemblies


- Two (Identical) Heaters mounted on the IR chamber used with insulation to improve temperature stability of the IR sampling system
- Heaters are analog proportional control with fixed set temperatures – set at 40°C +/-1°C.
- The temperatures are monitored by the software (but are not software controlled)
- A safety feature can shut down all heaters in the case of an overheat sense on any of the heaters.

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# Intoximeters EC/IR II
# IR Analyzer Assembly
# Major Components-Manifold Assembly

- Machined Solid Nylon Block
- Provide support and mounting for both the IR and Fuel cell sampling system
- Provides the exit porting for samples
- Purge fan is installed in exit port

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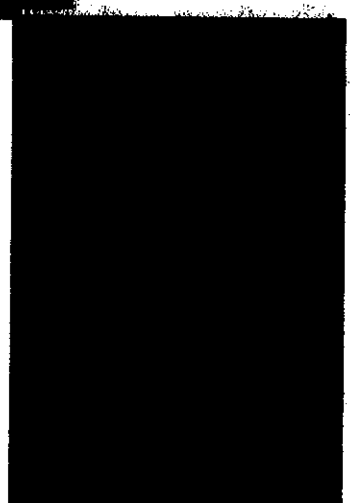
# Intoximeters EC/IR II
# IR Analyzer Assembly
# Major Components



- Purge Fan – Located in the Nylon Manifold block exit port
- Impeller type fan assembly with small dc motor
- Used to draw ambient air through the breath tube and sampling system to clear any contamination from a previous sample
- Highly efficient with excellent flow rate which the purges the sampling system quickly and effectively

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# EC/IR II Mouth Alcohol Detection

The operation of the Gross Mouth alcohol and $CO_2$ Mouth Alcohol Detection systems

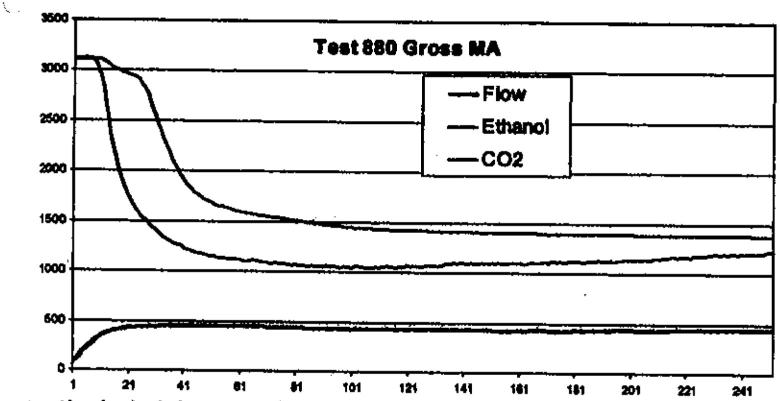




## EC/IR II Mouth Alcohol Detection

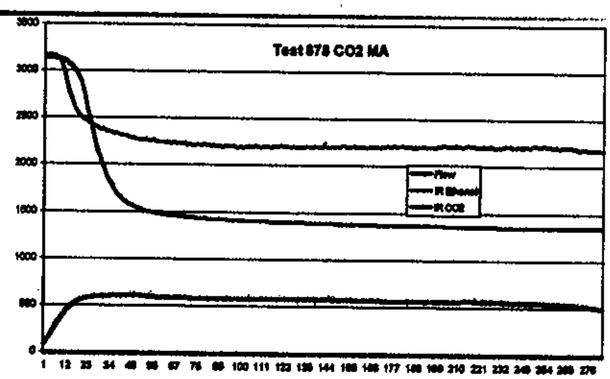
- The short path length of the IR system in the EC/IR II – 5" (12.5cm)
  - Provides enhanced real time tracking of the instantaneous ethanol concentration
  - There is a limitation in real time tracking of the instantaneous ethanol concentration in longer path length IR systems due to the extensive flushing and mixing affect inherent in these longer path and larger volume systems
- The two IR sensors in the EC/IR II
  - The IR Ethanol and the IR $CO_2$ are used in combination to determine the presence of mouth alcohol

# EC/IR II Infrared System
# Gross Mouth Alcohol Detection




- Gross mouth alcohol detection is applied only to the Ethanol I/R channel during the breath analysis to catch the classic gross mouth alcohol curve.
- A minimum IR Ethanol delta of 0.150 g/210L is required
- If there is a change of ≥0.030 g/210L in the IR Ethanol signal - The instrument will declare a mouth alcohol and abort the test sequence.

# EC/IR II Infrared System
# $CO_2$ Mouth Alcohol Detection

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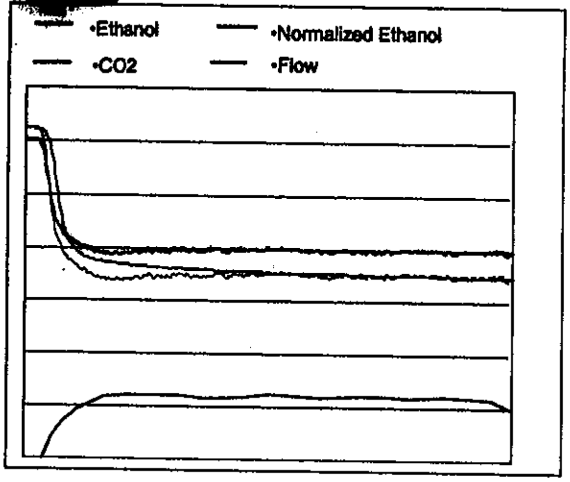
- An example of a Mouth Alcohol curve where Gross MA does not apply.
- The IR ethanol signal does not reach a well defined minima and does not change slope/direction to a significantly degree.
- The $CO_2$ signal remains unchanged and continues to track downwards

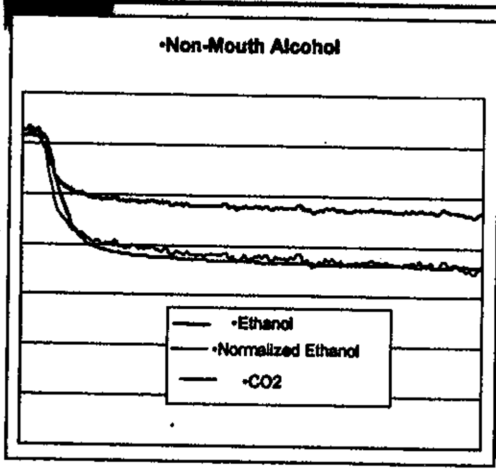
# EC/IR II Infrared System
# $CO_2$ Mouth Alcohol Detection




- Typical CO2 Mouth Alcohol detection curve.
- The Normalization of the IR Ethanol signal shows a distinct variance between the CO2 signal and the IR ethanol signal
- Once the area integral exceeds a threshold value a Mouth Alcohol is flagged.
- This offers enhanced mouth alcohol detection.




# EC/IR II Infrared System
# $CO_2$ Mouth Alcohol Detection Algorithm




- This graph shows a typical Non-mouth alcohol
- Intersection before CO2 begins to level out –
- The algorithm will report a None Mouth Alcohol based on the area between the Normalized Ethanol and CO2 curves from the first point of intersection to the second point of intersection.

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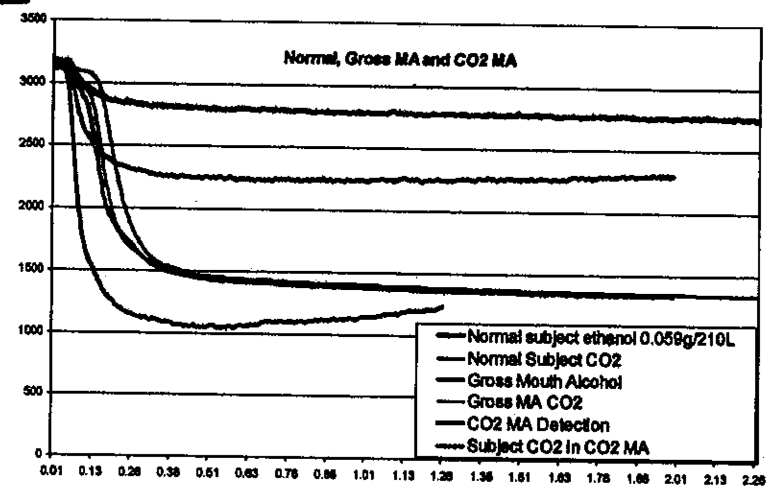
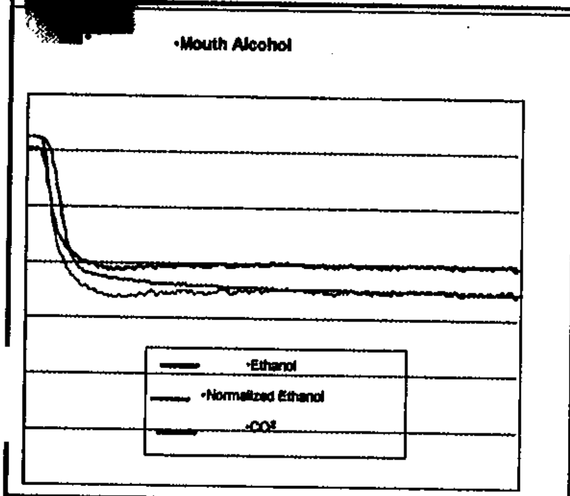
# Combined Normal, Gross MA and $CO_2$ MA data








# EC/IR II Infrared System $CO_2$ Mouth Alcohol Detection Algorithm




- **Mouth Alcohol Detected**
- Intersection after $CO_2$ begins to level out –
- The algorithm will report a Mouth Alcohol based on the area between the Normalized Ethanol and $CO_2$ curves from the beginning of the curve to the first point of intersection as in the graph





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## Intoximeters EC/IR II
## Ambient Pressure/Flow Sensor

**Dual Purpose Sensor:**
- Provides Ambient Barometric Pressure reading for dry gas pressure compensation
- Measures changes of pressure at the restriction in the breath tube adapter to detect sample flow rate

- Mounted on the motherboard
  - Block heated and temperature controlled to improve stability
  - Heater is analog proportional control with fixed set temperature –Set at 40°C +/-1°C.
  - Screwed Barbed tube connector used for tube connecting to IR assembly




## Intoximeters EC/IR II
## Ambient Pressure/Flow Sensor

- Ambient Pressure Sensor
  - When the EC/IR II is using dry gas standards to Calibrate the Fuel cell or carry out an accuracy check, the Pressure Sensor is used to measure the ambient pressure
  - The value of the ambient pressure is used to adjust the target value of the dry gas standard to compensate for the variation in this value due to varying ambient pressure
  - The output of the pressure sensor for this purpose is measured at the beginning of a Calibration or Accuracy check sequence
  - Software will detect any unacceptable changes in pressure and if $CO_2$ is present during a dry gas standard to prevent erroneous ambient pressure readings




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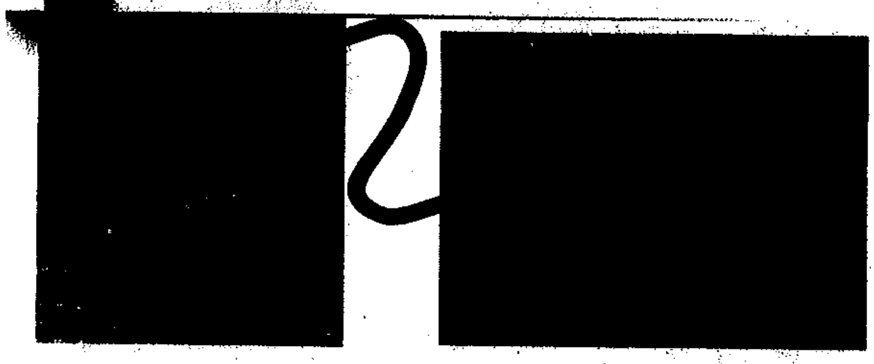
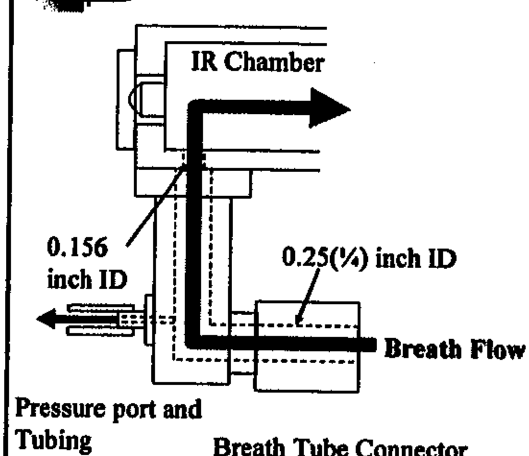
## Intoximeters EC/IR II
## Ambient Pressure/Flow Sensor



- Flow Sensor – the pressure sensor is also used as the flow sensor for monitoring the subject sample flow.
- The Pressure sensor – is connected by pressure tubing to the IR Chamber at the Breath Tube connector




## Intoximeters EC/IR II
## Pressure/Flow Sensor




- The Breath Tube Connector has an internal diameter of ¼ inch
- There is a restriction of 0.156 inch diameter at the point where the Breath Tube Connector is attached to the IR Chamber
- This restriction causes a pressure in the Breath Tube Connector which is proportional to and varies with the flow rate of the subject sample
- The pressure port and tubing allows the pressure sensor to measure the flow rate
- The pressure in the IR Chamber remains at or slightly above atmospheric pressure

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## Intoximeters EC/IR II

# *Subject Breath Alcohol Sample Sequence*

***How the IR Sensors, Flow Sensor and Fuel Cell Sensors work together to accept a subject breath sample and analyse the sample***





## Intox EC/IR II

### *Subject Breath Sample Sequence*

- For a subject test sequence:
  - The EC/IR II continuously monitors the Flow sensor, IR Ethanol and IR $CO_2$ sensors as the subject blows into the instrument.
  - The breath sample must satisfy all the sample criteria before the sample is accepted and a sample taken of the breath by the fuel cell for analysis.

