# DMT OPERATOR TRAINING MANUAL


Minnesota Department of Public Safety
Bureau of Criminal Apprehension
Forensic Science Services
Breath Alcohol Calibration Laboratory

# DATAMASTER DMT BREATH TEST OPERATOR TRAINING COURSE MANUAL

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Minnesota Department of Public Safety
Bureau of Criminal Apprehension
Forensic Science Services
Breath Alcohol Calibration Laboratory
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# General Course Information

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# General Course Information

## Introduction

Handouts supplement the material taught by the staff of the Minnesota Bureau of Criminal Apprehension (BCA) Forensic Science Services Breath Alcohol Calibration Laboratory and are intended only as an aide to training. They do not contain the complete content of the course nor are they an authoritative statement of Minnesota statute, rule, regulation, policy or procedure. Every effort has been made to provide correct information at the time of writing.

## Required P.O.S.T Statement

The BCA is a continuing education sponsor approved by the Board of Peace Officer Standards and Training (P.O.S.T). Peace officers who successfully complete this course will receive continuing education credits toward their P.O.S.T. license renewal. Operator training for new operators, as a basic course, constitutes twenty one (21) hours of approved continuing education credits.

The BCA endeavors to provide training in an environment free of discrimination or prejudice. Discriminatory or prejudicial acts or comments by faculty members, staff or students will not be tolerated. Complaints of inappropriate behavior based on race, gender, creed, age, color, religion, national origin or marital status may be communicated in any form to any representative of the BCA. All complaints received will be handled in accordance with BCA policy.

## Class credit and fee

You must attend 90% of the course to receive P.O.S.T. credit. If you need to leave because of a business or personal emergency, notify a course instructor. Your department will be charged the full registration fee if your absence is not cleared with an instructor.

## Maintenance

All DMT maintenance must be performed or authorized by the Minnesota Bureau of Criminal Apprehension Forensic Science Services Breath Alcohol Calibration Laboratory. Any unauthorized repairs could invalidate all subsequent subject tests. Any instrument problem should be brought to the immediate attention of the Bureau of Criminal Apprehension Forensic Science Services Breath Alcohol Calibration Laboratory.

## Operator Requirements

1. Minnesota DMT operators are required to attend and satisfactorily complete the Bureau of Criminal Apprehension Breath Test Operator course. During the course the student will run tests and learn the theory and background of breath testing sufficiently for competent court testimony. To complete the course successfully the student must obtain a score of 70% or higher on the written exams and successfully complete the tests assigned for the laboratory practical exam.

2. To maintain an active certification, an operator must take a recertification course periodically as instructed by the BCA and achieve a passing grade on the exam.

## Summary

The Breath Test Operator training program has been developed to assist with enforcement of DWI statutes. The DMT test procedure and operator requirements are the result of the experiences of the Bureau of Criminal Apprehension Forensic Science Services Breath Alcohol Calibration Laboratory and the recommendations of the National Safety Council's Committee on Alcohol and Other Drugs. The high standards placed on operators and instruments in Minnesota have established the DMT as an accurate and impartial test for alcohol concentration. It is *imperative* that this quality be maintained.

## Bureau of Criminal Apprehension and Laboratory Rules

1. 1430 Maryland is a smoke free building. Smoking is permitted only outside the building.
2. Side arms are prohibited in class whenever alcohol is being consumed. Lockers are provided for their storage.
3. Clean up spilled liquids promptly and properly. Notify an instructor immediately of any spill.
4. Return all materials to their proper storage areas at the conclusion of their use. Dispose of all refuse properly. Containers for recycling are provided. Please use them for cans, bottles and paper.
5. Keep all working areas clean and neat.

## Policy on Breath Test Students Who Have a Positive Alcohol Concentration Outside of the Controlled Drinking Session

At any time during the DataMaster DMT Breath Test Operator Training course, other than a controlled drinking session, if a student is found to have alcohol in their system (as tested by PBT or DMT-G), the following will occur:

- Breath Alcohol Calibration Laboratory staff will immediately notify Supervisor and Directors who will ensure that:
  - The student is removed from class and not allowed to drive regardless of alcohol concentration.
  - The law enforcement agency that employs the student will be contacted and attempts to speak with a direct supervisor will be made.
  - An appropriate response will be agreed upon between the student's agency and the BCA.

# DMT Certification Course Schedule

**Required Live Session:** Students must attend a WebEx Live online component of the course, which includes Concepts of Alcohol, Pharmacology and Toxicology, DMT Inside and Out, Ancillary Equipment, Status Messages, and Troubleshooting.

| | Day 1: Wednesday | Day 2: Thursday |
|---|---|---|
| 8:00 | **Introduction** | **Class begins at 8:30** |
| 8:30 | **Observation Period & MN Testing Sequence** | **Prosecutor Lecture** |
| 9:00 | **Hands On DMT Lab 1** | |
| 9:30 | | |
| 10:00 | | **Mock Trials** |
| 10:30 | **Status Messages Review** | |
| 11:00 | **&** | |
| 11:30 | **Hands On DMT Lab 2** | **eCharging** |
| 12:00 | **Quiz** | |
| 12:30 | **Lunch and Drinking Session** | **Lunch** |
| 1:00 | | **Course Evaluation & Course Review** |
| 1:30 | **Hands On DMT Lab 3** | |
| 2:00 | | |
| 2:30 | | **Written and Practical Exams** |
| 3:00 | | |
| 3:30 | | |
| 4:00 | | |

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# Concepts of Alcohol Testing

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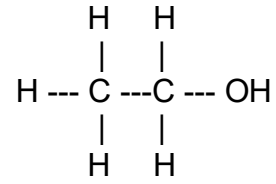
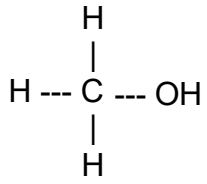
## Chemistry of Alcohol

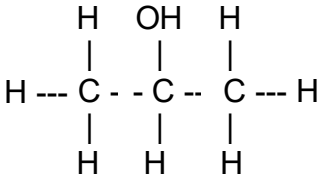
C = Carbon
H = Hydrogen
O = Oxygen



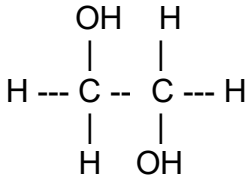
Ethyl alcohol



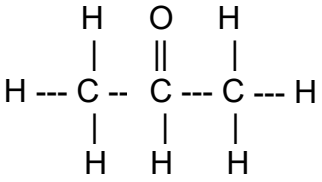
Methyl alcohol



Isopropyl alcohol



Ethylene Glycol



Acetone

Ethyl alcohol, a simple organic compound, is composed of two carbon atoms, five hydrogen atoms and a hydroxyl group (C2H5OH). A hydroxyl group (OH) is an oxygen atom and a hydrogen atom bound together, and is common to all alcohols. Ethanol is the alcohol which is contained in all alcoholic beverages. The first byproduct of ethanol is acetaldehyde, followed by ethanoic acid, commonly known as acetic acid or vinegar. Ethyl alcohol is also known as ethanol, alcohol, grain alcohol, neutral spirits and spirit of wine. The term alcohol is from the Arabic word **AL-KOHL**. Ethyl alcohol is a clear, colorless, volatile liquid with a slight characteristic odor, which is detectable at 10 parts per million (PPM) in air and becomes disagreeable at around 500 PPM. It mixes well with water. It is flammable and considered a hazardous material. Boiling point = 78.5° C (173.3° F) freezing point = -114.1° C (-173.4° F). The density is .791 @ 20° C and .787 @ 25° C (water = 1). The vapor density is equal to 1.6 (air = 1).

Methyl alcohol, also called methanol or wood alcohol, contains one carbon atom, three hydrogen atoms and a hydroxyl group (CH3OH). Methanol is extremely toxic to the human body. The metabolic byproducts of methanol are the reason for its toxicity. The first byproduct is methaldehyde, commonly known as formaldehyde. The body converts this to formic acid. Formic acid will dissolve the rods and cones in the retina resulting in vision impairment or blindness. Formic acid unchecked results in death by causing the kidneys to cease functioning.

Isopropyl alcohol, also called isopropanol or rubbing alcohol, contains three carbon atoms, seven hydrogen atoms and a hydroxyl group (CH3CHOHCH3). The body converts Isopropanol into acetone.

Ethylene Glycol, commonly called anti-freeze, contains two carbon atoms, four hydrogen atoms and two hydroxyl groups.

Acetone, contained in fingernail polish remover, contains three carbon atoms, seven hydrogen atoms and one oxygen atom. While acetone is not an alcohol, acetone vapors may be present in the breath of diabetics, dieters or highly exercised individuals. The infrared filters used in the DMT are able

to detect when the absorption pattern is not consistent with ethanol. Fuel cell technology used in preliminary breath testing devices do not respond to the presence of acetone.

## Beverage Labeling

The following are different means of measuring the amount of alcohol contained in an alcohol beverage.

### Alcohol Percent by Volume (ABV)

Percent by Volume is the required expression of a beverage's alcohol concentration for all distilled beverages. To determine the Percent by Volume, divide the volume of pure ethyl alcohol by the total volume of the alcoholic beverage and multiply by 100.

$$\frac{\text{Volume of Pure Ethyl Alcohol}}{\text{Total Volume}} \times 100 = \text{Percent by Volume}$$

### Alcohol Percent by Weight

To determine the Percent by Weight, divide the weight of pure ethyl alcohol by the total weight of the alcoholic beverage and multiply by 100.

$$\frac{\text{Weight of Pure Ethyl Alcohol}}{\text{Total Weight}} \times 100 = \text{Percent by Weight}$$

### Proof

In the United States, proof is the traditional way to measure alcohol content in distilled beverages.

Before scientific methods, beverage strength was measured by mixing equal amounts of spirit and gunpowder. When ignited, if the mixture did not burn it was too weak. If it burned too rapidly it was too strong. When it produced an even blue flame it was proved. This concentration is now known to be about 100 proof, or 50 percent alcohol by volume.

Proof is twice the alcohol percent by volume. Therefore, pure (100%) ethyl alcohol is 200 proof; 50% alcohol by volume distillates are 100 proof and 40% alcohol by volume distillates are 80 proof.

$$\text{Percent by Volume} \times 2 = \text{Proof}$$

## Alcohol Production

### Fermentation

Fermentation is the chemical breakdown of a substance by bacteria, yeasts, or other microorganisms. Ethyl alcohol is produced naturally through the process of fermentation and is the only process by which beer and wine are produced. It is also the first step in the production

of distilled spirits. Fermentation stops at about 16% ethyl alcohol by volume because natural, common yeast cannot survive in high levels of alcohol.

**Distillation**

Distillation is the action of purifying a liquid through a process of heating and cooling. Ethyl alcohol is traditionally concentrated through distillation. This is accomplished by heating the fermented mixture (mash) to evaporate the alcohol. The type of grain or cereal used in the mash, along with the manner of processing, determines the type of beverage produced. The vapors from the heated mash are collected and cooled to form a liquid. The liquid distillate portion contains the ethanol plus some water and flavorings. Simple distillation can generate 95% ethyl alcohol by volume. Pure 100% ethyl alcohol is produced by dehydration of the 95% distillate.

**Fortification**

Fortification is the process of increasing the alcohol concentration of a fermented beverage (wine) by adding alcohol distillate. It is used primarily to produce sweet dessert wines such as Port, Sherry, and Madeira.

**Names, Sources and Approximate Alcoholic Content of Various Beverages**

| Process | Beverage | Raw Material | Percent by Volume |
|---|---|---|---|
| Fermentation | Beers and Ales | Cereals | 2.3 – 6.0 |
| | Craft/Designer Beers | Cereals | 6.0 – 15.0 |
| | Ciders | Apples | 8.0 – 10.0 |
| | Wines | Grapes | 9.0 – 14.0 |
| | Wine and Malt Coolers | Wine or beer | 4.0 – 7.0 |
| | | | |
| Distillation | Whiskey | Beer | 40.0 – 55.0 |
| | Rum | Molasses | 40.0 – 75.5 |
| | Brandy | Wine | 40.0 – 55.0 |
| | Vodka | Neutral Spirits | 40.0 – 55.0 |
| | Gin | Grain | 35.0 – 50.0 |
| | | | |
| Fortification | Sherry, Port, Madeira | Grapes | 17.0 – 22.0 |

**Congeners**

After the distillate is collected it is commonly placed in charred wooden barrels for aging. During the aging process certain chemicals are leached from the wood and dissolved in the distillate. These compounds are called congeners. Congeners are responsible for the variable taste, aroma, and color of different beverages. Congeners can also be responsible for adverse hangover symptoms.

## Analytical Techniques for Measuring Alcohol Concentration in Breath

### Chemical / Photoelectric Devices

A sample of breath passes through crystals or a solution that contains a colored chemical substance. The substance reacts with alcohol to produce a color change that can be measured. The intensity of the color change reflects the amount of alcohol in the sample.

### Gas Chromatography

A sample of breath passes through a tubular column to a detector. Substances in the breath move through the column at different rates and arrive at the detector at different times. The detector measures the amount of each substance and the alcohol concentration can be reported by a data system. Gas chromatography can identify and measure substances in the breath other than alcohol and it can be used to analyze other body fluids, such as blood or urine.

### Infrared Absorption

A breath sample passes into a chamber of fixed volume and temperature. A beam of infrared light passes through the chamber. When the light beam exits the chamber, it is filtered to remove undesired wavelengths. The remaining wavelengths are converted to an electrical signal directly proportional to the concentration of the alcohol in the breath sample.

### Platinum Fuel Cell

A sample of breath is introduced to the fuel cell. Any alcohol that is present causes an oxidation reduction reaction and creates an electrical current. The electrical current is directly proportional to the concentration of alcohol in the breath sample.

### Catalytic Detector

The alcohol in a breath sample comes into contact with a semiconductor and increases the voltage across it. This voltage increase is directly proportional to the amount of alcohol in the sample.

Evidentiary Instruments (This is not an exhaustive list)

| **Instrument Name** | **Developer(s) and year** | **Material analyzed and volume** | **Method for quantitation** |
|---|---|---|---|
| Drunkometer | Harger and co-workers 1938 | Rebreathed air, volume varies | Potassium permanganate in sulfuric acid |
| Alcometer | Greenberg and Keator 1941 | Alveolar breath, 15 ml | Iodic acid |
| Breathalyzer | Borkenstein 1954 | Alveolar breath, 52.5 ml | Potassium dichromate and silver nitrate in sulfuric acid |
| Gas chromatograph Intoximeter | Forrester and Associates 1968 | Alveolar breath, .25 ml | Electronic flame ionization detector |
| Intoxilyzer 4011 | Omnicron Systems Corporation 1972 | Alveolar breath, 600 ml | Infra-red absorption |
| Intoxilyzer 5000 | MPD – CMI Inc. 1983 | Alveolar breath, 81.4 ml | Infra-red absorption |
| Intoxilyzer 5000EN | MPD – CMI Inc. 1997 | Alveolar breath, 82.2 ml | Infra-red absorption |
| DMT- G with Fuel Cell Option (Rev-A) | NPAS, Inc. 2010 (2011) | Alveolar breath, 23 ml | Infra-red absorption & Platinum Fuel Cell |

Preliminary Breath Testing Devices (This is not an exhaustive list)

| **Instrument Name** | **Developer(s) and year approved** | **Material analyzed and volume** | **Method for quantitation** |
|---|---|---|---|
| Alert J2 | Borg Warner 1973 | Alveolar breath | Catalytic Detector |
| Alert J3A, +C | Borg Warner 1978 | Alveolar breath | Catalytic Detector |
| Alco-Sensor PWF | Intoximeters Inc 1982 | Alveolar breath, 1ml | Platinum Fuel Cell |
| CMI – LION SL-2 | MPD – CMI Inc. 1989 | Alveolar breath, 1ml | Platinum Fuel Cell |
| Alco-Sensor IV | Intoximeters Inc 1992 | Alveolar breath, 1ml | Platinum Fuel Cell |
| Alco-Sensor III | Intoximeters Inc 1997 | Alveolar breath, 1ml | Platinum Fuel Cell |
| CMI – LION SD-2 | MPD – CMI Inc. 1997 | Alveolar breath, 1ml | Platinum Fuel Cell |
| FC-10 | LifeLoc Technologies 2001 | Alveolar breath, 1ml | Platinum Fuel Cell |
| FC-20 | LifeLoc Technologies 2002 | Alveolar breath, 1ml | Platinum Fuel Cell |
| Alco- Sensor FST | Intoximeters, Inc. 2004 | Alveolar breath, 1ml | Platinum Fuel Cell |
| Alco-Sensor V XL | Intoximeters, Inc. 2012 | Alveolar breath, 1ml | Platinum Fuel Cell |

## Concepts of Breath Testing

A basic assumption underlies breath alcohol testing:

⇒ *There is a determinable ratio between the alcohol concentration in the blood (and the brain) and the alcohol concentration found in the breath.*

The National Safety Council Committee on Alcohol and other Drugs ad hoc committee, and most experts in the field agree that 2100 parts of alveolar (deep lung) air contain the same amount of alcohol as 1 part of blood. ***Hence, the breath to blood ratio is 2100:1***

### Strengths of Breath Testing:

**Quick Results –** The results are obtained very quickly.

**Subject Identity –** There is very little question as to the identity of the subject.

**Easy Collection –** The sample is easy to obtain, therefore requires less technical expertise than the collection and analysis of body fluids and tissues.

**Low Cost –** Breath test equipment and facilities cost less per test than performing alcohol tests in a laboratory.

### Concerns with Breath Testing:

**Cooperative Subject –** The subject must be cooperative to provide a proper sample.

**Further Analysis –** The sample cannot be reanalyzed for drugs or alcohol.

**Mouth Alcohol –** Alcohol can remain in the mouth after ingestion and can be introduced through actions such as vomiting or belching, or use of products such as breath fresheners, cough syrups or some medications. The operator should perform an observation period of at least 15 minutes to ensure that mouth alcohol has dissipated.

**Interference –** The DMT is designed to detect substances other than ethanol on the breath and will report them as Interference.

**Other Substances in the Mouth –** The mouth must be free of foreign matter, such as gum, candy, cough drops, medications and tobacco products, during the observation period and the test. This prevents possible damage to the instrument, blockage of the breath flow, and mouth alcohol.

**Smoking –** Components in smoke can affect instrument performance. Smoke can destroy fuel cells in a PBT and can cause the DMT lenses to become cloudy.

**Acetone –** Acetone vapors may be present in the breath of diabetics, dieters or highly exercised individuals. The Infrared filters used in the DMT are able to detect the presence of acetone. Fuel

cell technology used in preliminary breath testing devices do not respond to the presence of acetone. The DMT will treat the presence of acetone on the breath as an Interference.

**Alveolar Air –** Deep lung air provides a more accurate representation of the alcohol concentration in the body. A shallow breath sample can produce an erroneously low reading. Although the DMT and most PBTs are designed to ensure a deep lung sample, encourage subjects to blow in a long and steady manner.

**Temperature –** Temperature variances can affect the alcohol readings. The DMT will not allow a test to be run if the instrument temperature is not in the proper range. PBTs should be warmed or cooled to operating temperature before administering a test.

**Moisture –** Breath condensation can result if the instrument is not at operating temperature. This moisture can absorb alcohol and cause a low reading. The DMT provides a heated path for incoming breath to prevent this from happening.

## History of Breath Testing

Many procedures have been developed to analyze alcohol in human body fluids and tissues. The first reported breath alcohol studies were in 1847 on rabbits, and in 1874 on human subjects. Tests for alcohol have been the most commonly performed forensic chemical examination over the past 50 years, the great majority being performed to determine the extent of alcoholic influence in drivers and victims of traffic accidents.

Timeline for DWI and Breath Testing

1621 – The Pilgrims landed in America
1632 – First commercial brewery in the U.S.
1814 – Steam Locomotive invented
1830 – First passenger trains
1840 – Concern about intoxicated railroad engineers
1843 – New York Central Railroad bans employee drinking
1847 – Alcohol recognized on the breath of humans and rabbits
1874 – Anstie determines mouth alcohol dissipates after 15 minutes
1898 – First patent for the automobile
1904 – Many drunk driving fatalities
1913 – First chemical test for alcohol concentration in body fluids
1914 – Widmark relates urine alcohol to driving impairment (Sweden)
1920 – Prohibition began
1930's – American Medical Association called for alcohol testing
1933 – Prohibition repealed
1938 – First law enforcement breath test instrument (Drunkometer)
1939 – Indiana passed the first *per se* law at 0.15
1954 –Breathalyzer introduced
1972 –Intoxilyzer introduced
1975 – Modern PBTs with fuel cells introduced
1986 – DataMaster introduced
2005 – Minnesota adopts *per se* limit of 0.08
2010 – DMT-G with fuel cell option introduced
2018 – Utah adopted *per se* limit of 0.05

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# DMT

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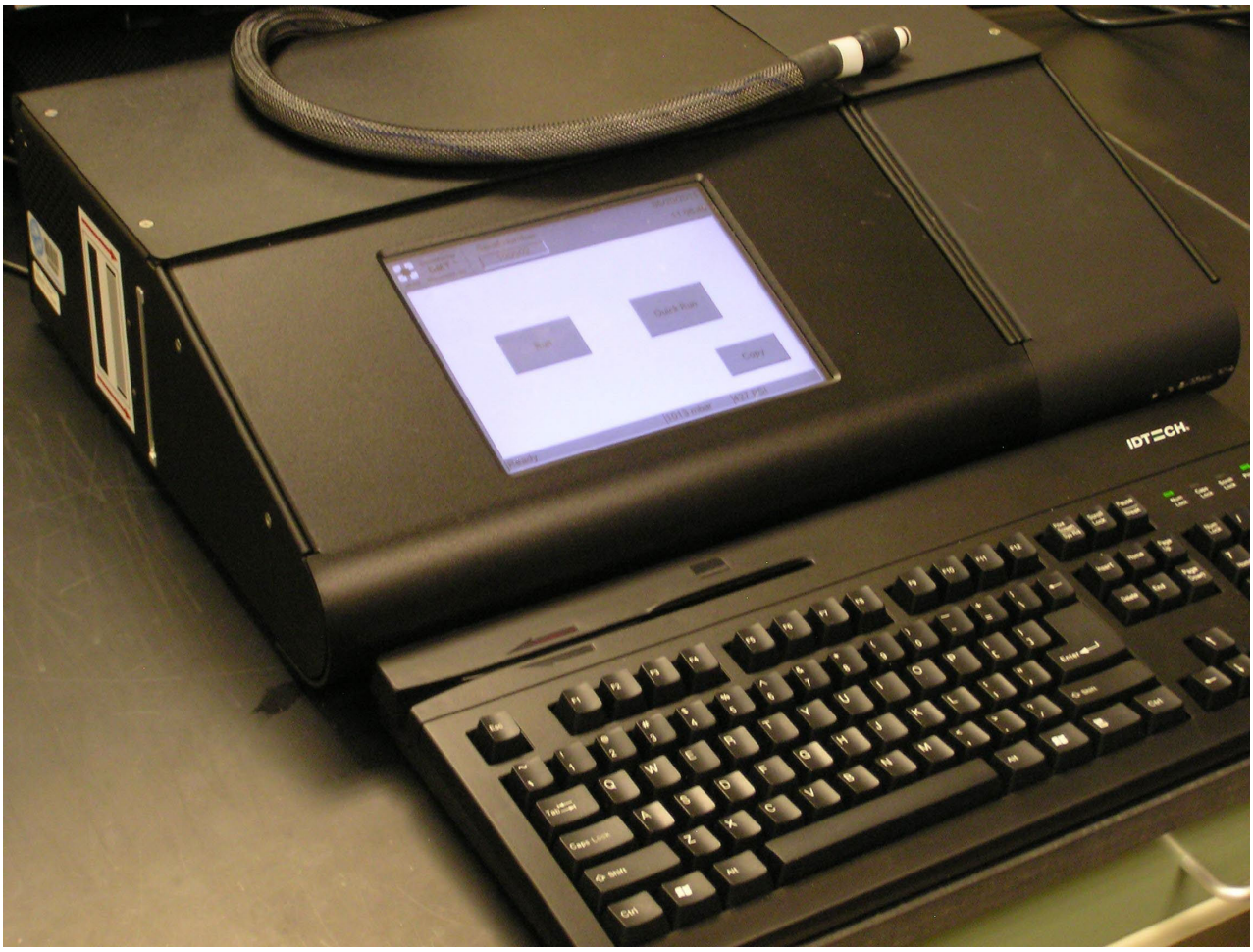
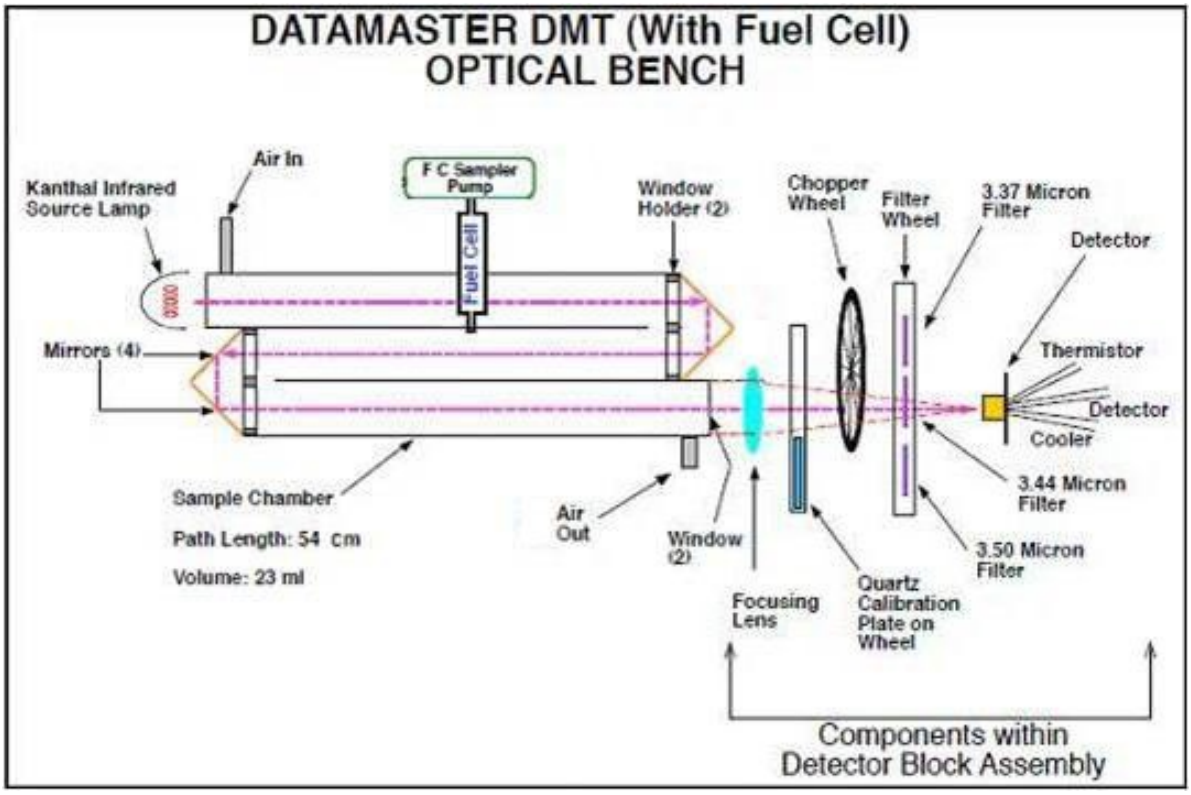



In 2013, National Patent sold the DataMaster DMT product line to Intoximeters, Inc. With this sale, the name changed from DataMaster DMT-G with Fuel Cell Option or DataMaster DMT-G with Rev. A Fuel Cell Option to IntoxDMT. Regardless of the official name, the breath test instruments used throughout Minnesota are most often referred to as the DMT.