# Intox EC/IR II

## *Subject Breath Sample Sequence*

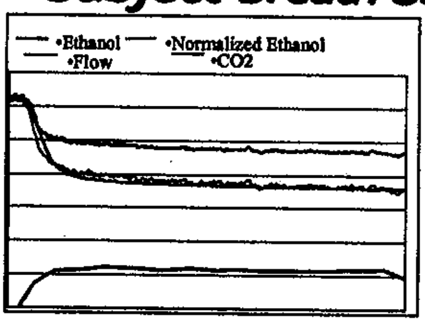
- The sample criteria are:
  - Flow – Minimum 0.2L/sec,
  - Flow - Variation during blowing -20% of maximum flow rate.
  - Volume – Minimum 1.5L
  - Sample point – When flow drops by -5% from the highest flow after minimum volume.
  - Mouth Alcohol - InfraRed Ethanol – No Gross Mouth Alcohol detected.
  - Mouth Alcohol – InfraRed and CO2 – No CO2 mouth alcohol detected.





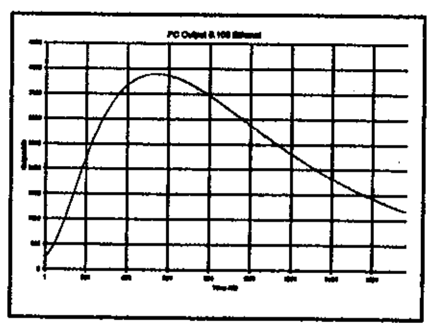
# Intox EC/IR II

## *Subject Breath Sample Sequence*




1. Flow Sensor – Detects subject blowing
2. Ethanol and $CO^2$ sensors monitor subject sample for mouth alcohol
3. Acceptable flow and volume
4. Fuel Cell Sample taken

1. Fuel Cell sample is taken and is analyzed.
2. No Mouth Alcohol detected based on IR analysis
3. No IS detected based on fuel cell analysis
4. Ethanol Result displayed



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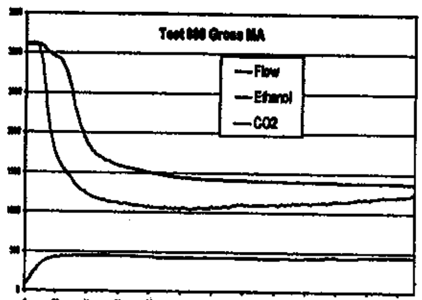
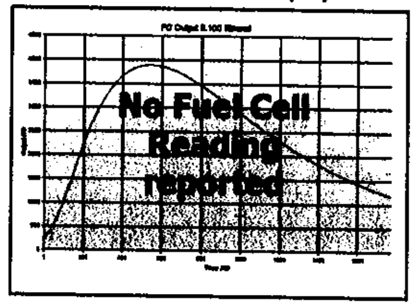
# Intoximeters EC/IR II
# Breath Sample Sequence – Gross Mouth Alcohol

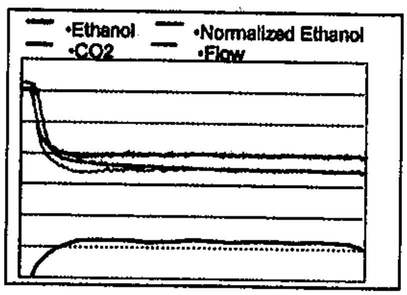



1. Flow Sensor – Detects subject blowing
2. Ethanol and CO2 sensors monitor subject sample for mouth alcohol
3. Acceptable flow and volume
4. Fuel Cell Sample taken

1. Fuel Cell sample is taken and is analyzed.
2. Gross Mouth Alcohol detected based on IR Analysis
3. No IS detected based on fuel cell analysis
4. No Ethanol Result displayed

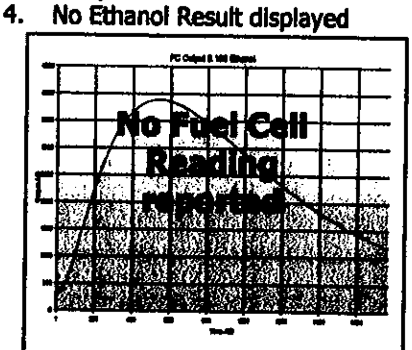



# Intoximeters EC/IR II
# Breath Sample Sequence – $CO_2$ Mouth Alcohol




1. Flow Sensor – Detects subject blowing
2. Ethanol and $CO_2$ sensors monitor subject sample for mouth alcohol
3. Acceptable flow and volume
4. Fuel Cell Sample taken

1. Fuel Cell sample is taken and is analyzed.
2. $CO_2$ Mouth Alcohol detected based on IR analysis
3. No IS detected based on fuel cell analysis
4. No Ethanol Result displayed

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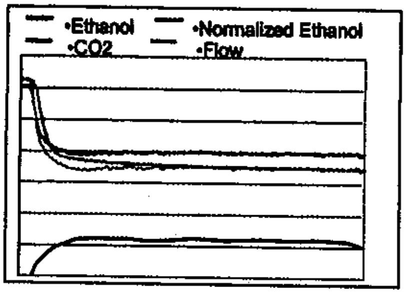
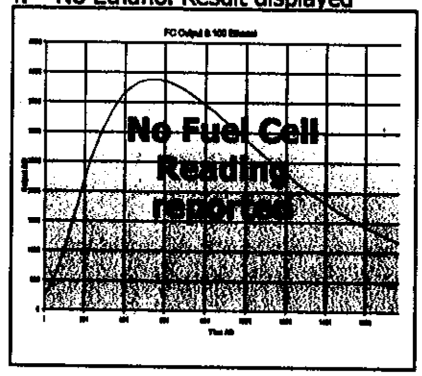
## Intoximeters EC/IR II
## Breath Sample Sequence – $CO_2$ Mouth Alcohol




1. Flow Sensor – Detects subject blowing
2. Ethanol and $CO_2$ sensors monitor subject sample for mouth alcohol
3. Acceptable flow and volume
4. Fuel Cell Sample taken

1. Fuel Cell sample is taken and is analyzed.
2. No Mouth Alcohol detected based on IR analysis
3. IS detected based on fuel cell analysis
4. No Ethanol Result displayed




## Intoximeters EC/IR II

***IR and Flow Sensor***
***End of presentation***
***Thank you***





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# Theory of Dry Ethanol standards and their application

Introduction to Dry Gas Standards used in Intox EC/IR II instruments

4/24/2008

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## Dry Gas Standards

- Dry Gas standards are becoming widely used in the USA - and are replacing Wet standards
  - Dry Gas mixtures – Intox has been using dry gas standards for a long time. Originally developed for use with the Intox GC unit.
  - Widely used for many years for calibration and accuracy checking of hand held PBT's.
  - DOT/Omnibus Act – caused Dry Gas to be evaluated and approved for evidential application – NHTSA report produced on Dry Gas
  - Dubowski Research and Paper –Gave scientific backing to use of dry gas.

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## Dry Gas Standards

- Original Application -
  - to simplify the process of accuracy checking the GC
- Original gas manufacturers–
  - Mixed ethanol and argon gas, stabilized over time
  - Ethanol Value – uncertain due to limited weighing and mixing facilities
  - Final Ethanol Value - named using instrument calibrated against wet standards
  - Tank material – used mild steel, heavy, prone to contamination – especially moisture

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## Dry Gas Standards

- Today's Gas Standard manufacturers
  - Use ethanol mixed with dry nitrogen
  - Use advanced weighing and mixing facilities manufacturers are now able to produce gas standards with predictable ethanol value.
  - <u>National Institute of Standards and Technology Traceable</u> – Gas Manufacturers have established NIST traceability by sending samples of gas to NIST to quantify the content and establish NTRM's– very expensive process.
  - NTRM – NIST Traceable Reference Materials – Manufacturer then uses these NTRM's as part of Production QC process – only two in the USA.
  - Tank material – Aluminium tanks now available, lighter, easier to prepare, less susceptible to moisture

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# Gas Tank Filling –

[redacted]

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# Dry Gas Tank - Preparation

1. The smaller desk top scales are used to measure the pure ethanol to be injected into the large gas tanks which have a vacuum.
2. The larger floor mounted scales are used to measure the Nitrogen which is added to the gas tank after the ethanol.

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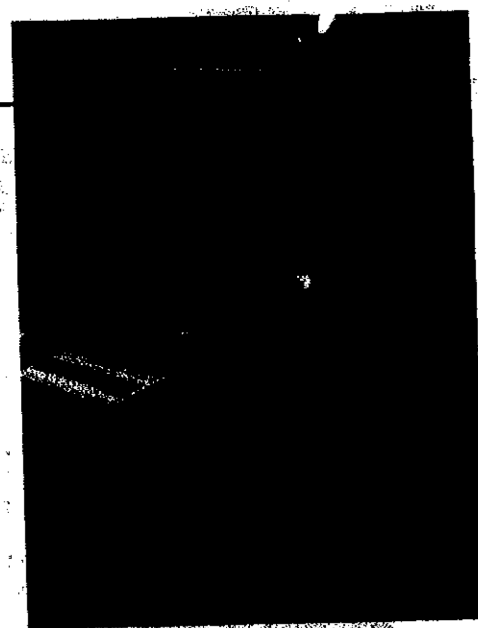
NTRM – Gas Tank

Used for production QC of ethanol Dry Gas Standards



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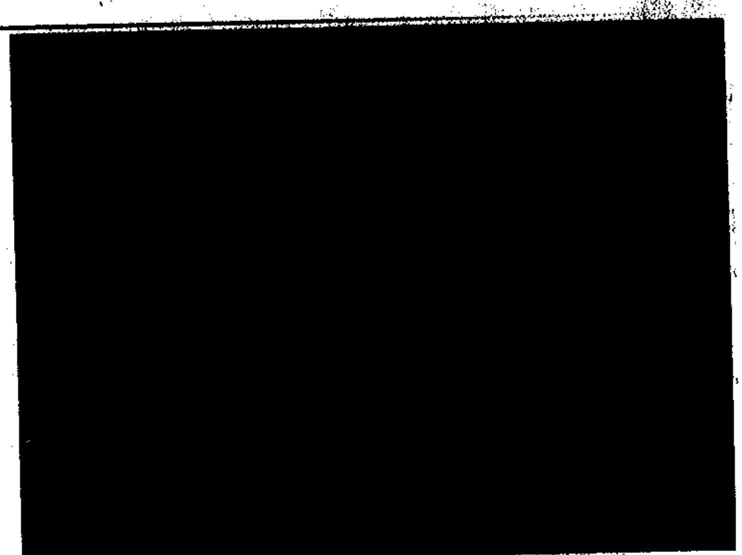
# Dry Gas - Production QC Station



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# Dry Gas Standards -

- Gas Law – applies to the ethanol/nitrogen mix:
  - $P^1 V^1 / T^1$=Constant, or $P^1 V^1 / T^1 = P^2 V^2 / T^2$
- Pressure Variation - The expected ethanol value of a dry gas standard varies with pressure
- Therefore, it is necessary to calculate a correction factor to compensate for pressure changes
  - Standard pressure – refers to pressure at sea level = 760 mm of Hg – this is the value shown on the gas tank
- If, the air pressure is = 749 mm of Hg at your location, then
  - Gas value 0.082 is - 749/760 X 0.082 =0.0808 = 0.080'
- Observed BrAC = Labeled BrAC x Ambient Pressure / 760 mm
- Automated Correction in Most EBT's

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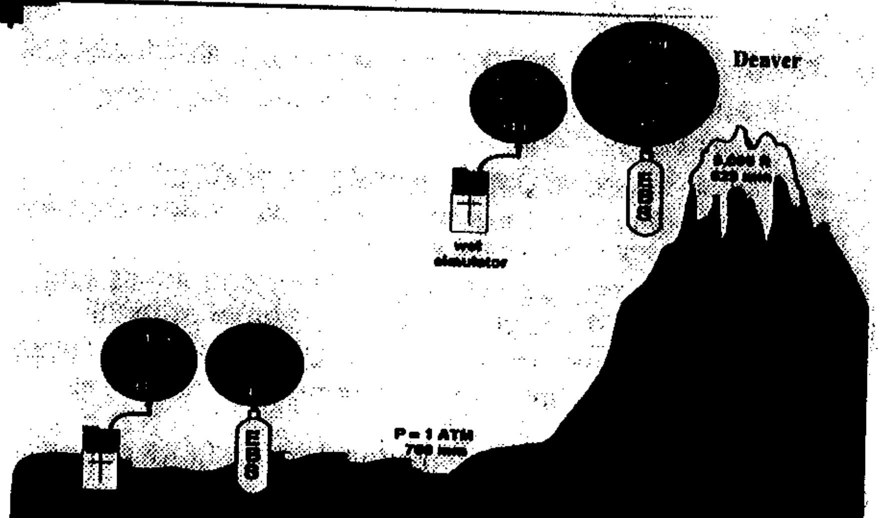
# Pressure Effect

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## Pressure Correction

Dry Gas Standards – are often used with PBT's or Screening Instruments which do not have pressure sensors and automatic pressure adjustment. In this case the user must refer to the Correction Table printed on the Dry Gas tank label. They then use the following simple calculation:

- Labeled BrAC x correction factor = Observed BrAC

**Altitude Conversion Chart**

| Elevation above sea level (ft) | Correction factor |
|---|---|
| 0 | 1.0 |
| 500 | 0.981 |
| 1000 | 0.962 |
| 2000 | 0.925 |
| 3000 | 0.889 |
| 4000 | 0.854 |
| 5000 (Denver) | 0.820 |
| 6000 | 0.804 |
| 7000 | 0.755 |