The DMT is designed for countertop or mobile breath alcohol testing. The DMT uses the proven method of absorption of infrared energy to quantify breath ethanol levels and guard against false positives from potentially interfering compounds. This instrument incorporates a 2D barcode reader, an IDTech keyboard with a magnetic stripe reader and a Hewlett Packard printer. Read the respective sections for more information on these items.

# Infrared Breath Testing: The Analytical System

Analytical Bench




Testing for the presence and quantity of a chemical such as ethanol using Infrared absorption has been in use by law enforcement for breath alcohol testing since the early 1970's.

The molecular bonds of chemical compounds such as alcohol have the characteristic of being "excited" at certain wavelengths of infrared (IR) energy, meaning that the molecular bonds holding the atoms of hydrogen and carbon together begin to vibrate when the IR energy is focused on them. When they vibrate, they absorb some of the energy.

If it is known how much IR energy was present before the alcohol was in the sample chamber and it is known how much remains while the alcohol is in the sample chamber, measuring the difference will tell how much alcohol is in the sample chamber. By allowing only wavelengths of IR energy that are sensitive to ethanol to pass through the sample, it precludes the possibility of something other than ethanol adding to the measurement.

The DMT provides a controlled and consistent environment by maintaining the temperature of the sample chamber at 48ºC ± 4 to prevent condensation.

The DMT employs the theory that in infrared testing the longer the distance the energy must travel through the chemical, the better opportunity it will have to be absorbed and therefore a more precise differential in before and after measurement may be obtained. This is referred to as "resolution" and is a direct function of the length of the sample chamber. The longer the sample chamber, the better the resolution, thus the length of the sample chamber is 54 centimeters.

The DMT also employs the theory that the more pure the sample of the chemical being tested, the better the accuracy. In breath testing, it is more desirable to have a small sample of alveolar air than a large sample of air, which would, of necessity, include more air that was not alveolar. The smaller the volume, the better the accuracy, thus the volume of the sample chamber is 23 milliliters.

For greater sensitivity, there should be as great a temperature differential as possible between the emitted IR energy and that of the detecting element. This makes the detector more responsive and gives a better signal. The DMT cools the detector to 0ºC. The cooler the detector, the better the sensitivity and precision.

The DMT employs three filters at three different wavelengths. After the breath sample is accepted as adequate by the instrument, the sample is measured at each of the three wavelengths,, 3.37 microns, 3.44 microns and 3.50 microns. The results are compared to each other for acceptable ratios and to ensure the sample being measured does not contain an interferent.

The quartz plate is a translucent glass filter that absorbs IR light, designed to simulate an alcohol concentration and is the Internal Standard. The filter absorbance is established during the adjustment of each DMT. The results of the Internal Standard during each subsequent Diagnostic test, must measure ±4% of the value established during the most recent adjustment.

The DMT is approved for use in the state of Minnesota using only Infrared technology or Infrared in conjunction with a fuel cell. It was determined that the lifespan of the fuel cells used in the DMT was inadequate. As a result, the fuel cell option of the DMT was turned off in May 2012.

## Sample Acceptance

The DMT sampling system incorporates the following criteria to establish an acceptable breath sample:

(1) The subject must provide the breath sample with a minimum flow rate of 2.87 L/min.

(2) The subject must provide a minimum total volume of 1.5 L in a single breath sample.

(3) The slope of the alcohol concentration must be level. The DMT deems the slope to be level when:
   a. The 1.5 L total volume requirement has been met at the point when the flow rate drops below 2.87 L/min.
   b. The increase from the second-to-last two-point average to the last is less than or equal to 0.001 g/210L and not a negative slope. To be considered a negative slope, the change in consecutively compared averages must be greater than 0.001 g/210L in the negative direction.
   c. The absolute value of the change between the final two, two-point averages must be 0.001 g/210L or less.

(4) The subject's flow rate must drop below the minimum flow rate of 2.87 L/min.

*****ALL FOUR ACCEPTANCE CRITERIA MUST BE MET IN A SINGLE BREATH WITHIN A THREE MINUTE WINDOW.*****

**Criteria (1):**

The breath sample must be provided at a minimum flow rate of 2.87 L/min. to change the ***flashing*** “Please Blow” indicator on the display to a ***non-flashing*** “Please Blow” and an audible “beeping” to a constant tone. The breath flow rate is measured by a flow sensor located adjacent to the breath path.

**Criteria (2):**

The sample volume is calculated as long as the continuous breath flow rate meets or exceeds 2.87 L/min. When a minimum volume of 1.5 liters of air has passed into the system, the minimum volume requirement is met. The DMT requires that the subject deliver a minimum volume of 1.5 L to accept a sample.

**Criteria (3)**:

As a subject blows, the percentage of alcohol in the breath moving through the sample chamber will increase. The first part of a breath sample is mouth air, which has little alcohol relative to lung air. The DMT displays rising numbers as mouth air, and then lung air passes through the sample chamber. When the subject reaches the deep lung or alveolar air, which is characterized by a relatively uniform concentration of alcohol, the reading will rise at a slower rate. Although some rise can still be detected, the subject is beginning to run out of breath.

The DMT monitors the rise in alcohol concentration for a corresponding plateau. If the subject stops blowing before the instrument notes a uniformity of concentration (deep lung or alveolar air), the breath sample will not be accepted. The subject may start blowing again and introduce a sufficient amount of breath into the instrument as long as it is completed within the three minutes allowed. If the three-minute time limit is exceeded the DMT will display and print “Deficient” as the test result.

**Criteria (4):**

After the first three criteria are met, the fourth criteria, a reduction of the flow rate below 2.87 L/min, can then be established. At this time the breath sample will be accepted.

## The DMT: Rear Panel

## Rear Panel

1. **DRY GAS HOUSING**: Allows for the instrument to be used with an external dry gas standard.

2. **PUMP OUT**: This port is used when conducting a re-circulating simulator test. This port should be connected to the “In” port of the simulator (usually the highest port on the simulator). The simulator may remain connected to this port as long as desired.

3. **VAPOR IN**: This port is used when conducting a re-circulating simulator test. This port should be connected to the “Out” port of the simulator (usually the lowest port on the simulator). The simulator may remain connected to this port as long as desired.

4. **SIM TUBES POWER**: This plug provides a source of power for the simulator hose heaters. It is also used to monitor the temperature of the simulator hoses.

5. **CAL**: This port is used to vent the sample chamber during a purge and is used to provide recirculation during the calibration procedure. It is never used while conducting a simulator test.

6. **BREATH TUBE**: The breath tube is used to introduce a subject sample into the instrument.

7. **BREATH TUBE POWER**: This plug provides a source of power for the breath tube heater. It is also used to monitor the temperature of the breath tube.

8. **DC/OFF/AC**: This switch controls power to the DMT. The switch is equipped with two positions. Pressing the switch to the “AC” side allows for the use of AC power. Pressing the switch to the “DC” side allows for the use of DC power. The instrument may be turned off during periods of prolonged inactivity. An internal battery backup system will maintain correct time and date.

9. **SIM TEMP**: The RS-232 port is used for serial communication with an external device. This is usually a simulator capable of communicating information to the DMT.

10. **12 VDC**: For use in mobile testing with a BCA supplied power cord (if applicable).

11. **100/240 VAC 47/63 HZ**: Use only the grounded power cord furnished with the instrument.

12. **USB**: The USB ports serve a variety of functions on the DMT. The primary uses are for the keyboard connector and for the printer cable as the DMT utilizes an external USB capable printer.

13. **ETHERNET**: The RJ-45 port is used to connect the DMT to an Ethernet network for data transmission with the DMT.

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# Dry Gas

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# CONTROL SAMPLES AND DRY GAS CYLINDERS

## Dry Gas Controls

A control is defined as a material of known alcohol concentration that is analyzed with test samples in order to evaluate the accuracy of an analytical procedure. The DMT utilizes a dry gas cylinder with an approximate alcohol concentration of 0.080 g/210 Liters as the control sample. Dry gas cylinders for use in the DMT are pre-installed by the BCA at no cost to departments.

## Dry Gas Cylinder Certificates of Analysis

Each dry gas cylinder provided by the BCA comes with a Certificate of Analysis .

## Barometric Pressure

Barometric pressure has an effect on the alcohol concentration value when delivered from a compressed gas cylinder. The DMT compensates for this through the use of an integrated barometric sensor. As a result, a control target value is established for the test that will be slightly different than the value printed on the Certificate of Analysis, which is established at sea level. For example, the concentration on the dry gas cylinder label may read 0.080, but the control target printed on the test record is 0.077 due to the barometric pressure at the time of the test. The control samples analyzed by the DMT must read within 0.005 g/210L of the control target printed on the test record, not the alcohol concentration value printed on the label and Certificate of Analysis.

## Tank Pressure

An integrated pressure sensor for the gas cylinder is utilized by the DMT. This feature allows the user to monitor the dry gas cylinder pressure. The dry gas cylinder pressure in Pounds per Square Inch (PSI) can be found in the status bar of the main page on the DMT display. A full tank will usually contain around 1000 PSI of pressure. When the tank pressure reaches 200 PSI, the operator will be notified with the message “Tank pressure getting low”. This should allow sufficient time for the department to arrange for and receive a new DMT from the BCA or a designated Minnesota State Patrol Headquarters. If the tank pressure drops below 25 PSI during a test, the operator will receive the message “Tank Pressure Too Low” and the test will end prior to completion. When the tank pressure is below 25 PSI, the operator will not be allowed to begin a test.

## Expiration

The DMT will monitor the expiration date of the dry gas cylinder and notify the operator with the message “”X” days until tank expires” when the gas is within 30 days of expiration. This should allow sufficient time for the department to arrange for pickup of a new DMT from the BCA or a designated Minnesota State Patrol Headquarters. The DMT will not allow tests to be performed after the dry gas has expired.

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# Touch Screen Menu

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## Main Screen

The DMT is equipped with a color LCD touch screen display. The main screen allows you to view the date and time, monitor tank pressure, begin a subject test or quick test or print a copy of the last test run.

## DMT Icon Drop Down Menu

Selecting the DMT icon in the top left corner opens a drop down menu with several functions. Tests and functions can be initiated by trained operators by selecting the appropriate option on the display. If a menu item is not accessible to an operator it will be grayed out or will notify the operator that they do not have a high enough security level to access that function.

## Setup

The setup menu allows certain parameters to be set. When a setup function is selected from the left screen, additional options may appear on the right screen.

### DMT

Serial Number – The DMT serial number is displayed.

Title – The title “State of Minnesota” appears on each test record.

Location – The location should indicate where the DMT is located. Double tap in the space to the right of Location. Using the keyboard, enter the department name where the DMT is located.

### Units

Alcohol concentration is set to report in grams per 210 Liters (g/210L).

### Simulator

Displays settings for the wet bath simulator.

### Subject

Operators can change the number of copies automatically printed at the completion of a subject test. Double tap the value listed after Copies and enter the desired value (1-5) from the drop down menu. Each printed copy will be identical.

### Control

Operators can change the number of copies automatically printed at the completion of a control test. Double tap on the value listed after Copies and enter the desired value (1-5) from the drop down menu. Each printed copy will be identical.

### Monthly Test

This menu displays settings for the DMT to perform an automatic control test on the first day of every month and the hour at which the test will occur.

### Control Change

Operators can change the number of copies automatically printed at the completion of a control change test. Double tap on the value listed after Copies and select the desired value (1-5) from the drop down menu. Each printed copy will be identical.

### Diagnostic

Operators can set the number of copies automatically printed at the completion of a diagnostic test. Double tap on the value listed after Copies and enter the desired value (1-5) from the drop down menu.

### Printer

Operators can turn the printer On or Off. While the DMT can operate without a printer, in most instances this will be set to On. Network Printer should be set to No and the Printer IP Address should remain blank.