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## Dry Gas Standards

- Temperature Affect on the gas tank and contents
  - Has no measurable affect over normal operating temperatures range.
  - It must be above **Dew Point Temperature**
    - Dew point – the temperature at which the ethanol condenses out of the mixture onto the inside of the tank
  - Dew Point temperature is dependent on the gas tank pressure and the ppm – concentration of ethanol
    - the higher the tank pressure the higher the Dew Point temperature
    - The higher the ethanol content the higher the Dew Point temperature
  - Dew Point Temperature for full tank of 0.082 at pressure 1136 psi = 0°C = 32°F

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## Dry Gas Standards

- Gas Tank and Regulator capacities
- Flow rate of regulator is 1.5 liters per minute
- Used properly, a 108 liter tank should supply at least 300 tests
- New tanks show approximately 1000 - 1125 psi on the gauge.
- Expiration date is stamped on the label of the dry gas standard
- Tanks should only be used when they are above the Dew Point temperature

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## Advantage & Disadvantages of Dry Gas Standards

**ADVANTAGES**

- ✓ **Many test samples in one tank – up to 300+**
- ✓ **Shelf life of up to 24 months on 108 liter tank**
- ✓ **Value of tank traceable to NIST**
- ✓ **Operates anywhere at any normal operating temperature or elevation**
- ✓ **Does not need electric power**
- ✓ **Can be easily automated**
- ✓ **Readings do not deteriorate with use. No depletion**

**DISADVANTAGES**

- **Barometric pressure adjustment is recommended (This can be done with TRUE-CAL)**
- **Cannot be transported on commercial airlines.**
- **Dew Point Temperature**

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# Wet Simulator Standards

- The following variables should be closely monitored to ensure correct and accurate operation of wet bath simulators
  - **Correct operating temperature** - of 34°C +/- 0.2°C (1°C=6+% variation)
  - **Correct flow rate** - through simulator – typically 7 to 9 L/min
  - **Simulator must be leak proof** – any leaks around the seal between the jar and head assembly will result in incorrect (low) vapour values.
  - **Condensation** - in the outlet tubes between the simulator and the instrument must be avoided– if possible heated tubes should be used.
  - **Stabilization time** – there is a delay between when the solution is at temperature and the head assembly has reached a constant temperature – typically up to 20 minutes
  - **Temperature Control of environment** – Care is required to ensure heating or cooling system do not affect the simulators e.g. from AC blowing onto head assemblies – this can and will reduce readings
  - **Depletion** – Change solution at regular intervals – record usage of simulators to ensure that the solutions are changed at correct intervals. Alternatively, use Tandem Simulators – Use 2 or more Tandem Simulators to reduce depletion affect

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# Dry Ethanol Gas Standards

End of presentation

Thank you

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# Dry Gas Standards Corrected versus Uncorrected

Fuel Cell response to Dry and Wet gas standards. Intoximeters approach to this fuel cell sensor characteristic

1

# Wet – Dry Fuel Cell Offset

- **Dry gas standards – 4.5% offset**
  - There is an offset in readings obtained in comparing a gravimetrically prepared dry gas against a carefully operated wet simulator at 34°C using Harger's values for ethanol-water partitioning at 34°C.
  - That is, a Gravimetrically prepared Dry Gas standard will give an approximately 4 to 4.5% lower reading when it is analyzed by an instrument calibrated against a wet bath simulator.
  - Intoximeters has done extensive wet-dry comparisons and has concluded that for its full line of fuel cell based instruments a 4.5% wet/dry off set applies
  - For example: a 0.0856 g/210L (223ppm ethanol dry gas) ethanol dry gas standard will read 0.082 ±1% at 760mm Hg on an instrument carefully calibrated with a wet simulator.

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## Wet – Dry Fuel Cell Offset

- **Dry gas standards – 4.5% offset**
  - It is important to note that tests have shown that this characteristic does not vary with age of fuel cells
  - It should be noted that InfraRed sensors typically also demonstrate some water vapor sensitivity
  - IR instruments which require multi point calibration included a Zero (typically: distilled water) simulator sample for water absorption.

3

## Wet – Dry Fuel Cell Offset

- What causes Wet-Dry Offset?
  - Dr Lance Silverman (formerly of Scott Gases) proposed:
  - The effect is due to the mechanics of drawing a fixed volume sample into the fuel cell headspace.
  - There is a moisture equilibrium in the headspace above the fuel cell surface determined by the acid concentration of the electrolyte.
  - This fuel cell moisture equilibrium is in between the RH of the dry and the RH of the wet gases. i.e. :
    1. Higher moisture content than the Dry (0%RH) ethanol-nitrogen sample.
    2. Lower moisture content than the breath or simulator (100%RH) ethanol sample.

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## Wet – Dry Fuel Cell Offset

- At 34°C, 100% RH the moisture content of the breath or simulator sample is 5.2% by volume.
  - When this 100%RH sample is drawn into the fuel cell headspace:
    1. The sample water vapour which is in excess of the relative humidity in the cell is quickly taken up into equilibrium by the electrolyte.
    2. The sample size is therefore reduced due to the loss of water.
    3. Additional sample therefore additional ethanol is drawn in to compensate for the shrinkage in sample.

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## Wet – Dry Fuel Cell Offset

- At 25°C, 0% RH the moisture content of the dry ethanol-nitrogen sample is 0% by volume.
  - When this 0%RH sample is drawn into the fuel cell headspace:
    1. The water vapour in the cell electrolyte is quickly taken up into the dry sample to come into equilibrium.
    2. The dry sample size is therefore increased due to the absorption of water into the sample.
    3. Therefore; a proportion of the sample is pushed out of the sampling chamber removing some ethanol, because of the absorption of water into the sample.

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## Wet – Dry Fuel Cell Offset

- Under ideal conditions:
  - The volume difference between the dry and humid sample should be 5.2%.
  - By experiment it has been found to be approximately 4.4% - slightly less than the 5.2% expected.
  - This could be caused by some of the alcohol from the dry sample reacting with the cell catalytic surface before the water absorption process creates an increase in the volume.
  - This initial reaction slightly reduces observed difference between the theoretical and experimental results so that a compensation factor of 4.5% has been adopted by Intoximeters.

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## How to handle the offset

- The varying instrument manufacturers have handled this 4.5% offset in two ways.
  1. Correct the Dry Gas - Add ethanol to the dry gas standard – so that it is equivalent to the wet standard value.
  2. Software option – the instrument firmware requires the confirmation that the gas standard is wet or dry. So that the 4.5% offset is applied in the software calculation of the ethanol reading depending on the medium of the ethanol standard.

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## Intoximeters Policy

- Intoximeters policy is to be "up front" with this issue and has labeled gas tanks as 'C' – (Corrected) or 'U' – (Uncorrected) such that:
  - 0.100 g/210L C – contains 272 ppm of ethanol
  - 0.100 g/210L U – contains 260 ppm of ethanol
  - 0.082 g/210L C – contains 223 ppm of ethanol
  - 0.038 g/210L C – contains 103 ppm of ethanol

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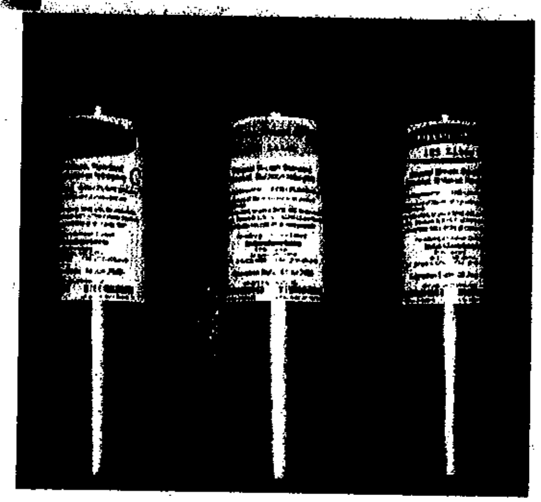
## Intoximeters Gas Tanks



- Intoximeters 108L Dry Gas Tanks
- Labeled clearly with 'C'

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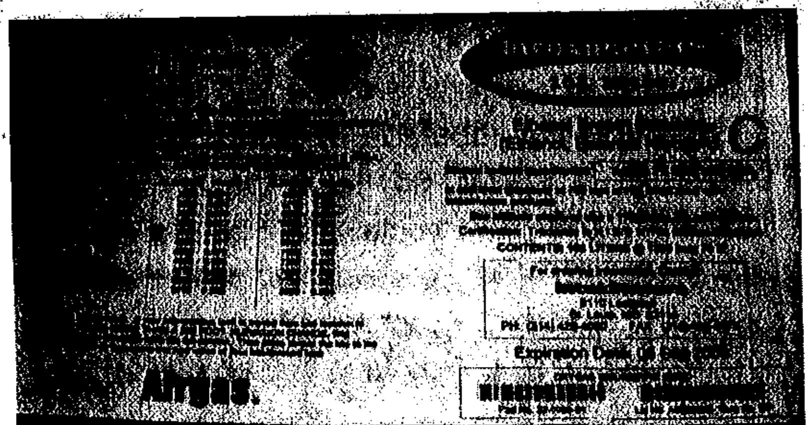
## Intoximeters Gas Tanks




- Example of Gas Tank Label – 'C' - Corrected Gas

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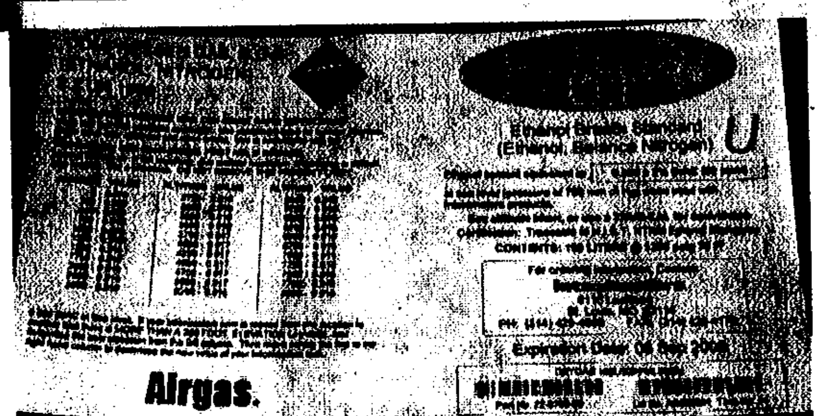
## Intoximeters Gas Tanks




- Example of Gas Tank Label – 'U' – Un-Corrected Gas

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## What this means

Using this C – Corrected Dry Gas method means that:

1. If an Intoximeters instrument is correctly calibrated with a wet standard e.g. 0.100g/210L.
2. It will give a result of 0.100 g/210L for an Intoximeters supplied dry gas 0.100 g/210L 'C' (272 ppm ethanol) and:
3. It will give a result of 0.082 g/210L for an Intoximeters supplied dry gas 0.082 g/210L 'C' (223 ppm ethanol).

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## NTRM – Quality Gas Suppliers

- NTRM – NIST Traceable Reference Materials
  - When considering using Dry Gas Standards it is very important that the Gas Standard is supplied by a gas manufacturer certified to NTRM through NIST.
  - At present there are 2 Gas manufacturers in the USA certified to NTRM through NIST
    - Air Gas Specialty Gases
    - Scott Gases
  - A 3rd Gas manufacturer in the USA is NTRM certified through a reciprocal agreement NIST has with the NMI in the Netherlands –
    - Air Liquide

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# NHTSA - Position

- This characteristic was investigated by NHTSA for the use of dry gases for calibration of fuel cell breath testers.
- ***"The offset for fuel cell breath testers averaged somewhat less than 4% of the nominal BrAC when dry gas calibrators were used to check calibration of fuel cell evidential breath testers.***
- ***The standard deviations for the wet and dry data were in the fourth decimal place except in one instance when a value of 0.002 was obtained, which was still acceptable.***
- ***These results indicate that the offsets are small and reproducible enough that reliable corrections can be applied to ensure accurate test results.***
- ***The offsets observed cannot be assumed to arise only from the inherent differences in measurement of moist samples compared to the measurement of dry samples since there are also uncertainties of <plus-minus>0.001 in the true concentration of wet bath or dry gas calibration unit vapors."***

- From - Federal Register 62 43416-43425 para 5d

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# Corrected Dry Gas

- Finally: In considering the introduction and use of dry gas standards with evidential instruments State administrators might consider the following
  - Specifying NTRM traceable Gas suppliers.
  - Using wet simulators for Calibration of evidential instruments and then dry gas for accuracy checks during subject test sequences and/or during scheduled Certification check at regular intervals e.g. every 60 days.
  - Calibrating with one value of ethanol (dry or wet) and checking accuracy with another value of ethanol (dry or wet).
  - This helps prevents potential errors caused by using the same standard to calibrate and accuracy check instruments.