### Control Panel

Operators can set up the DMT to communicate with the FTP server at the BCA. Select the DMT drop down menu, Setup, Control Panel then Network. Double tap the NCPLBCE-SMSC91181 icon. Enter the appropriate IP Address, Subnet Mask and Default Gateway information for your department. Select OK. Close the box by tapping on the X in the top right corner of the display. Select the Save button. If a connection has been made to the BCA, you will see the network connection and the folder symbol on the bottom right corner of the display. This may not appear immediately.

## Functions

The functions menu allows certain functions to be initiated.

### Set Date/Time

Operators can set the current time and date.

### Return to Service

Authorized BCA personnel can return an instrument to a functional status after having previously been removed from service.

### Remove from Service

Authorized BCA personnel can make an instrument non-functional to operators in the field.

### Purge Sample Chamber

Operators can run an air blank that will continue for five minutes or until the Exit button is selected. This function would be used if liquid were believed to have entered either the breath tube or the sample chamber. It can also be used after a test result of Detector Overflow to assist in clearing the alcohol out of the breath path of the DMT.

### Import/Export

Authorized BCA personnel can import or export DMT tables, software or data via a USB port.

### Reset Options

Authorized BCA personnel can reset default settings on the DMT. This **does not** invalidate the existing control change or delete any transmitted data.

### Invalidate Instrument Setup

Authorized BCA personnel can ensure all settings are appropriate for field use by selecting this function. This function **does** invalidate the existing control change.

## Filter Test

Authorized BCA personnel can test the functionality of the filter assembly of the DMT.

## Training Mode

Authorized BCA personnel can set the instrument to Training Mode to ensure results from training tests are appropriately marked and are not included in field reports.

## Instrument Setup

This allows for the location of the DMT to be entered and set up the DMT to communicate with the FTP server at the BCA. After Location, enter the department name where the DMT is located. Select the Set Local IP button. Double tap the NCPLBCE-SMSC91181 icon. Enter the appropriate IP Address, Subnet Mask and Default Gateway information for your department. Select OK. Close the box by tapping on the X in the top right corner of the display. Select the Save button. If a connection has been made to the BCA, you will see the network connection and the folder symbol on the bottom right corner of the display. This may not appear immediately.

## Reports

Operators can view and print test records of tests previously run on this DMT while at its current location. After selecting Reports, the most recent test will be displayed on the left. Select the Print button to print this test record. To view or print a previous test, use the plus (+) symbol to expand the selection of the test type on the top right display. Use the plus (+) symbol to expand the date of the test. Select the appropriate time for the test. The test record will be displayed on the left screen. Select the Print button to print the test record or the Exit button to exit Reports.

## Subject Test

Operators can begin an evidential subject test. Refer to Subject Test under Testing with the DMT for further information.

## Control Test

Operators can begin a control test. Refer to Control Test under Testing with the DMT for further information.

## Diagnostic

Operators can begin a Diagnostic Test. Refer to Diagnostic under Testing with the DMT for further information.

## Adjustment

Authorized BCA personnel can initiate the portion of the certification procedure used when calibration criteria are not met.

## Technician Mode

Authorized BCA personnel can access the technician screen that allows for monitoring and adjusting of several settings.

## Control Change

Authorized BCA personnel will conduct Control Changes,

## Verification

Authorized BCA personnel can initiate a verification test. This test is run as part of the DMT certification procedure.

## Security

Operators can enter their password to log into the DMT to conduct tests and log off at the completion of testing.

## Enter Password

Operators can enter a passcode. If an appropriate certification number and passcode are entered the operator's name will appear on the lower left corner of the display.

## Log Off

Select Log Off to sign out of the DMT at the completion of testing.

## Help

### About

The software version installed in the DMT will be displayed.

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# ID TECH Keyboard and Integrated Barcode Reader

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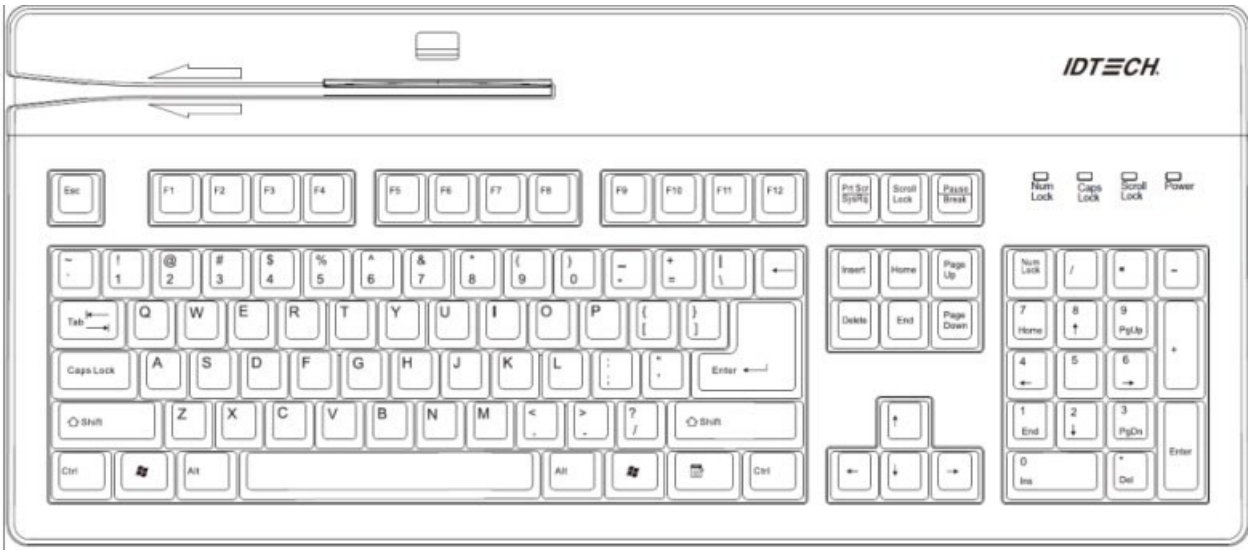



## Installation and Operation

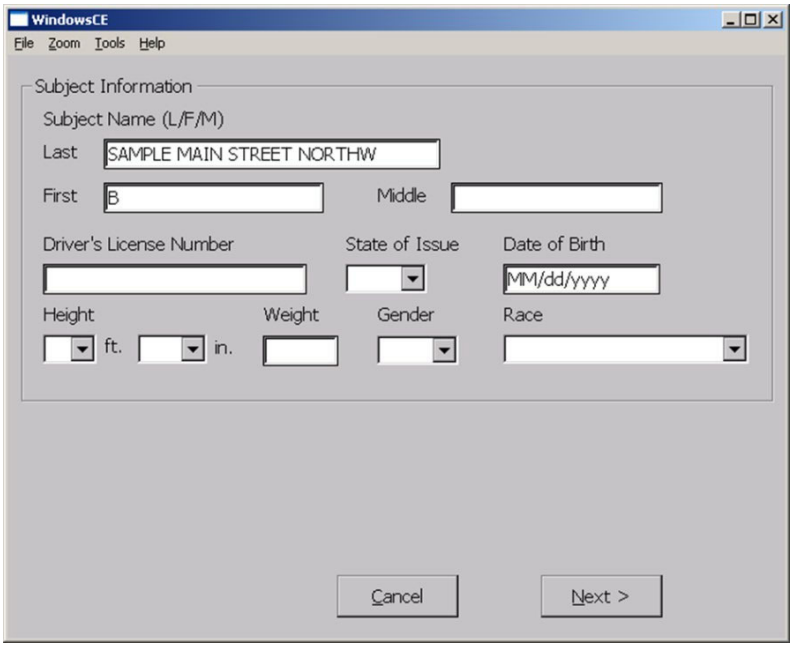
The VersaKey is a standard size keyboard with an integrated magnetic stripe (MagStripe) reader. When the VersaKey is initially plugged into the DMT, it performs a self-test and initiation sequence with the DMT. During the self-test the MagStripe reader will beep and the keyboard power LED will light to indicate power is applied. The LEDs will show the status of the *Scroll Lock*, *Num Lock*, & *Caps Lock* functions.

## Magnetic Stripe Reader

The magnetic stripe reader can be used during the data entry portion of a subject test to retrieve necessary information from the subject's driver's license. To use the magnetic stripe reader, select **Swipe DL** as your method of data entry. When told, swipe a magnetic stripe card through the reader slot. The magnetic stripe must be facing the front of the keyboard with the magnetic stripe towards to bottom then swipe right to left. A beep will sound to indicate a good read on each of the magnetic tracks. There will be three beeps for a complete swipe.

The magnetically encoded data on the MagStripe is decoded (read) by the card reader. The stripe data has a fixed format defined by ISO standards. The VersaKey Reader is an intelligent magnetic stripe reader that decodes, verifies, and transmits stripe data.

If the license swipe is not complete, the DMT will reject it and offer the operator an opportunity to Scan the 2D bar code instead. If the operator does not read the entire message or misinterprets it, they may swipe the magnetic stripe again. This will result in data being assigned, in whole or in part, to the wrong fields in the subject information portion of the test record as in the following example. The same result will occur if the operator selects Scan as the method of data entry, but instead swipes the magnetic stripe of the driver's license.




When this occurs, the instrument will bypass the first screen of data entry. Operators can use the "Previous" button at the bottom of the display to go back and review the data captured on the first screen. If the data is not correct, the operator can cancel the test and begin again or make manual corrections. If data entry errors are noticed on the test record, a DMT Data Correction Form listing the necessary changes can be submitted to the BCA and the corrections will be made by BCA personnel.

**2D Barcode Reader**

The 2D barcode reader is integrated into the left-hand side of the DMT. Licenses from most states can be read. Select **Scan DL.** With the barcode facing forward, insert the license into the slot. Select **OK** to scan.

# Hewlett Packard LaserJet P1606dn

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The printer supplied with the DMT-G is the HP LaserJet P1606 dn. It connects with the DMT-G via a USB cable. This printer uses a toner cartridge that can easily be replaced after several hundred tests. Each department is responsible for replacement toner cartridges. The part number is CE278A.

## Printer Lights

1. Toner light: When toner is low, the toner light illuminates. When toner is empty, the toner light blinks.

2. Attention light: Indicates that the toner cartridge door is open or other errors exist.

3. Ready light: When the printer is ready to print, the ready light is on. When the printer is processing data, the ready light blinks.

4. Go light: Indicates that there is an error (along with the attention light).

5. Go button: To print a configuration page, press and hold the go button, then release the button when the ready light blinks. To print a demo page, press and release the go button. When the go light is flashing, press the go button to continue the print job.

6. Cancel button: To cancel the print job, press the cancel button.

## Paper Jams

Occasionally paper can become jammed during printing. A common cause of paper jams is overfilling the paper tray or loading paper incorrectly. When you add new paper, always remove the paper from the tray and straighten the entire stack. This helps prevent multiple feeds and reduces paper jams. Additionally, the printer may need to be cleaned to remove paper dust and other particles from the paper path. Loose toner might remain in the product after a paper jam. This toner clears up after a few sheets print.

## To Clear a Paper Jam

1. Open the toner cartridge door and remove the toner cartridge.

2. Keep the toner cartridge door open, using both hands grasp the side of the jammed paper that is most visible (this includes the middle), and carefully pull it free from the printer.

## Replacing the toner cartridge

1. Open the toner cartridge door and remove the old toner cartridge. Follow the recycling information inside the toner cartridge box.

2. Remove the new toner cartridge from the packaging. To prevent damage to the print cartridge, hold the print cartridge at each end.

3. Pull the tab and completely remove the tape from the cartridge. Put the tab in the toner cartridge box to return for recycling.

4. Insert the new toner cartridge into the printer and close the toner cartridge door.

# Testing with the DMT

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## DMT Setup

Installing a new DMT or exchanging an instrument in a law enforcement agency requires a series of connections. The following steps will install an instrument, although some are unnecessary when exchanging an instrument. A keyboard carrel (organizer) with an upper shelf for the DMT and a roll out keyboard drawer is provided at each instrument location. This step-by-step setup assumes you are using the carrel.

- Install the carrel in the location where the instrument will be used. Provide sufficient space for the subject to stand.
- Install the keyboard in the drawer and route its cable out the back of the carrel.
- Position the instrument on the upper shelf of the carrel with the front edge just over the front edge of the organizer.
- Plug the power cord socket end into the AC plug-in on the back panel and its plug into a 110V AC outlet.
- Turn on DMT and wait for main screen to appear.
- Plug the USB connector of the keyboard cable into a USB jack on the DMT back panel.
- Position the printer in a convenient location adjacent to the instrument. Generally this should be to the right of the DMT away from where the test subject is likely to be standing. If not already in place, install a toner cartridge in the printer. Place paper in the paper input bin.
- Plug the printer power cord into the back of the printer and its plug into a 110V AC outlet. Turn the printer on. Plug the printer USB cable into the back of the printer and into a USB jack on the DMT back panel.
- Allow the DMT to warm up for at least one hour.

## Observation Period

Recent alcohol ingestion or reintroduction of alcohol into the mouth from actions such as belching, regurgitating or refluxing stomach contents into the mouth are possible sources of mouth alcohol. Alcohol vapors can remain in the mouth for as long as 15 minutes. A test subject should be observed for a minimum of 15 minutes prior to administering a breath test to ensure nothing is placed in the mouth and nothing erupts into the mouth. During this time the observer should remain in close enough proximity to the subject to see, hear, or smell them at all times. While non-operators may conduct this observation period, it is up to the operator to ensure that the process is performed correctly. Performing the observation period in a squad car is not recommended.

## Subject Test - Minnesota Test Sequence (DABACABA)

A subject test is an evidential test performed to measure a person's breath alcohol concentration.

- If the DMT is in stand-by mode, touch the display anywhere other than the scrolling Minnesota State seal.

- Under the DMT icon: select **Security** then select **Enter Password**. Enter DMT Certification number and passcode then Select **OK**.

- Initiate a test by pressing the **Run** button on the display, the F1 key on the keyboard or selecting Subject Test in the DMT drop-down menu.

- Indicate the method you intend to utilize to enter the driver's information.

  **Scan DL** indicates you intend to use the bar code scanner on the left side of the instrument. Scanning the 2D bar code on the driver's license will auto-fill the subject's last name, first name, middle name, driver's license number, State of issue and date of birth. You must manually enter the subject's height, weight and gender. Review the information for accuracy.

  **Swipe DL** indicates you intend to use the magnetic stripe reader on the keyboard. Swiping the license will auto-fill the subject's last name, first name, middle name, driver's license number, State of issue, date of birth, height, weight and gender. Swiping the license is only effective on licenses issued by the State of Minnesota. Review the information for accuracy. If three beeps are not heard or there is an error in the data capture, see below.

  **Manual** indicates you intend to enter all required information manually.

  *Incomplete Swipe*

  If an operator does not hold the license level during the swipe or the swipe is not complete, the DMT will recognize that the swipe was not complete and reject it. The DMT will offer the operator an opportunity to Scan the 2D bar code on the back of the license. Do not attempt to swipe the license at this point. Swiping the license will result in some of the data being assigned to the incorrect fields in the subject information portion of the test record, such as portions of the address appearing in the subject name field. The same result will occur if the operator selects Scan as the method of data entry, but instead swipes the magnetic stripe of the driver's license.

*Data Entry Review and Correction*

After swiping a license, the data captured from that license is displayed on the first of three sequential DMT display screens. The first screen shows the subject information captured and the field to which it was assigned. If the first swipe fails and a second swipe is attempted, the instrument will bypass the first screen. Use **Previous** at the bottom of the display to go back and examine the data entered on page one. If the data is not correct, the operator can make manual corrections. If this step is missed, a test record with license data in improper fields is created. Review the data and correct data entry errors to ensure the test record contains accurate information. If data entry errors are noticed on the printed test record, a DMT Data Correction Form listing the necessary changes can be submitted to the BCA so the corrections can be made. The DMT Data Correction Form can be found on the BCA website or obtained through the Breath Alcohol Calibration Laboratory.

- Enter the subject's race. This is not a required field.
- Select the **Next** button.
- Operator Information is auto-filled based on the log-in information. Verify the information is correct. If the name is incorrect, cancel the test, log that individual out of the DMT and log in using your certification number. If your department has changed, you can correct this field for each test you run, however you must notify the BCA for a permanent change to occur.
- If the Arresting Officer and test Operator are the same person touch the **Same as Operator** box to auto-fill the last name, first name and department of the arresting officer. If they are not the same, manually enter the information.
- Enter the arresting department ORI number, MN#######. The MN is automatically entered after you begin entering the number. The seven digits must be entered manually. For police and sheriff's offices, the first three numbers are the county number (Minnesota has 87 counties so the first of these will be zero). For this record to automatically attach when eCharging, it is imperative that this number exactly matches the number stored in the eCharging database. Check County for accuracy and correct if needed. For State agencies the county must be selected from the drop down menu.
- Select the **Next** button.
- Using the drop down menu, select the appropriate Type of Test: Traffic, Boating, Underage Consumption, Court - Corrections, ATV – Snowmobile, Other, Hunting, Hand Gun Possession.
- Enter the PBT result, up to 12 characters are allowed. This is not a required field.
- Enter the Date of Stop or press the space bar to auto-fill today's date.
- Enter the Time of Stop.
- Enter the Case Number. This is not a required field.

- Indicate whether the subject was driving a commercial vehicle by selecting Y for Yes or N for No.

- Enter the start time of the Observation Period. The time entered must be after the time of stop and prior to the current time. You will be required to wait additional time if 15 minutes from the time entered have not lapsed.

- Enter the name of the individual that conducted the Observation Period.

- Select the **OK** button to begin testing.

- **D**IAGNOSTIC: After data entry is complete, the instrument will automatically begin the diagnostic test. The purpose of the Diagnostic Check is to ensure the instrument is in proper working order at the time of the test. Each step and outcome is shown on the display. When the diagnostic test is complete, the results will condense and a summary stating Diagnostic Check Passed will appear. If the Diagnostic Check fails, the DMT will display Diagnostic Check Failed and the test will end.

- **A**IR BLANK: An Air Blank consists of a Purge, Ambient Zeroing and a Blank Test. During the Purge, ambient (room) air is drawn through the breath tube and sample chamber and is expelled out the back of the DMT, purging the system of residual alcohol. The Ambient Zeroing sets a zero reference point. If the result is not 0.000 the DMT will display the appropriate status message and the test will end.

- **B**REATH SAMPLE: When "PLEASE BLOW!" is flashing and the tone is beeping, the instrument is ready for the subject to provide a breath sample. Insert a mouthpiece and instruct the subject to provide a long and steady sample. While the subject is blowing into the breath tube, the "PLEASE BLOW" and tone are constant. The subject is allowed three minutes to provide a breath sample. The sample will be accepted by the DMT when a single exhalation reaches a minimum volume of 1.5 Liters of air at a flow rate at or above 2.87 Liters per minute, the slope of the alcohol concentration is deemed to be level, and the flow rate drops below 2.87 Liters per minute.

- **A**IR BLANK: An Air Blank consists of a Purge, Ambient Zeroing and a Blank Test. During the Purge, room air is drawn through the breath tube and sample chamber and is expelled out the back of the DMT, purging the system of residual alcohol. The Blank Test verifies that the DMT is measuring an alcohol concentration of zero. If the result is not 0.000 the DMT will display the appropriate status message and the test will end.

- **C**ONTROL SAMPLE: The dry gas control is sampled and measured between the two breath samples. The known alcohol concentration is approximately 0.080, but is adjusted for barometric pressure and may vary from test to test. The result of the control sample must be within ±0.005 g/210L from the control target on the display and printed on the test record or the test will end.

- **A**IR BLANK: An Air Blank consists of a Purge, Ambient Zeroing and a Blank Test. During the Purge, room air is drawn through the breath tube and sample chamber and is expelled out the back of the DMT, purging the system of residual alcohol. The Blank Test verifies that the DMT is measuring an alcohol concentration of zero. If the result is not 0.000 the DMT will display the appropriate status message and the test will end.

- The DMT will ensure that three minutes have elapsed between the two subject breath samples. You will see a countdown on the status bar on the display.

- **B**REATH SAMPLE: When "PLEASE BLOW!" is flashing and the tone is beeping, the instrument is ready for the subject to provide a breath sample. Insert a mouthpiece and instruct the subject to provide a long and steady sample. While the subject is blowing into the breath tube, the "PLEASE BLOW" and tone are constant. The subject is allowed three minutes to provide a breath sample. The sample will be accepted by the DMT when a single exhalation reaches a minimum volume of 1.5 Liters of air at a flow rate at or above 2.87 Liters per minute, the slope of the alcohol concentration is deemed to be level, and the flow rate drops below 2.87 Liters per minute.

- **A**IR BLANK: An Air Blank consists of a Purge, Ambient Zeroing and a Blank Test. During the Purge, room air is drawn through the breath tube and sample chamber and is expelled out the back of the DMT, purging the system of residual alcohol. The Blank Test verifies that the DMT is measuring an alcohol concentration of zero. If the result is not 0.000 the DMT will display the appropriate status message and the test will end.

- A Remarks / Comments box will appear on the display. Using the keyboard, enter remarks. Typical comments include remarks regarding the observation period and a description of how the subject provided the breath samples. After you have completed entering your remarks, select **OK**. An Operator Signature box will appear on the display. Using a stylus, sign your signature. To clear the box and sign again, select **Clear**. To accept the signature as it appears, select **Accept**.

- After the signature is accepted, the DMT will create a PDF and display Saving PDF in the status bar. This will be followed by Printing if the printer function is turned on. The test data will then be transmitted to the BCA via a secure Ethernet connection and the message Transmitting data can be seen on the status bar at the bottom of the DMT.

## Quick Run

A quick run is performed as a means of determining a person's breath alcohol concentration for non-evidential purposes.

- If the DMT is in stand-by mode, touch the display anywhere other than the scrolling Minnesota State seal.
- Logging in is not required for a Quick Run test.
- Initiate a test by pressing **Quick Run** on the display.
- Enter the data requested: Type of Test, Subject Last Name, First Name and Middle Initial. If you are logged into the DMT prior to selecting Quick Run, the operator information will be auto-filled based on your certification number. If you are not logged in enter the operator's last name, first name and department. Note: this test can be performed by a non-certified operator.
- Select **OK** to begin the test.
- **D**IAGNOSTIC: After data entry is complete, the instrument will automatically begin the diagnostic test. The purpose of the Diagnostic Check is to ensure the instrument is in proper working order at the time of the test. Each step and outcome is shown on the display. When the diagnostic test is complete, the results will condense and a summary stating Diagnostic Check Passed will appear. If the Diagnostic Check fails, the DMT will display Diagnostic Check Failed and the test will end.
- **A**IR BLANK: An Air Blank consists of a Purge, Ambient Zeroing and a Blank Test. During the Purge, ambient air is drawn through the breath tube and sample chamber and is expelled out the back of the DMT, purging the system of residual alcohol. The Ambient Zeroing sets a zero reference point. If the result is not 0.000 the DMT will display the appropriate status message and the test will end.
- **B**REATH SAMPLE: When "PLEASE BLOW!" is flashing and the tone is beeping, the instrument is ready for the subject to provide a breath sample. Insert a mouthpiece and instruct the subject to provide a long and steady sample. While the subject is blowing into the breath tube, the "PLEASE BLOW" and tone are constant. The subject is allowed three minutes to provide a breath sample. The sample will be accepted by the DMT when a single exhalation reaches a minimum volume of 1.5 Liters of air at a flow rate at or above 2.87 Liters per minute, the slope of the alcohol concentration is deemed to be level, and the flow rate drops below 2.87 Liters per minute.
- **A**IR BLANK: An Air Blank consists of a Purge, Ambient Zeroing and a Blank Test. During the Purge, room air is drawn through the breath tube and sample chamber and is expelled out the back of the DMT, purging the system of residual alcohol. The Blank Test verifies that the DMT is measuring an alcohol concentration of zero. If the result is not 0.000 the DMT will display the appropriate status message and the test will end. .

- A Remarks / Comments box will appear on the display. Using the keyboard, enter remarks. Typical comments include remarks regarding the observation period and a description of how the subject provided the breath samples. After you have completed entering your remarks, select **OK**. An Operator Signature box will appear on the display. Using a stylus, sign your signature. To clear the box and sign again, select **Clear**. To accept the signature as it appears, select **Accept**.

- After the signature is accepted, the DMT will create a PDF and display Saving PDF in the status bar. This will be followed by Printing if the printer function is turned on. The test data will then be transmitted to the BCA via a secure Ethernet connection and the message Transmitting data can be seen on the status bar at the bottom of the DMT.

# Status Messages

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When the DMT has identified a specific set of circumstances, a status message will be generated and a final result will not be reported on the test record.. Below are some of the more common status messages. However, this is not a complete list of all possible messages. Should you encounter a status message you do not recognize, contact the BCA Breath Alcohol Laboratory for guidance.

## 0.02 AGREEMENT NOT MET – DEFICIENT TEST

The subject provided two adequate breath samples, however the results between the two breath samples exceeded the maximum allowed difference of 0.020 g/210L. This can be caused by mouth alcohol, but is more commonly a result of the subject providing the two samples in an inconsistent manner. If mouth alcohol may be the cause, conduct a new observation period before beginning a new test.

## 0.02 AGREEMENT NOT MET – SECOND DEFICIENT TEST

The subject provided two adequate breath samples, however the results between the two breath samples exceeded the maximum allowed difference of 0.020 g/210L. This can be caused by mouth alcohol, but is more commonly a result of the subject providing the two samples in an inconsistent manner. This has occurred on two consecutive tests and may serve as a basis for statutory refusal.

## AMBIENT FAIL

The DMT was unable to establish a zero alcohol reference when measuring the air around the instrument during the initial air blank. This can be caused by a poorly ventilated room that does not allow for sufficient clearing of alcohol vapors, a breath tube pointed toward a subject, room deodorizers or hand sanitizers, etc. If possible, remove the source of ambient alcohol or move it farther away from the instrument and begin a new test.

## BLANK ERROR

The DMT was unable to establish the same zero alcohol reference when measuring the air around the instrument compared to the previous air blank. This can be caused by a poorly ventilated room that does not allow for sufficient clearing of alcohol vapors, a breath tube pointed towards a subject, room deodorizers or hand sanitizers, etc. If possible, remove the source of ambient alcohol or move it farther away from the instrument and begin a new test.