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# End of presentation

Thank you

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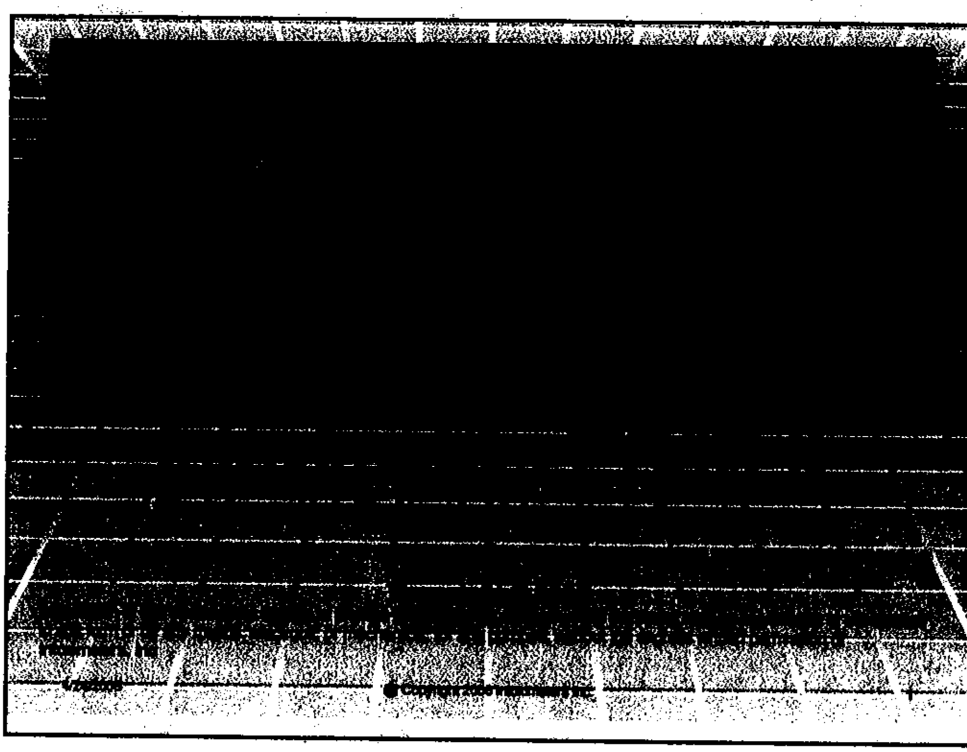

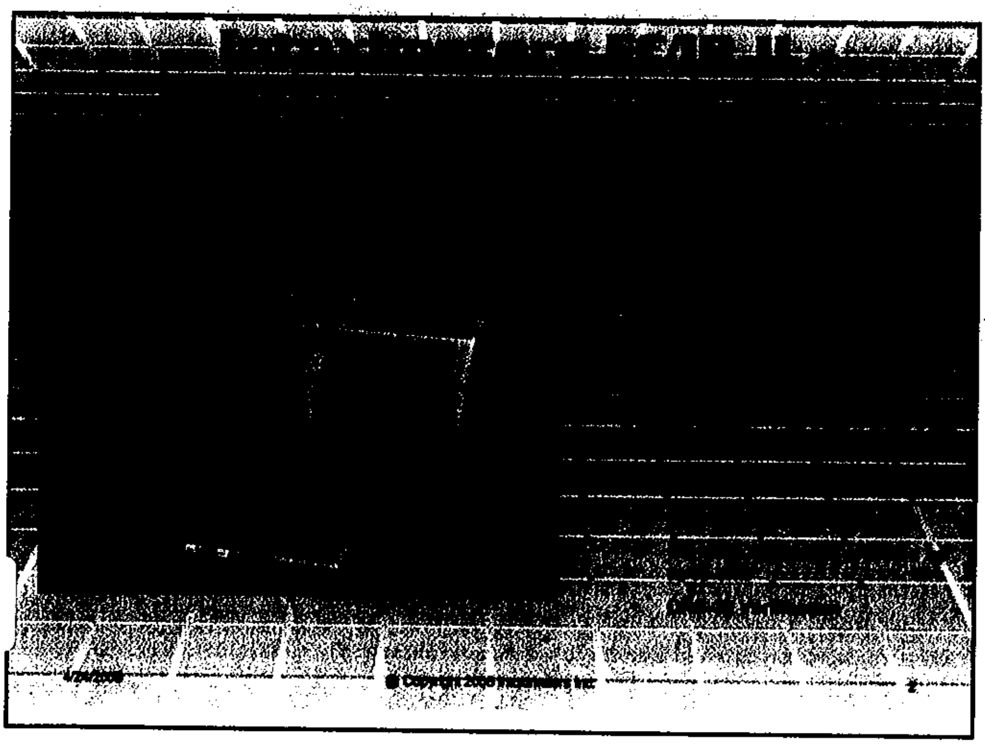

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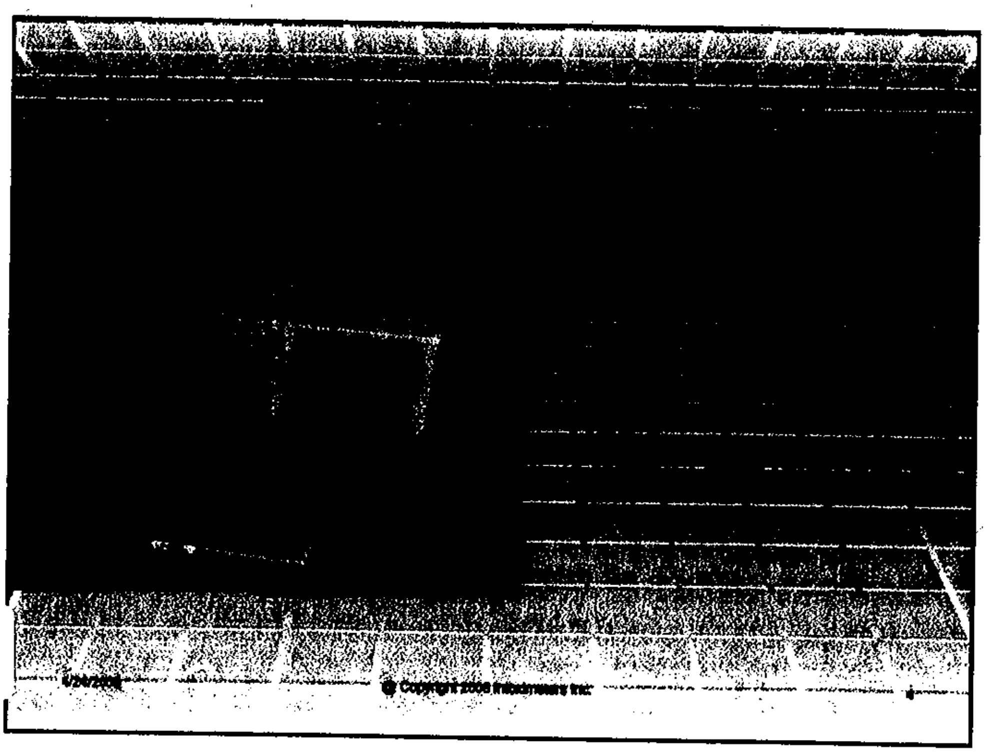
# Intoximeters EC/IR II

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Manufacturer: | INTOXIMETERS INC. EC/IR 2 sn200004 | | | | | | | | | | | | | |
| Test | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Mean | SD | SE | Pass |
| (target BAC indicated in brackets) | | | | | | | | | | | | | | |
| 1. Precision and Accuracy | | | | | | | | | | | | | | |
| (0.020) | 0.021 | 0.022 | 0.021 | 0.021 | 0.021 | 0.021 | 0.021 | 0.021 | 0.021 | 0.021 | 0.021 | 0.0002 | 0.001 | |
| (0.040) | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.0001 | 0.001 | |
| (0.080) | 0.083 | 0.083 | 0.082 | 0.082 | 0.082 | 0.082 | 0.081 | 0.082 | 0.081 | 0.081 | 0.082 | 0.0008 | 0.002 | |
| (0.160) | 0.162 | 0.161 | 0.161 | 0.161 | 0.161 | 0.161 | 0.160 | 0.161 | 0.160 | 0.160 | 0.161 | 0.0006 | 0.001 | YES |
| (0.300) | 0.308 | 0.307 | 0.308 | 0.307 | 0.308 | 0.306 | 0.302 | 0.301 | 0.300 | 0.300 | 0.304 | 0.0031 | 0.004 | *** |
| 2. Acetone Interference | No testing required - Fuel cell | | | | | | | | | | | | | |
| low acetone (0.020) | | | | | | | | | | | | | | |
| high acetone (0.020) | | | | | | | | | | | | | | |
| 3. Blank Reading (0.000) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | YES |
| 4. Breath Sampling (0.080) | | | | | | | | | | | | | | |
| 0.2 Liters/sec. | 0.083 | 0.084 | 0.083 | 0.084 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.0003 | 0.003 | |
| 0.3 Liters/sec. | 0.082 | 0.083 | 0.082 | 0.082 | 0.082 | 0.082 | 0.081 | 0.081 | 0.081 | 0.081 | 0.082 | 0.0006 | 0.002 | |
| 0.5 Liters/sec. | 0.080 | 0.080 | 0.080 | 0.080 | 0.079 | 0.079 | 0.079 | 0.079 | 0.078 | 0.079 | 0.079 | 0.0007 | -0.001 | YES |
| 5. Power (0.080) | | | | | | | | | | | | | | |
| 108 Volts, AC | 0.084 | 0.084 | 0.085 | 0.084 | 0.084 | 0.083 | 0.083 | 0.082 | 0.082 | 0.082 | 0.083 | 0.0012 | 0.003 | |
| 123 Volts, AC | 0.083 | 0.082 | 0.082 | 0.081 | 0.081 | 0.082 | 0.080 | 0.080 | 0.080 | 0.080 | 0.081 | 0.0010 | 0.001 | YES |
| 6. Temperature (0.080) | | | | | | | | | | | | | | |
| 20 deg. C | 0.081 | 0.081 | 0.079 | 0.080 | 0.080 | 0.079 | 0.078 | 0.078 | 0.078 | 0.078 | 0.079 | 0.0011 | -0.001 | |
| 30 deg. C | 0.083 | 0.084 | 0.084 | 0.084 | 0.083 | 0.084 | 0.083 | 0.082 | 0.082 | 0.082 | 0.083 | 0.0007 | 0.003 | YES |
| 7. Post Vibration (0.080) | 0.085 | 0.084 | 0.084 | 0.083 | 0.083 | 0.083 | 0.082 | 0.083 | 0.082 | 0.082 | 0.083 | 0.0010 | 0.003 | YES |
| 8. Electrical Safety Insp. | | | | | | | | | | | | | | YES |

| | | |
|---|---|---|
| Units | Acetone-in-air Concentration | Requirements |
| BAC: gm/210L Air | low: 0.3 mg/L | SD: 0.0042 or less |
| SD: Standard Deviation | high: 0.5 mg/L | SE: plus or minus 0.005 BAC or 5 % whichever is greater |
| SE: Syst. Error, Mean -target BAC | | *No single result greater than 0.005 BAC |
| | | **No requirement (information only for hand-held devices) |
| Date: January 2002 | | ***No requirement (information only) |

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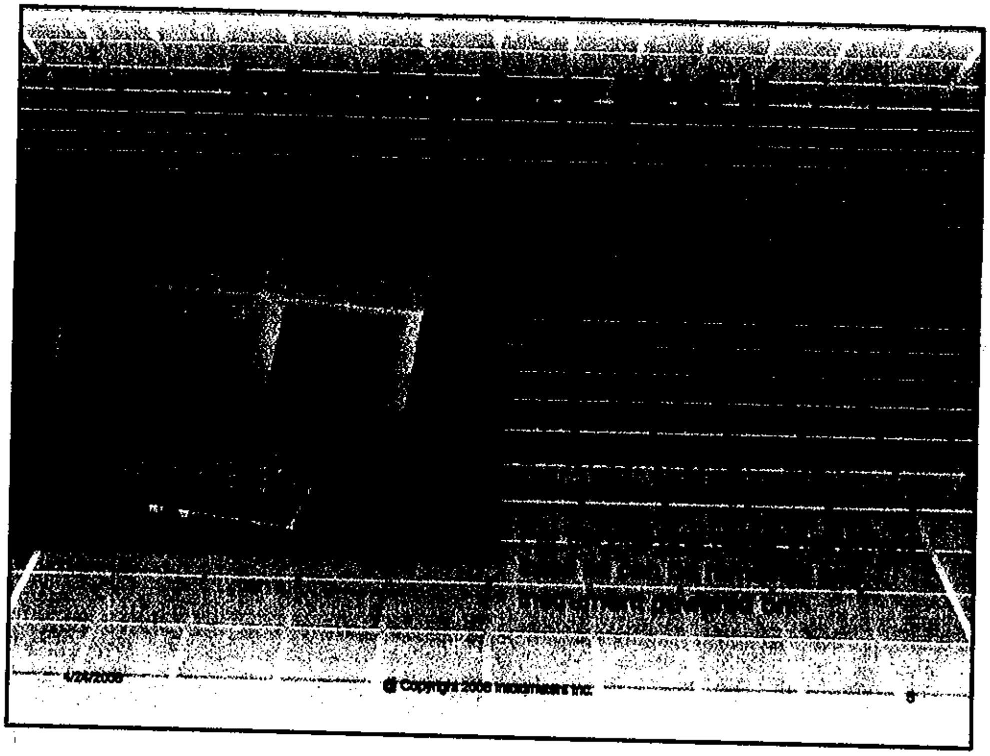

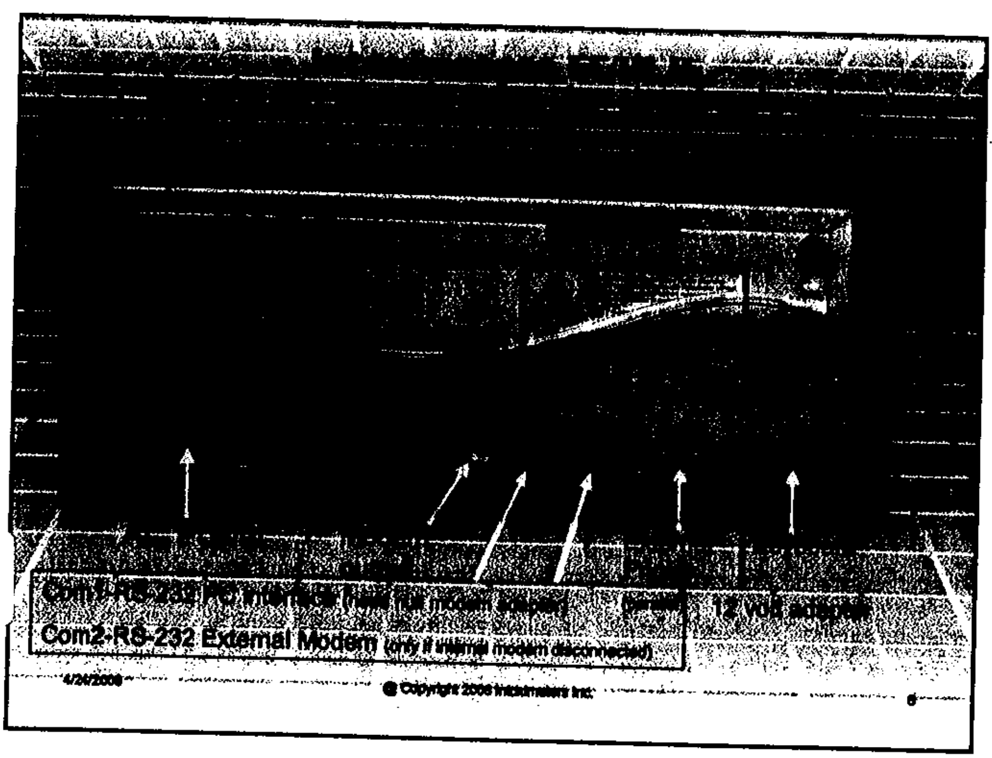
Com2-RS-232 External Modem (only if internal modem disconnected)

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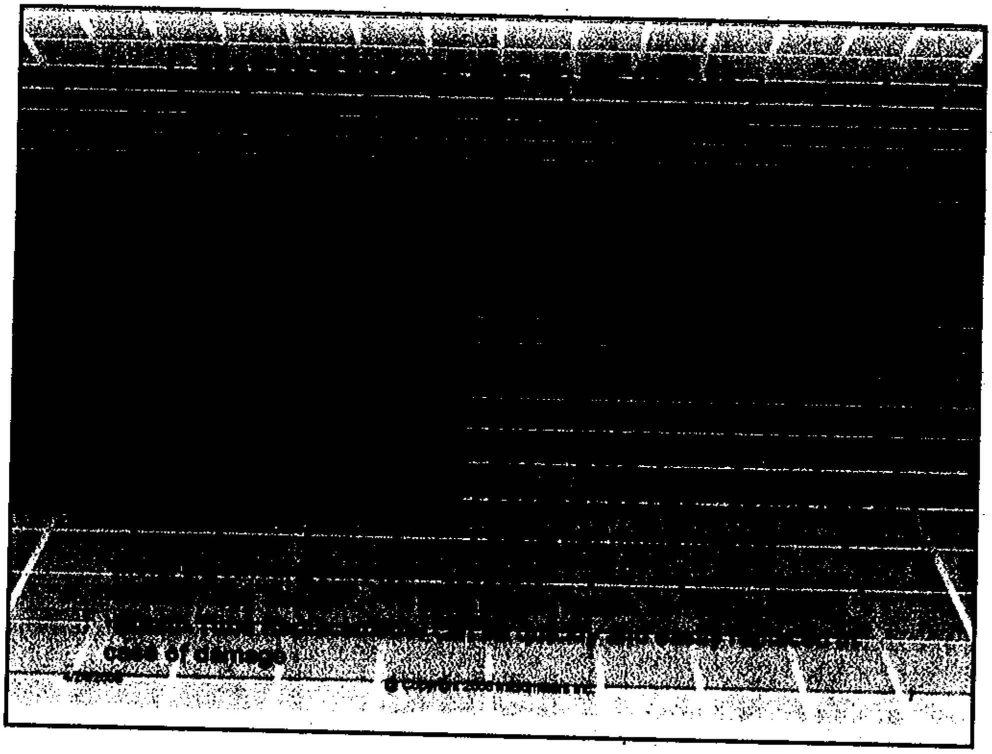


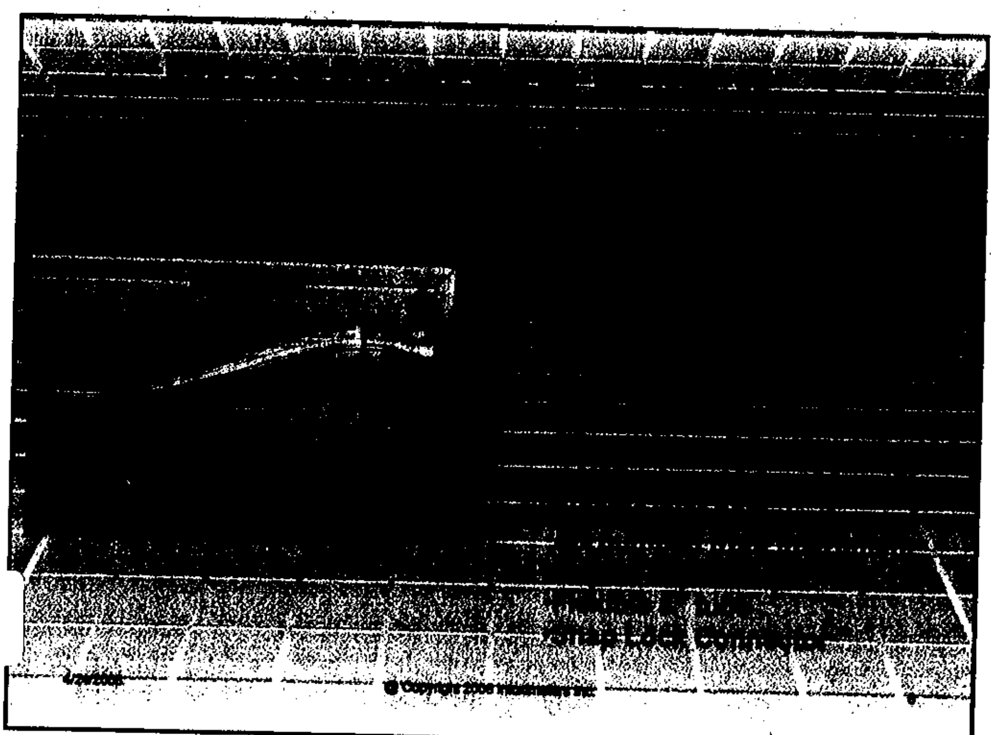


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ambient pressure





·Functions Keys – F1, F2, F3 etc. - Used to access instrument settings and configuration menus – password protected





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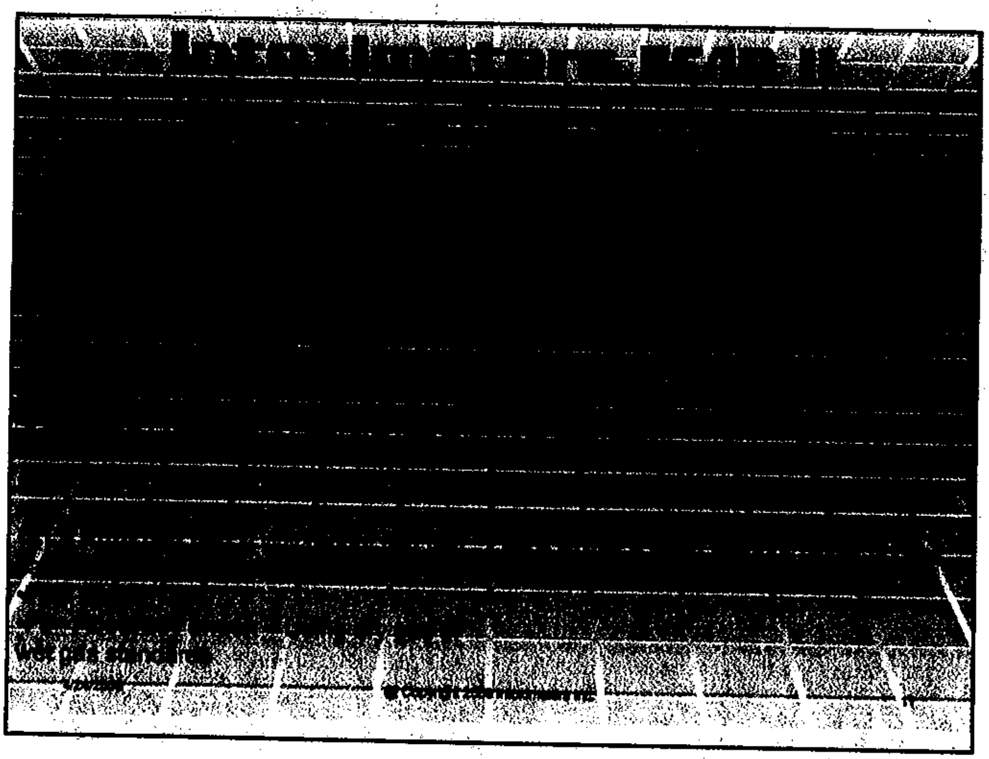

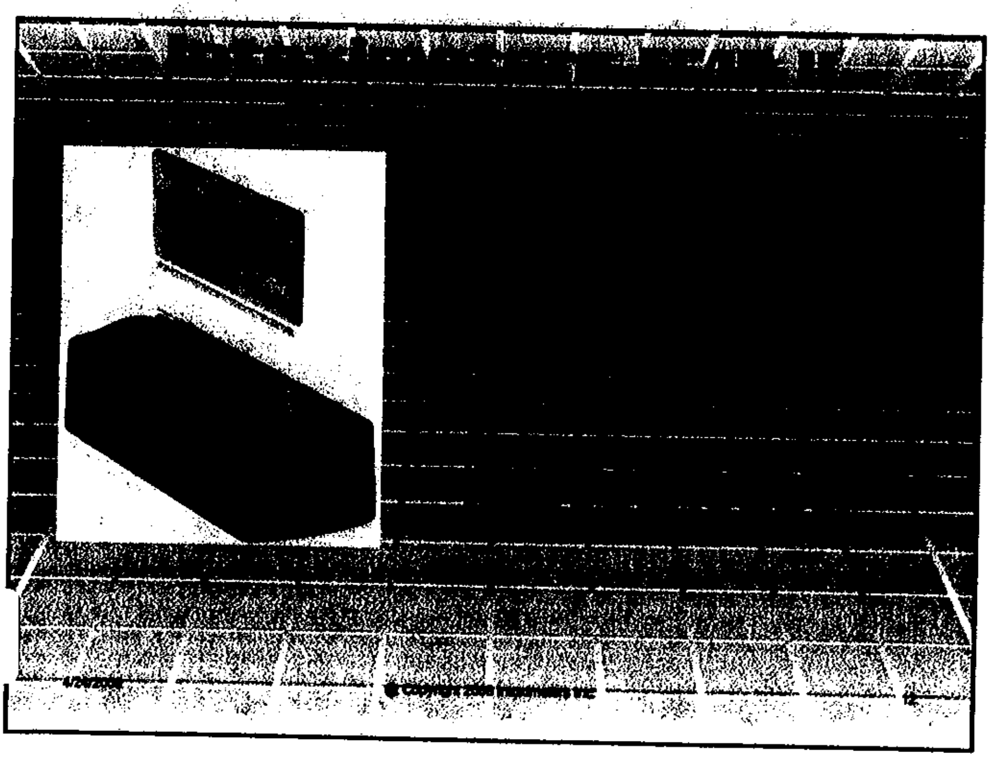

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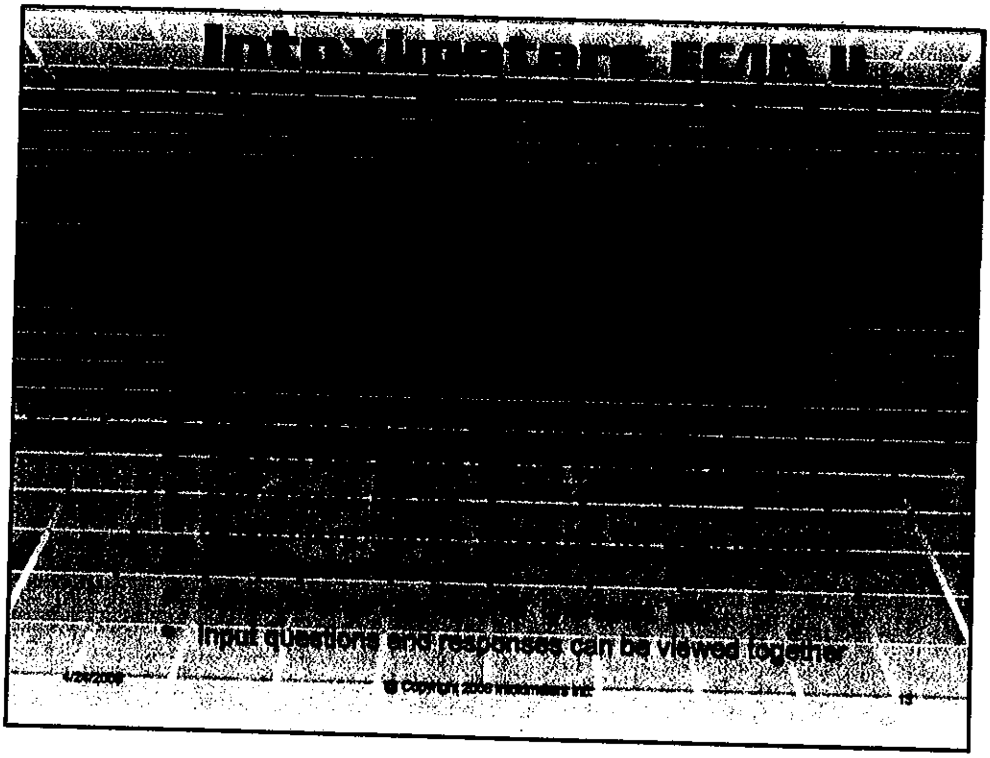
Intoximeters EC/IR II
Input questions and responses can be viewed together
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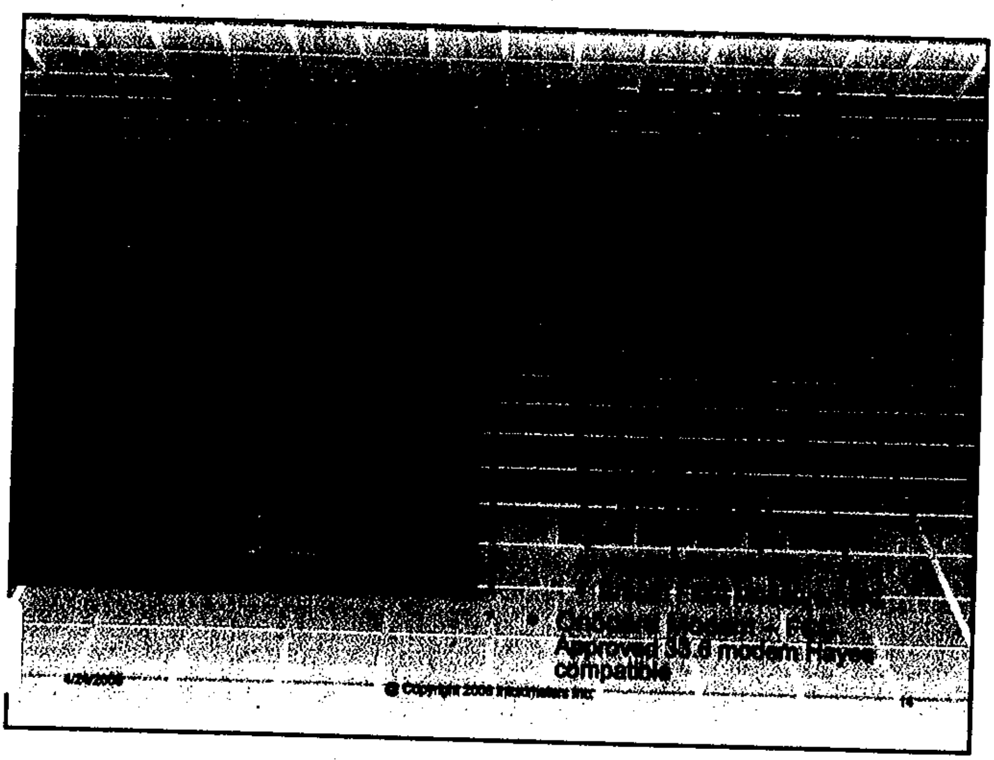
modem Hayes
compatible
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years) calculated per MIL STD 217 at 30°C ambient