## DEFICIENT

The DMT requires the following criteria be met to establish an acceptable breath sample:

- The subject must provide the breath sample at or above the minimum flow rate of 2.87 L/min.
- The subject must provide a minimum total volume of 1.5 L in a single breath sample.
- The subject's flow rate must drop below the minimum flow rate of 2.87 L/min.
- The slope of the alcohol concentration must be level. The DMT deems the slope to be level when:

- The 1.5 L total volume requirement has been met at the point when the flow rate drops below 2.87 L/min.
- The increase from the second-to-last two-point average to the last is less than or equal to 0.001 g/210L and not a negative slope. To be considered a negative slope, the change in consecutively compared averages must be greater than 0.001 g/210L in the negative direction.
- The absolute value of the change between the final two, two-point averages must be 0.001 g/210L or less.

## INTERFERENCE

The ratios between the filters has exceeded the filter agreement threshold. The breath sample submitted may contain a substance other than ethanol or a combination of ethanol and an interfering substance. Obtain a warrant to collect blood or urine for analysis.

## INVALID

An Invalid message can be an indication of mouth alcohol, but can also be the result of the subject's blowing behavior. An Invalid can be triggered in the following ways:

- Three consecutive comparisons of quarter-second averages where the slope was in the negative direction of greater than 0.001 g/210L, after first seeing at least six positive comparisons of quarter-second averages within the same continuous breath sample.

- The last quarter-second average ≥ 0.060 g/210 L was less than 95% of any previous high reading during that successfully delivered sample, or

- The last quarter-second average ≥ 0.003 g/210 L but < 0.060 g/210 L that is lower than any previous high reading during that successfully delivered sample by at least 0.003 g/210 L.

Invalid is one of three safeguards against mouth alcohol. The additional safeguards include the Observation Period and the 0.02 Agreement Not Met – Deficient Test status message.

## RADIO FREQUENCY INTERFERENCE (RFI)

High levels of radio frequencies have been detected and ended the test. This can be caused by keying a radio in the vicinity of the instrument or a static discharge to the breath tube that holds the RFI antenna. Turn off radios and restart the test.

## STABILITY FAIL

The instrument detected a shift in the detector voltage during the diagnostic test. This is usually caused by ambient alcohol around the instrument. Also see AMBIENT FAIL and BLANK ERROR. If possible, remove the source of the ambient alcohol or move it farther away from the instrument and begin a new test.

# Sample Test Records

Instructor _____

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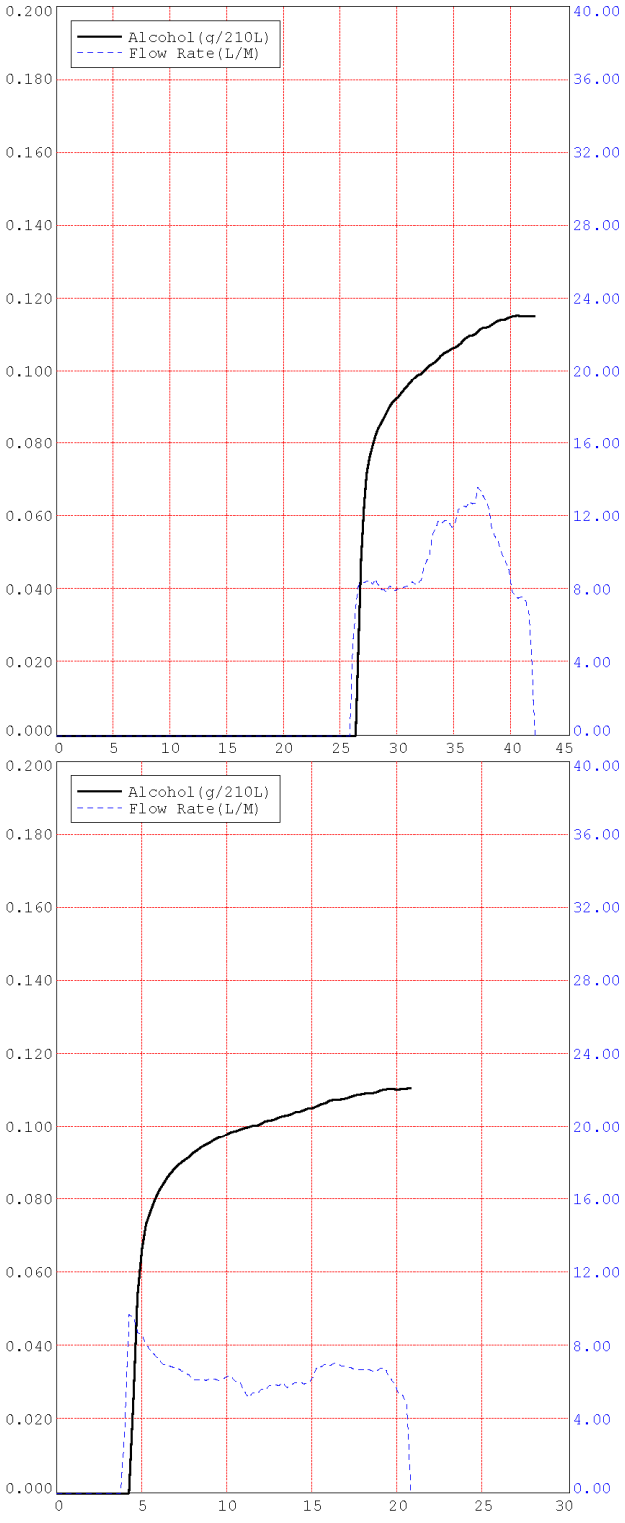
SUBJECT TEST

```
-------------------------
State of Minnesota
DataMaster DMT: 100521
Version: 208.206.205
-------------------------
Audit ID: 100521-12
Date: 04/17/2019
Time: 21:03:28
Location: Northfield PD

SUBJECT
Name: SUBJECT TEST
License Number: X123456789
State Of Issue: MN
DOB: 10/17/1969
Height: 5' 10"  Weight: 180
Gender: M

OPERATOR
Name: DMT OPERATOR
Certificate Number: 1000
Department: NORTHFIELD POLICE DEPT

ARRESTING OFFICER
Name: ARRESTING OFFICER
Arresting Department:
  NORTHFIELD POLICE DEPT
Department ORI: MN0660200
County: RICE
Type Of Test: TRAFFIC
Case Number / ICR Number: 19000000
Commercial Vehicle: N
Observation Start Time: 8:46 PM
Observed By: ARRESTING OFFICER

CONTROL INFORMATION
Lot Number: AG82830144
Control Target: 0.076
Expiration: 10/10/2020

DIAGNOSTIC CHECK            PASSED  21:03
AIR BLANK                    0.000  21:05
SUBJECT SAMPLE             Vol=2.56  21:06
  IR = 0.114
AIR BLANK                    0.000  21:07
CONTROL SAMPLE                      21:07
  IR = 0.074
AIR BLANK                    0.000  21:09
SUBJECT SAMPLE             Vol=1.82  21:10
  IR = 0.110
AIR BLANK                    0.000  21:11

**************************************
REPORTED VALUE IN g/210L      0.11  21:10
**************************************

For DMT test uncertainty of measurement
information, email the BCA Calibration
Laboratory at bca.breathtest@state.mn.us

REMARKS:
provided strong breaths on both tests. no
belching, vomiting or hiccups during the
observation period. mouth checked prior to
observation period and prior to each breath test.
```

Operator Signature

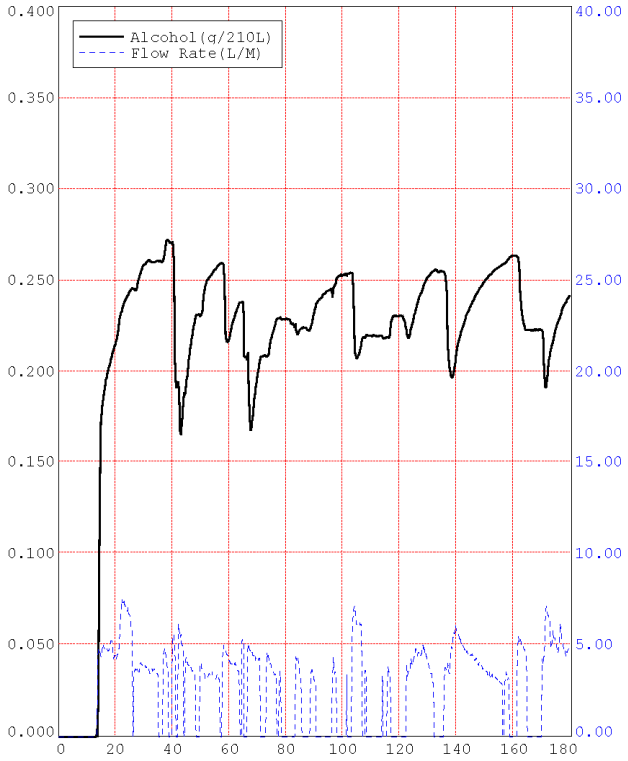



DMT Test Record showing a complete breath test consisting of two adequate samples using IR technology.

SUBJECT TEST

```
-------------------------
State of Minnesota
DataMaster DMT: 100614
Version: 208.206.205
-------------------------
Audit ID: 100614-19
Date: 01/14/2019
Time: 00:43:17
Location: St. Paul Police Department 1

SUBJECT
Name: SUBJECT TEST
License Number: L123456789
State Of Issue: MN
DOB: 08/11/1988
Height: 5' 11"  Weight: 145
Gender: M

OPERATOR
Name: DMT OPERATOR
Certificate Number: 1000
Department: ST. PAUL POLICE DEPT

ARRESTING OFFICER
Name: ARRESTING OFFICER
Arresting Department: SPPD
Department ORI: MN0620900
County: RAMSEY
Type Of Test: TRAFFIC
Case Number / ICR Number: 19000000
Commercial Vehicle: N
Observation Start Time: 11:43 PM
Observed By: DMT OPERATOR

CONTROL INFORMATION
Lot Number: AG712501-41
Control Target: 0.079
Expiration: 05/05/2019

DIAGNOSTIC CHECK            PASSED  00:43
AIR BLANK                    0.000  00:45
SUBJECT SAMPLE                      00:48
  IR = DEFICIENT
AIR BLANK                    0.000  00:49
CONTROL SAMPLE                      00:49
  IR = 0.076
AIR BLANK                    0.000  00:50

****************************************
Deficient
****************************************

For DMT test uncertainty of measurement
information, email the BCA Calibration
Laboratory at bca.breathtest@state.mn.us

REMARKS:
CONTINUOUSLY BLOCK THE PATH FOR AIR VIA TEETH.
DID NOT PROVIDE ONE STEADY BREATH.

NO BBV
```

Operator Signature

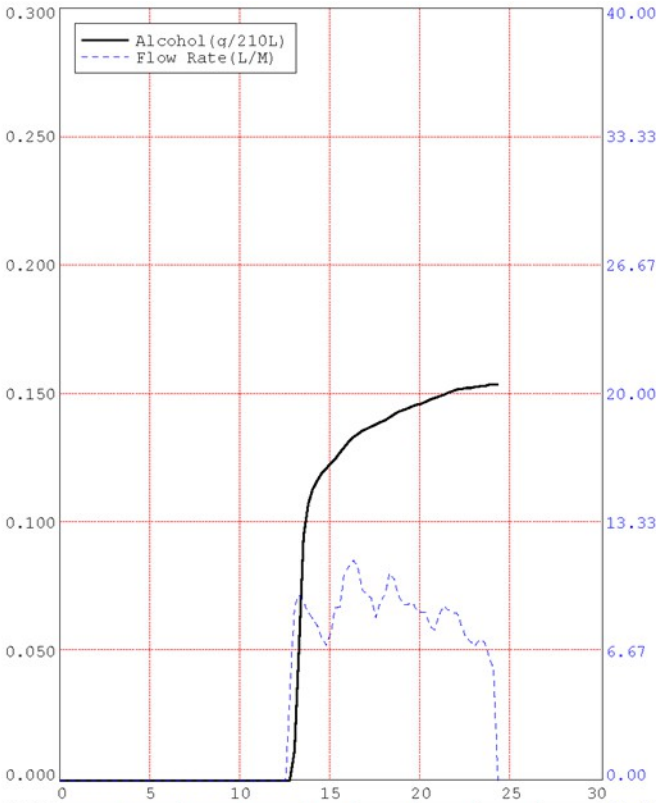


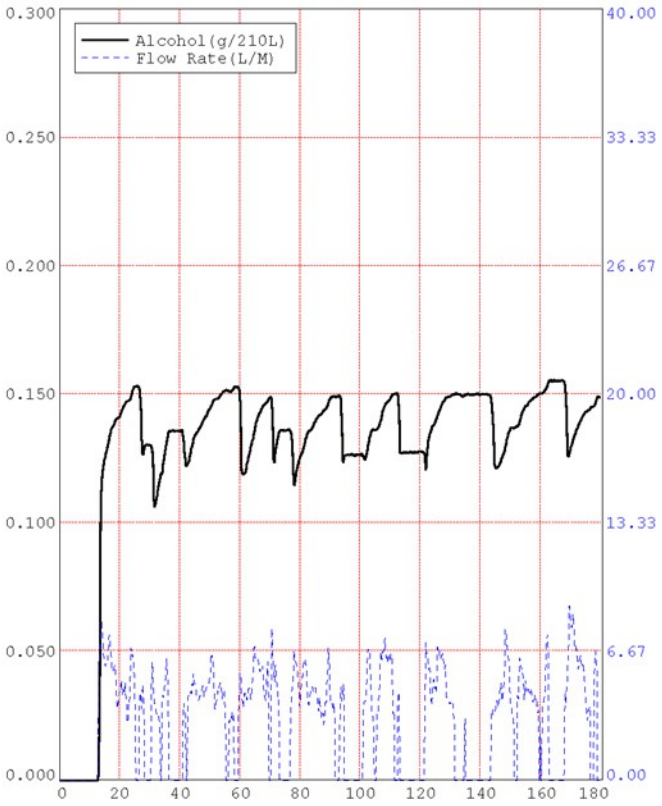

DMT Test Record showing Deficient in the first breath sample. This means that one or more of the sample acceptance criteria was not met in any of the subject's attempts. The DMT will run an air blank, the control sample and a final air blank before ending the test. A second breath sample will not be requested from the subject during this test sequence.