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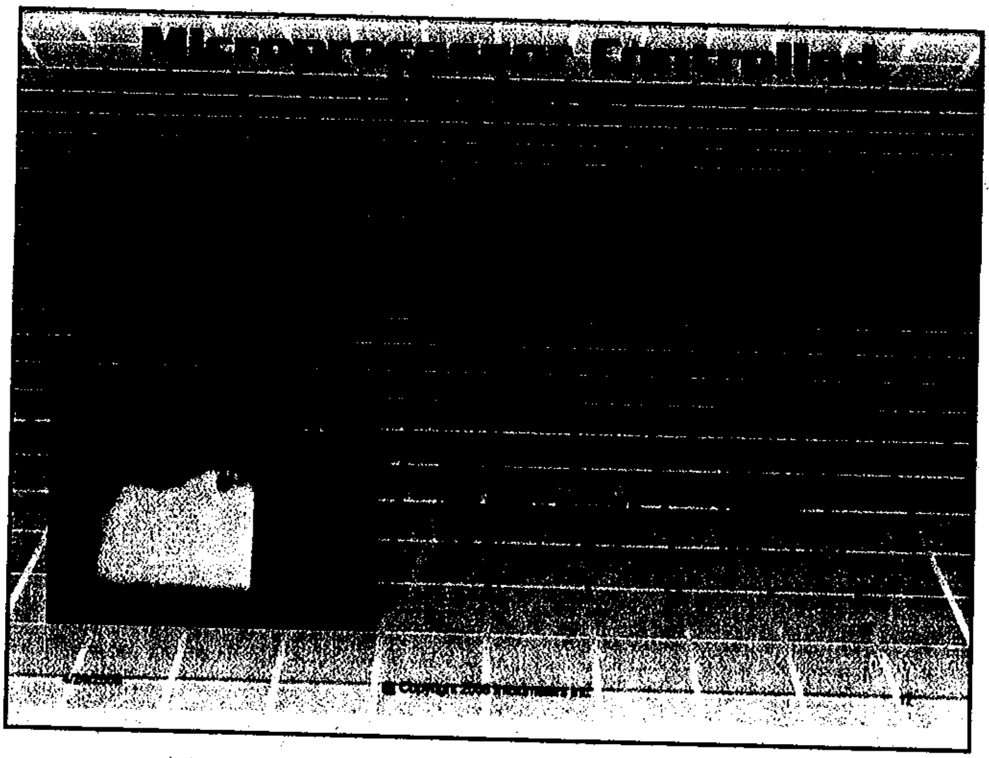
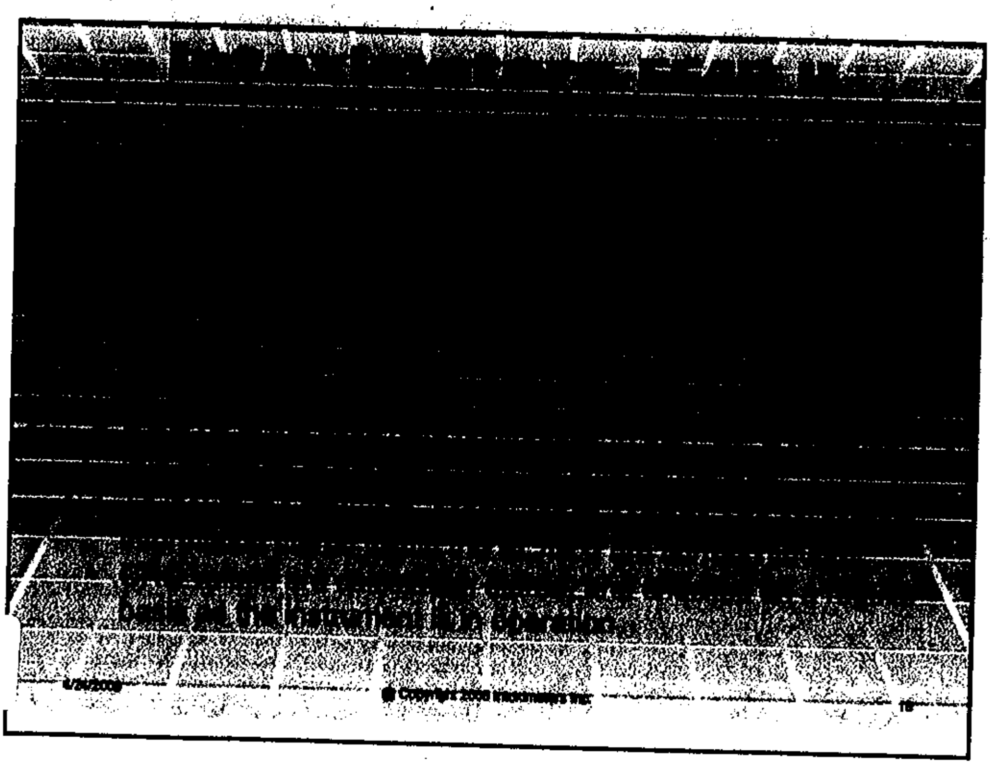

Microprocessor Controlled


basis as the instrument is in operation.

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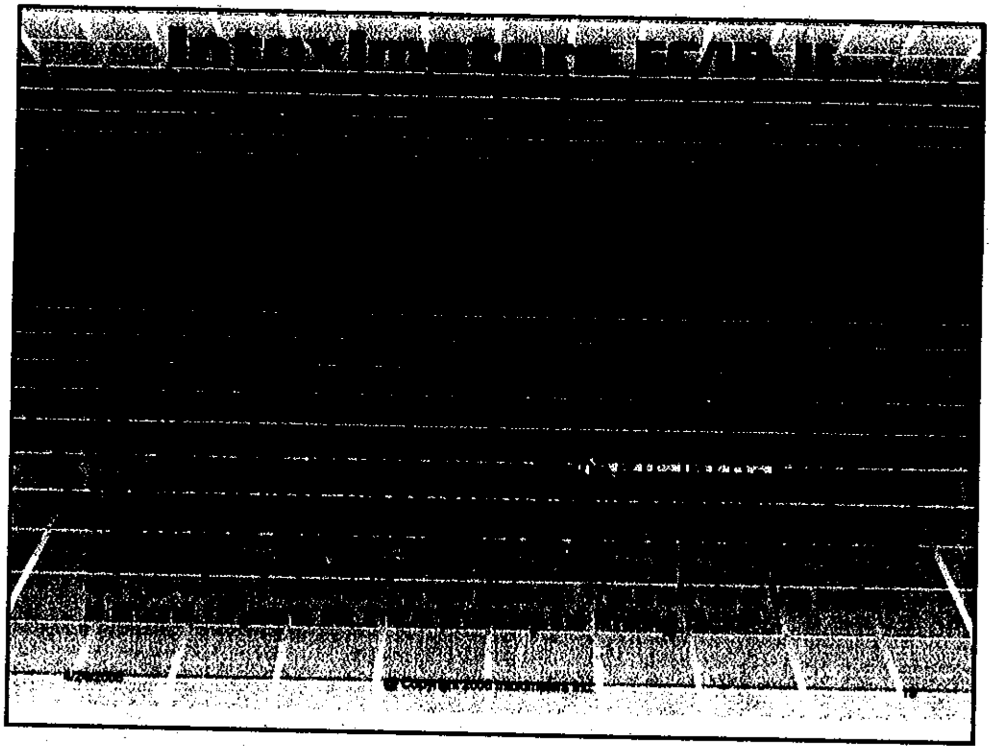

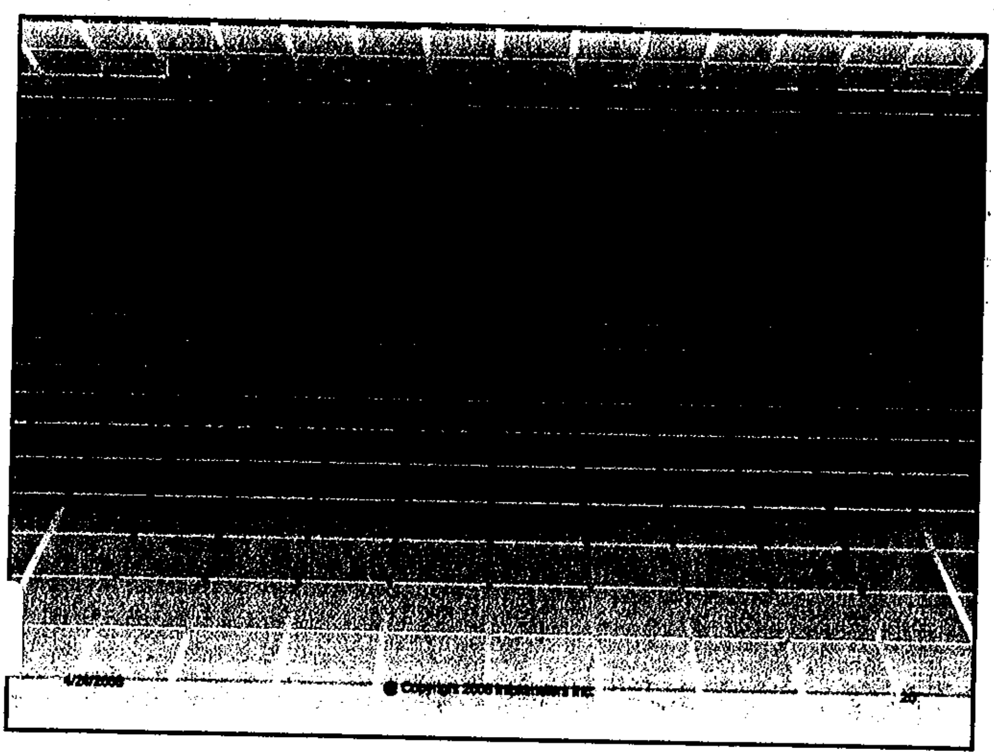


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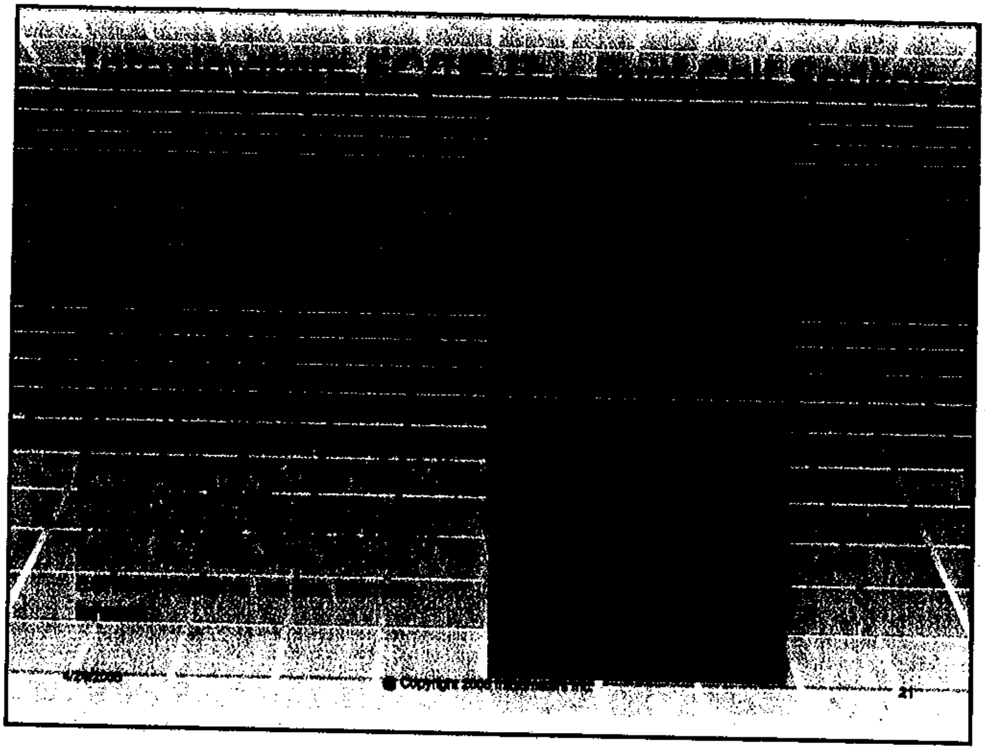