SUBJECT TEST

```
--------------------------
State of Minnesota
DataMaster DMT: 100766
Version: 208.206.205
--------------------------
Audit ID: 100766-993
Date: 01/03/2019
Time: 03:44:56
Location: Todd County Sheriff's Office

SUBJECT
Name: DMT OPERATOR
License Number: B123456789
State Of Issue: MN
DOB: 11/08/2000
Height: 5' 6"  Weight: 153
Gender: M

OPERATOR
Name: DMT OPERATOR
Certificate Number: 1000
Department: LONG PRAIRIE POLICE DEPT

ARRESTING OFFICER
Name: ARRESTING OFFICER
Arresting Department:
LONG PRAIRIE POLICE DEPT
Department ORI: MN0770100
County: TODD
Type Of Test: TRAFFIC
Case Number / ICR Number: 1900000
Commercial Vehicle: N
Observation Start Time: 3:12 AM
Observed By: DMT OPERATOR

CONTROL INFORMATION
Lot Number: AG708807
Control Target: 0.075
Expiration: 03/29/2019

DIAGNOSTIC CHECK            PASSED  03:45
AIR BLANK                    0.000  03:47
SUBJECT SAMPLE           Vol=1.66   03:47
  IR = 0.154
AIR BLANK                    0.000  03:48
CONTROL SAMPLE                      03:48
  IR = 0.075
AIR BLANK                    0.000  03:50
SUBJECT SAMPLE                      03:54
  IR = DEFICIENT
AIR BLANK                    0.000  03:55

**************************************
Deficient
**************************************

For DMT test uncertainty of measurement
information, email the BCA Calibration
Laboratory at bca.breathtest@state.mn.us

REMARKS:
First sample good deep lung breath sample.
Second sample no deep breaths, would stop before
required air sample amount, messed with tube
putting tougne in the way.  Did not do as advised
```

Operator Signature




DMT Test Record showing Deficient in the second breath sample. This means that one or more of the sample acceptance criteria was not met in any of the subject's attempts during the second breath sample.

SUBJECT TEST

```
-------------------------
State of Minnesota
DataMaster DMT: 100656
Version: 208.206.205
-------------------------
Audit ID: 100656-914
Date: 01/04/2019
Time: 01:31:25
Location: Rice County

SUBJECT
Name: SUBJECT TEST
License Number: H123456789
State Of Issue: MN
DOB: 07/02/1982
Height: 5' 11"  Weight: 175
Gender: M

OPERATOR
Name: DMT OPERATOR
Certificate Number: 1000
Department: DUNDAS POLICE DEPT

ARRESTING OFFICER
Name: ARRESTING OFFICER
Arresting Department: DUNDAS POLICE DEPT
Department ORI: MN0660300
County: RICE
Type Of Test: TRAFFIC
Case Number / ICR Number: 1900000
Commercial Vehicle: N
Observation Start Time: 12:36 AM
Observed By: DMT OPERATOR

CONTROL INFORMATION
Lot Number: AG828301-33
Control Target: 0.076
Expiration: 10/10/2020

DIAGNOSTIC CHECK           PASSED  01:31
AIR BLANK                   0.000  01:33
SUBJECT SAMPLE                     01:36
  IR = DEFICIENT
AIR BLANK                   0.000  01:37
CONTROL SAMPLE                     01:38
  IR = 0.075
AIR BLANK                   0.000  01:39

****************************************
Deficient
****************************************

For DMT test uncertainty of measurement
information, email the BCA Calibration
Laboratory at bca.breathtest@state.mn.us

REMARKS:
puffed check. mouth piece side of mouth appered
to be blowing out nose.
```

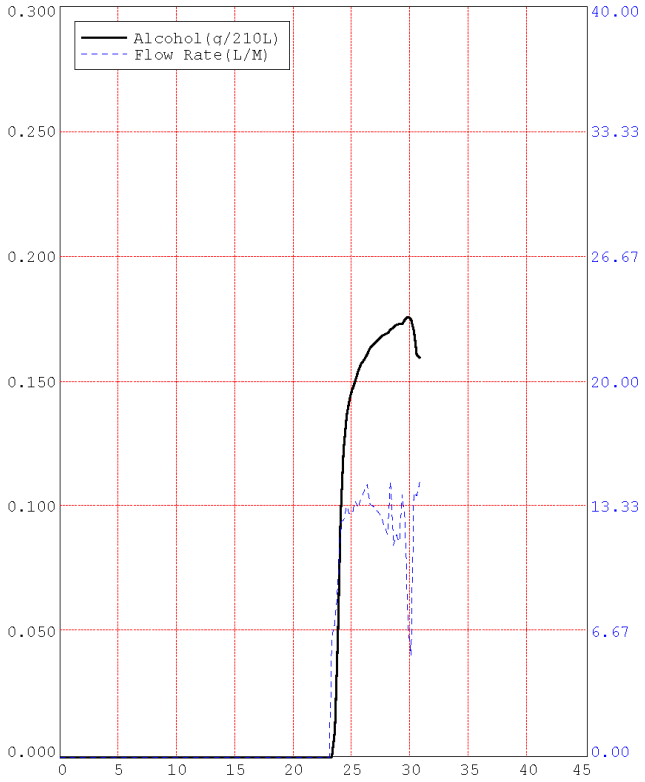
Operator Signature


DMT Test Record showing Deficient in the first breath sample. The subject did not blow at a minimum flow rate of 2.87 L/min. at the beginning of the sample, therefore there was initially no dashed line on the graph, however alcohol was measured and graphed. The sample acceptance criteria were not met within the three minute window and the test ended as Deficient.

SUBJECT TEST

```
-------------------------
State of Minnesota
DataMaster DMT: 100604
Version: 208.206.205
-------------------------
Audit ID: 100604-709
Date: 03/16/2019
Time: 02:26:01
Location: Waseca County

SUBJECT
Name: SUBJECT TEST
License Number: Y123456789
State Of Issue: MN
DOB: 01/26/1997
Height: 5' 7"  Weight: 150
Gender: M

OPERATOR
Name: DMT OPERATOR
Certificate Number: 1000
Department: WASECA COUNTY S.O.

ARRESTING OFFICER
Name: ARRESTING OFFICER
Arresting Department: WASECA COUNTY S.O.
Department ORI: MN0810000
County: WASECA
Type Of Test: TRAFFIC
Case Number / ICR Number: 20190000
Commercial Vehicle: N
Observation Start Time: 2:11 AM Observed
By: ARRESTING OFFICER

CONTROL INFORMATION
Lot Number: AG828301-19
Control Target: 0.077
Expiration: 10/10/2020

DIAGNOSTIC CHECK           PASSED  02:26
AIR BLANK                   0.000  02:28
SUBJECT SAMPLE                     02:29
  IR = INVALID
AIR BLANK                   0.000  02:29
CONTROL SAMPLE                     02:30
  IR = 0.075
AIR BLANK                   0.000  02:30

****************************************
Invalid
****************************************

For DMT test uncertainty of measurement
information, email the BCA Calibration
Laboratory at bca.breathtest@state.mn.us

REMARKS:
Subject began to suck in and out during his
breathing sequence. Instrument displayed invalid
sample.  Subjects mouth was checked prior to
observation period and prior to begining the
test.  No B/B/V during observation period.
Subject cooperative.
```

Operator Signature

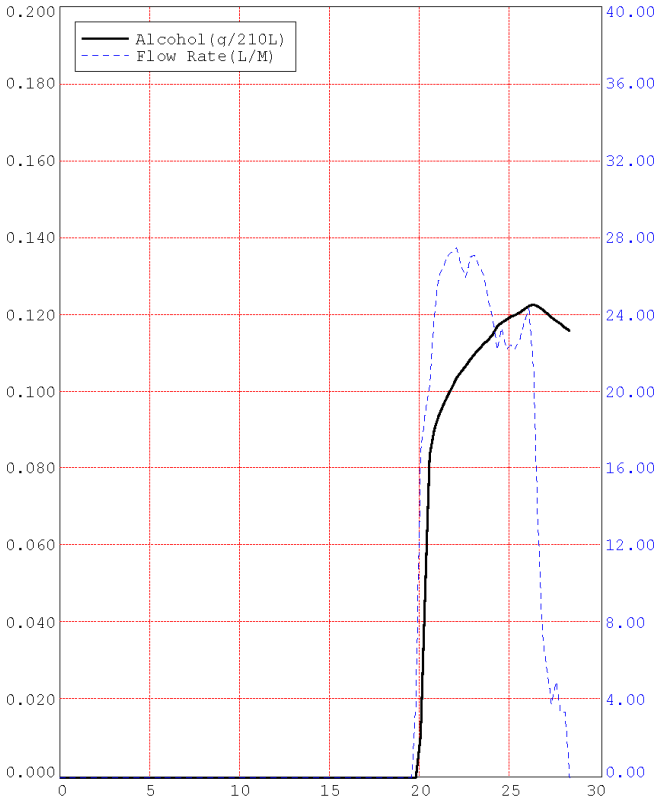



DMT Test Record showing Invalid in the first breath sample. This means there were three consecutive quarter-second average comparisons where the slope was in a negative direction of greater than 0.001 g/210L, after first seeing at least six positive comparisons within the same continuous breath sample. The DMT will run an air blank, the control sample and a final air blank before ending the test. A second breath sample will not be requested from the subject during this test sequence.

SUBJECT TEST

```
-------------------------
State of Minnesota
DataMaster DMT: 100738
Version: 208.206.205
-------------------------
Audit ID: 100738-867
Date: 03/23/2019
Time: 02:36:36
Location: Fridley Police Dept.

SUBJECT
Name: SUBJECT TEST
License Number: 0123456789
State Of Issue: MN
DOB: 11/19/1987
Height: 5' 6"  Weight: 195
Gender: M

OPERATOR
Name: DMT OPERATOR
Certificate Number: 1000
Department: BLAINE POLICE DEPT

ARRESTING OFFICER
Name: ARRESTING OFFICER
Arresting Department: BLAINE POLICE DEPT
Department ORI: MN0020200
County: ANOKA
Type Of Test: TRAFFIC
Case Number / ICR Number: 19000000
Commercial Vehicle: N
Observation Start Time: 2:11 AM
Observed By: DMT OPERATOR

CONTROL INFORMATION
Lot Number: AG822102-32
Control Target: 0.079
Expiration: 08/09/2020

DIAGNOSTIC CHECK           PASSED  02:36
AIR BLANK                   0.000  02:38
SUBJECT SAMPLE                     02:39
  IR = INVALID
AIR BLANK                   0.000  02:40
CONTROL SAMPLE                     02:40
  IR = 0.077
AIR BLANK                   0.000  02:41

****************************************
Invalid
****************************************

For DMT test uncertainty of measurement
information, email the BCA Calibration
Laboratory at bca.breathtest@state.mn.us

REMARKS:
HARD BREATH. LIPS WERE NOT SEALED. QUICK STOP
```

Operator Signature

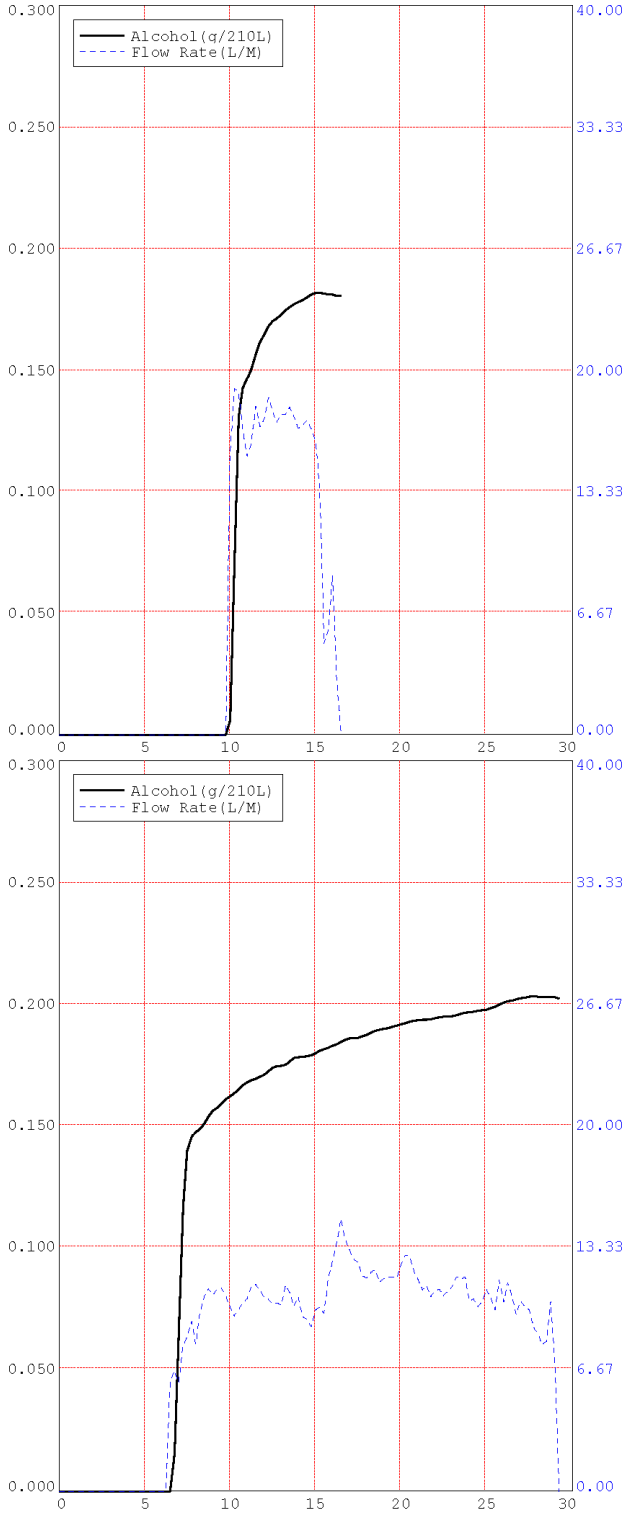



DMT Test Record showing Invalid in the first breath sample. The final result is ≥ 0.06, but less than 95% of the previous high reading during that successfully delivered sample. A second breath sample will not be requested from the subject during this test sequence.