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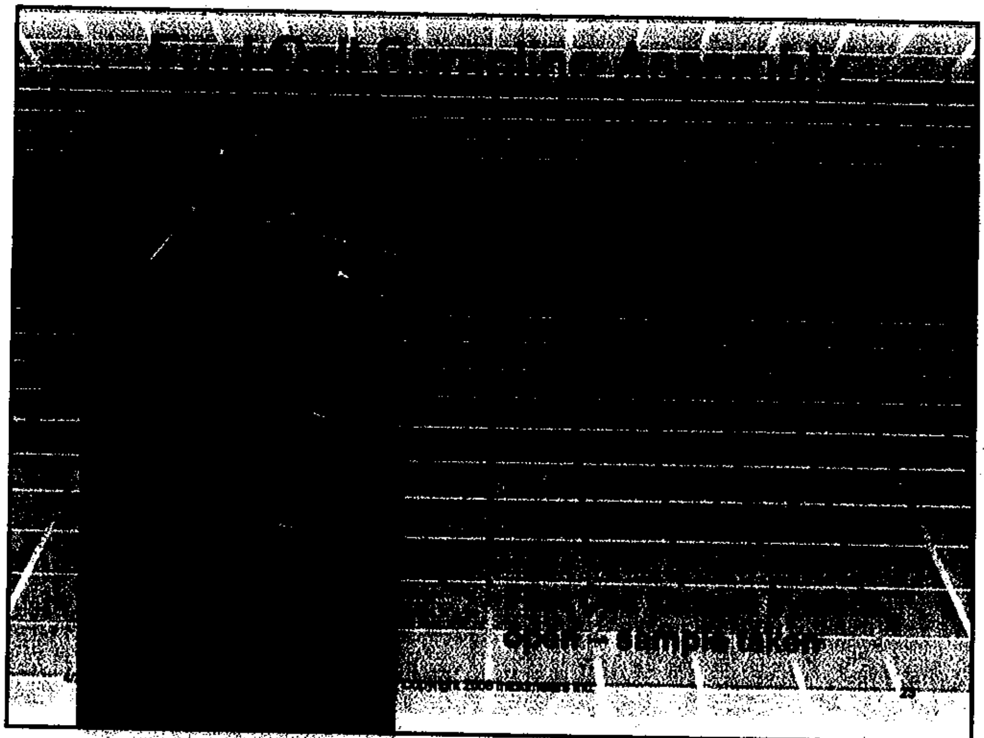


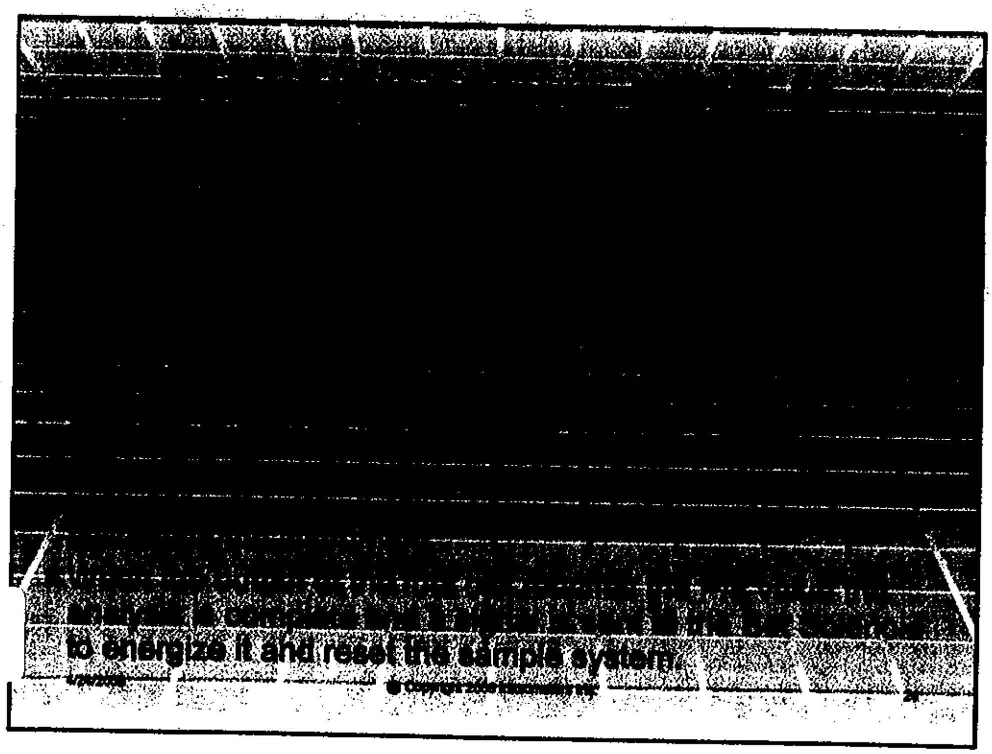


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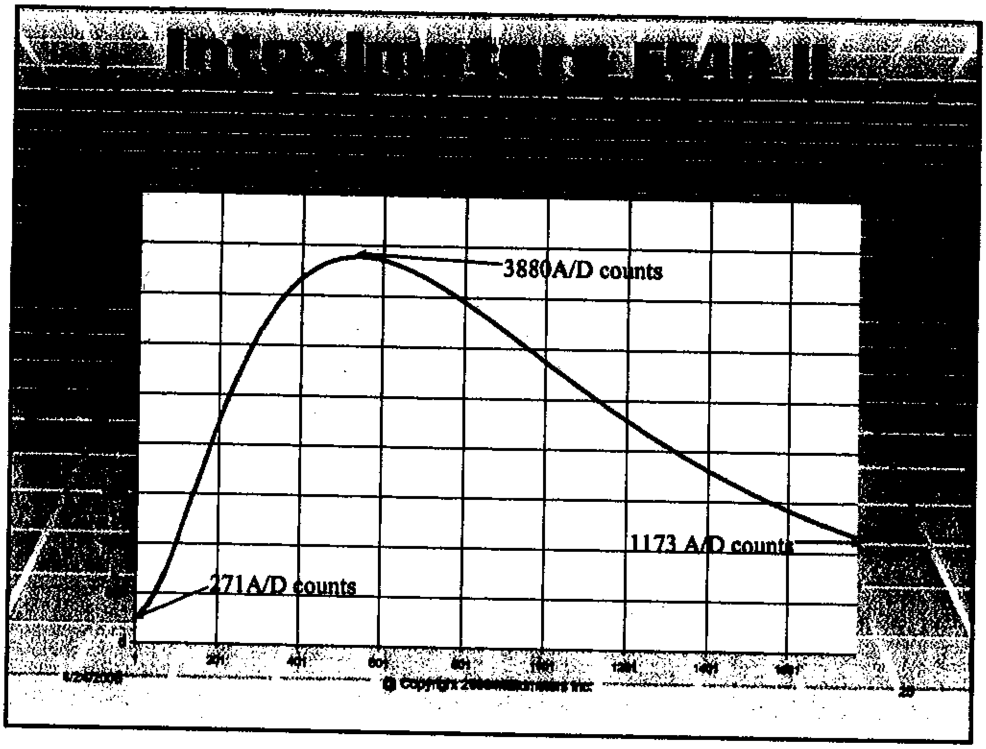


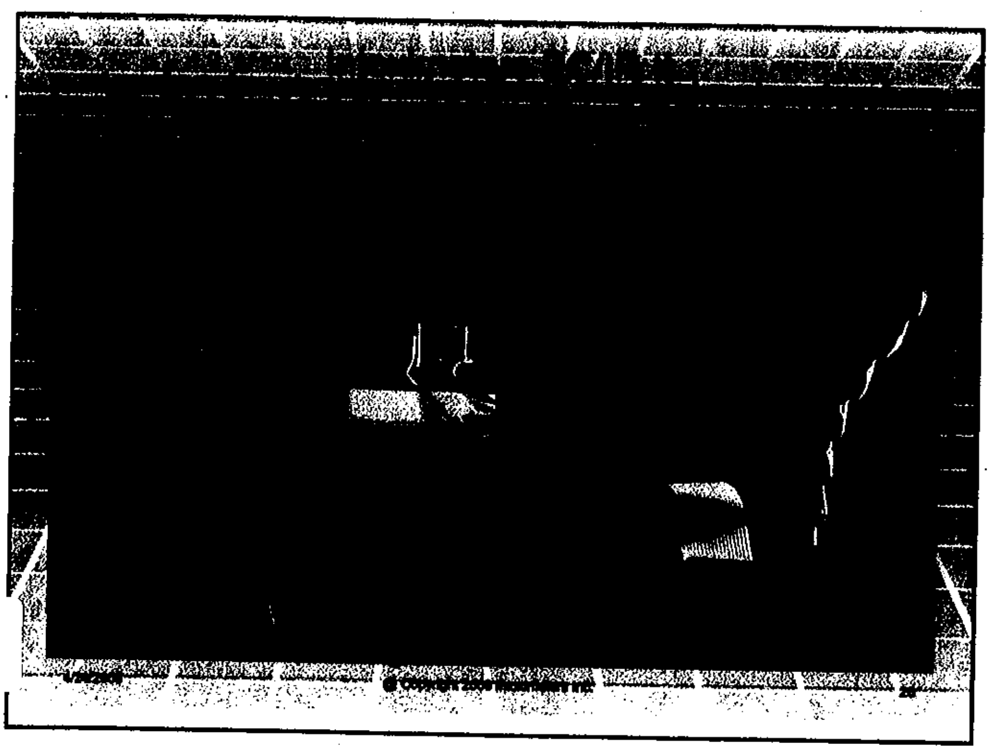

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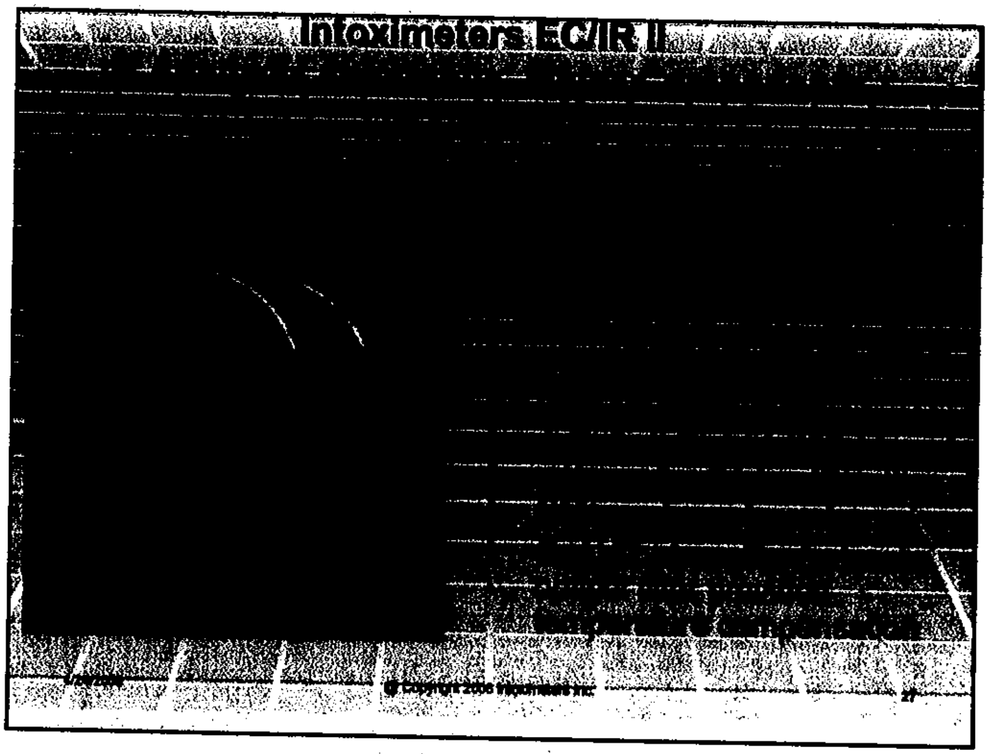


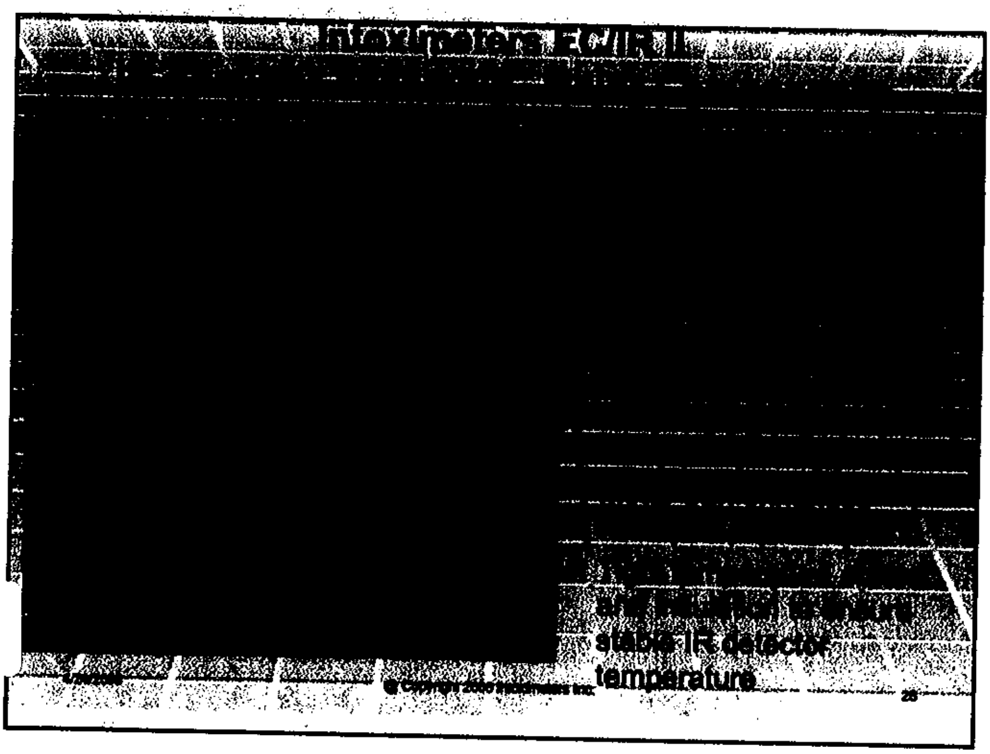


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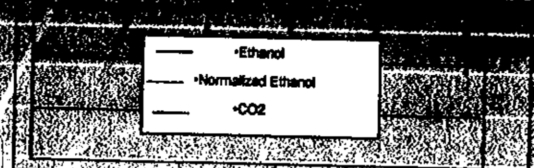


the beginning of the curve to the first point of intersection as in the following graph:

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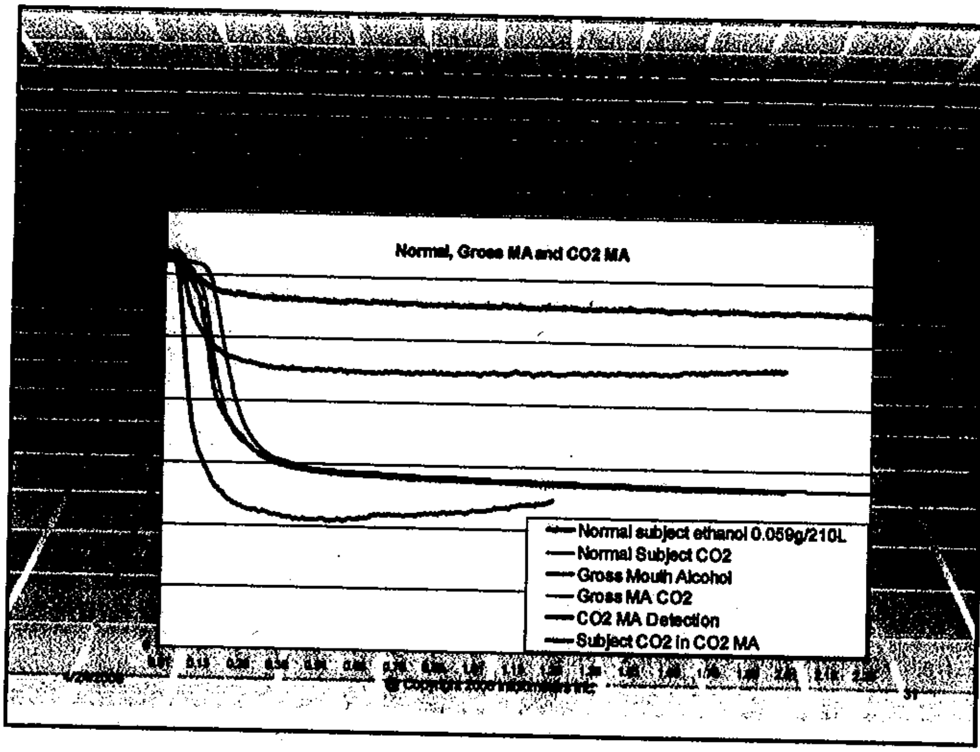

Normal, Gross MA and CO2 MA
Normal subject ethanol 0.059g/210L
Normal Subject CO2
Gross Mouth Alcohol
Gross MA CO2
CO2 MA Detection
Subject CO2 in CO2 MA
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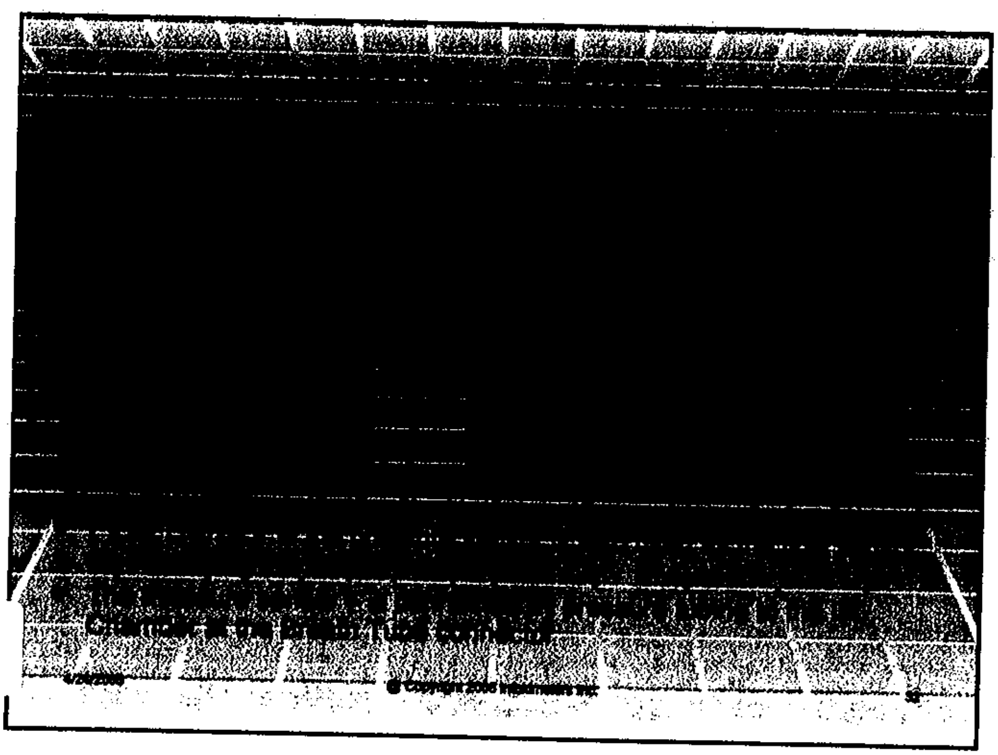

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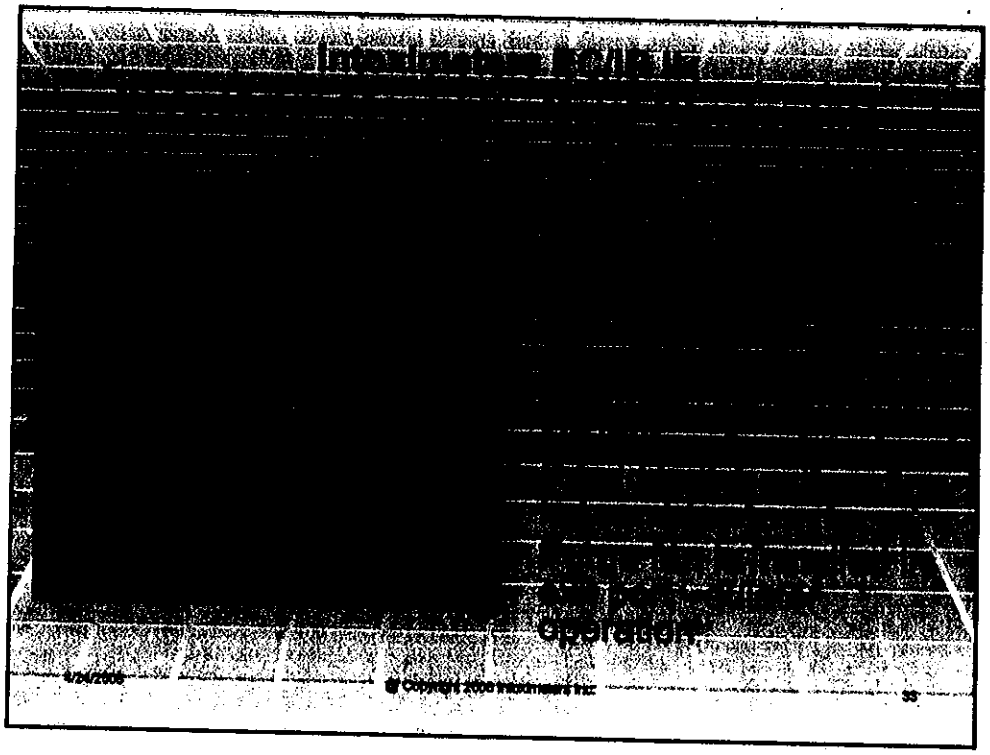


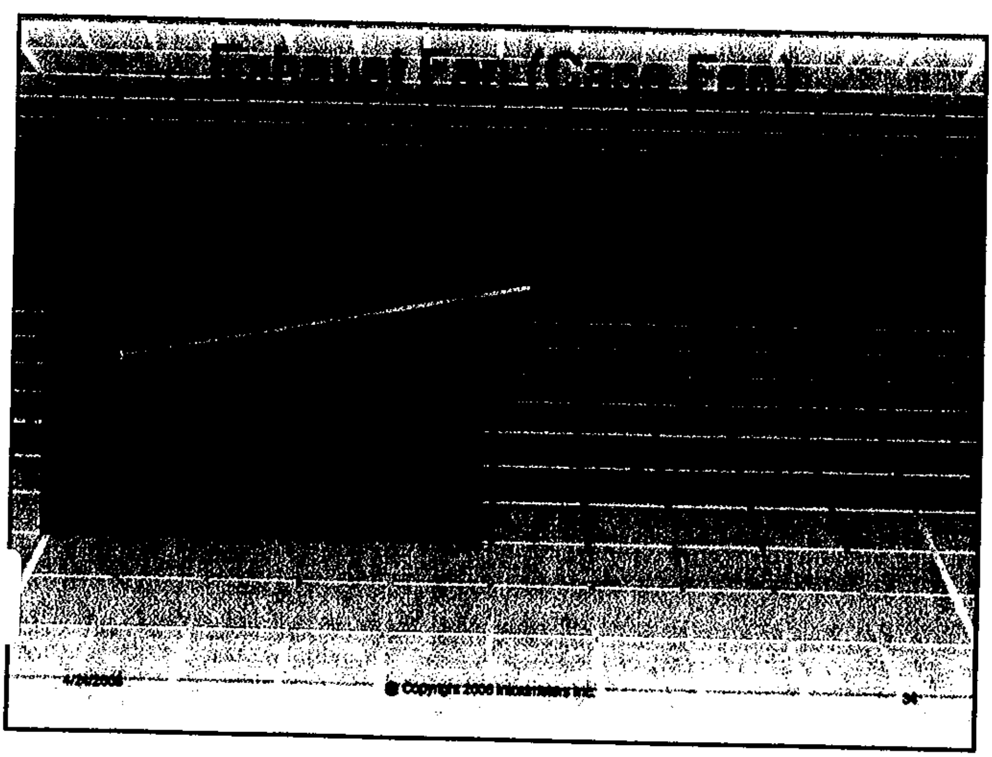


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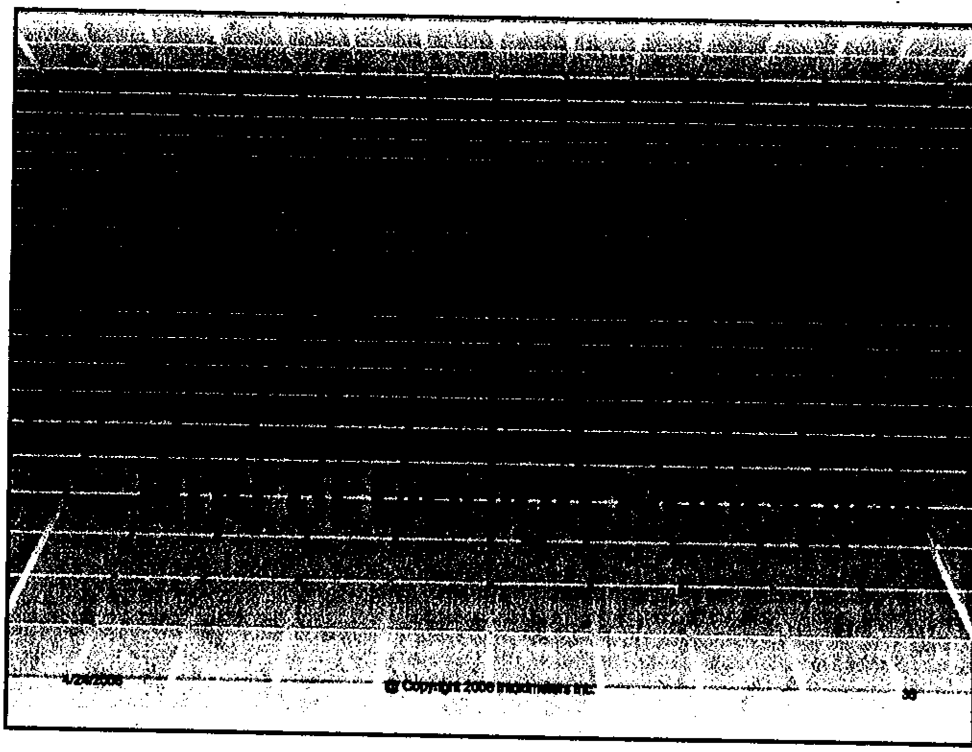

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