SUBJECT TEST

```
-------------------------
State of Minnesota
DataMaster DMT: 100500
Version: 208.206.205
-------------------------
Audit ID: 100500-1230
Date: 02/03/2019
Time: 00:14:47
Location: Blue Earth County Jail

SUBJECT
Name: SUBJECT TEST
License Number: T123456789
State Of Issue: MN
DOB: 01/02/1988
Height: 5' 10"  Weight: 190
Gender: M

OPERATOR
Name: DMT OPERATOR
Certificate Number: 1000
Department: MANKATO PUBLIC SAFETY DEPT

ARRESTING OFFICER
Name: Arresting Officer
Arresting Department: MANKATO DPS
Department ORI: MN0070100
County: BLUE EARTH
Type Of Test: TRAFFIC
Case Number / ICR Number: 201900000000
Commercial Vehicle: N
Observation Start Time: 11:52 PM
Observed By: DMT OPERATOR

CONTROL INFORMATION
Lot Number: AG828301-26
Control Target: 0.076
Expiration: 10/10/2020

DIAGNOSTIC CHECK           PASSED  00:14
AIR BLANK                   0.000  00:16
SUBJECT SAMPLE           Vol=1.65  00:17
  IR = 0.181
AIR BLANK                   0.000  00:18
CONTROL SAMPLE                     00:18
  IR = 0.074
AIR BLANK                   0.000  00:20
SUBJECT SAMPLE           Vol=4.02  00:21
  IR = 0.202
AIR BLANK                   0.000  00:22

****************************************
0.02 Agreement Not Met - Deficient Test
****************************************

REMARKS:
Mouth was checked prior to the test. Nothing
entered the mouth from the stomach.
Sample 1: Strong and hard breath and stopped very
quickly.
Sample 2: Breath was steady and then tapered down
at the end. The .02 Agreement was not met.
Invalid Sample.
```

Operator Signature

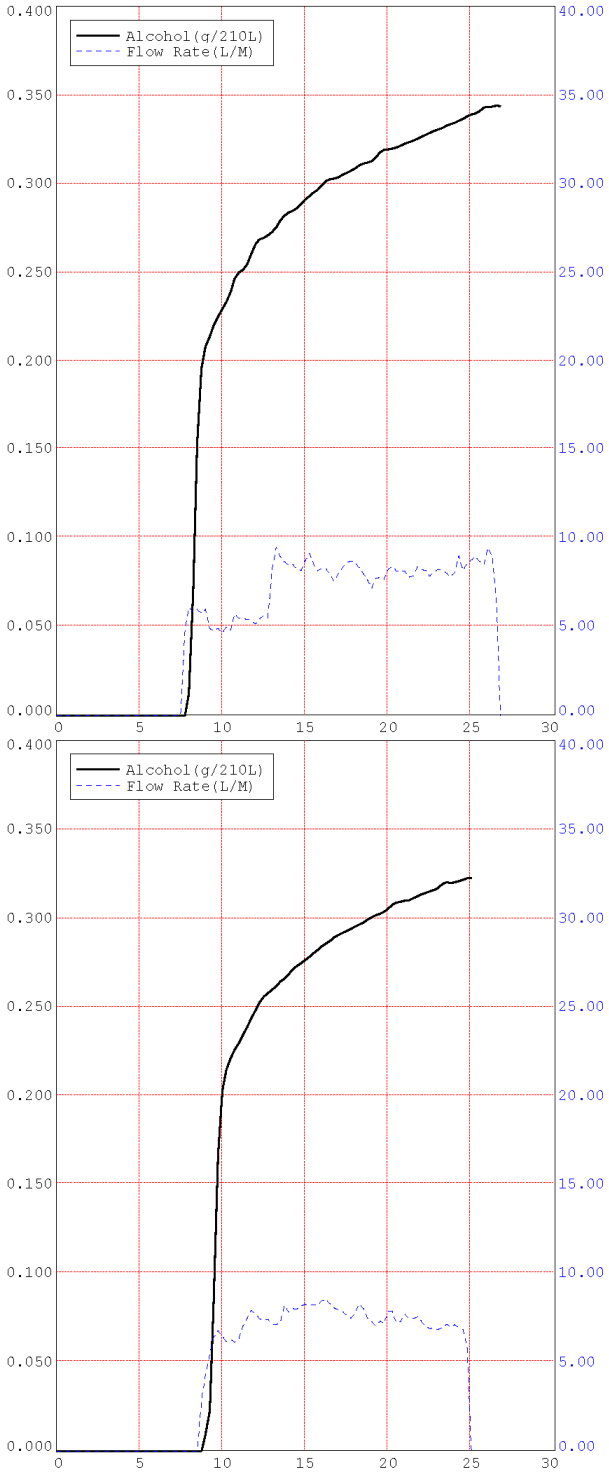



DMT Test Record showing 0.02 Agreement Not Met – Deficient Test. This means the results between the two breath samples differ by more than 0.02 g/210L (0.202 – 0.181 = 0.021). Administer a second breath test.

SUBJECT TEST

```
-------------------------
State of Minnesota
DataMaster DMT: 100596
Version: 208.206.205
-------------------------
Audit ID: 100596-816
Date: 05/03/2019
Time: 12:08:09
Location:  Carver County Sheriff's Office

SUBJECT
Name: SUBJECT TEST
License Number: F123456789
State Of Issue: MN
DOB: 11/04/1985
Height: 6' 6"  Weight: 260
Gender: M

OPERATOR
Name: DMT OPERATOR
Certificate Number: 1000
Department: CARVER COUNTY S.O.

ARRESTING OFFICER
Name: ARRESTING OFFICER
Arresting Department: CHASKA PD
Department ORI: MN0100200
County: CARVER
Type Of Test: TRAFFIC
Case Number / ICR Number: 201900000000
Commercial Vehicle: N
Observation Start Time: 11:34 AM
Observed By: DMT OPERATOR

CONTROL INFORMATION
Lot Number: AG903001-13
Control Target: 0.079
Expiration: 01/30/2021

DIAGNOSTIC CHECK            PASSED  12:08
AIR BLANK                    0.000  12:10
SUBJECT SAMPLE            Vol=2.36  12:10
  IR = 0.341
AIR BLANK                    0.000  12:12
CONTROL SAMPLE                      12:12
  IR = 0.076
AIR BLANK                    0.000  12:14
SUBJECT SAMPLE            Vol=1.96  12:14
  IR = 0.319
AIR BLANK                    0.000  12:15

**************************************
0.02 Agreement Not Met - Second Deficient Test
**************************************

REMARKS:
two mouth pieces used
sample one start/stop
sample two not as strong as the first
mothe checked at 1208
no b,b,v
agreed to another test
```

Operator Signature

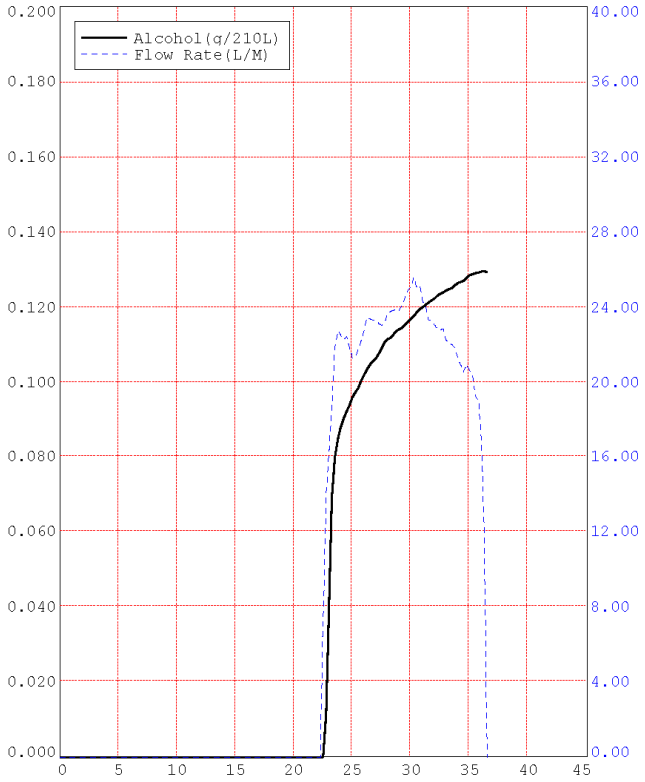



DMT Test Record showing 0.02 Agreement Not Met – Second Deficient Test. The DMT specifically identifies the result as the second deficient test to demonstrate there were two consecutive tests ending in 0.02 Agreement Not Met by the same subject.

SUBJECT TEST

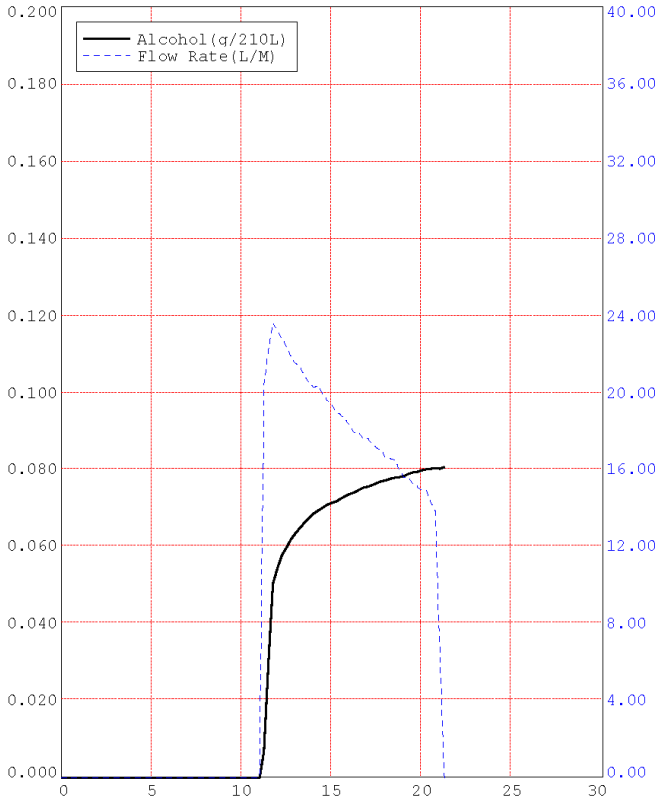
```
-------------------------
State of Minnesota
DataMaster DMT: 100820
Version: 208.206.205
-------------------------
Audit ID: 100820-1083
Date: 01/04/2019
Time: 01:44:49
Location: Crow Wing County Jail

SUBJECT
Name: SUBJECT TEST
License Number: Q123456789
State Of Issue: MN
DOB: 08/16/1994
Height: 5' 9"  Weight: 170
Gender: M

OPERATOR
Name: DMT OPERATOR
Certificate Number: 1000
Department: CROW WING COUNTY L.E.C.

ARRESTING OFFICER
Name: ARRESTING OFFICER
Arresting Department:
  PEQUOT LAKES POLICE DEPARTMENT
Department ORI: MN0181100
County: CROW WING
Type Of Test: TRAFFIC
Case Number / ICR Number: 19000000
Commercial Vehicle: N
Observation Start Time: 1:19 AM
Observed By: DMT OPERATOR

CONTROL INFORMATION
Lot Number: AG812902-17
Control Target: 0.075
Expiration: 05/09/2020

DIAGNOSTIC CHECK            PASSED  01:44
AIR BLANK                    0.000  01:46
SUBJECT SAMPLE                      01:47
  IR = INTERFERENCE
AIR BLANK                    0.000  01:48
CONTROL SAMPLE                      01:48
  IR = 0.072
AIR BLANK                    0.000  01:49

**************************************
Interference
**************************************

For DMT test uncertainty of measurement
information, email the BCA Calibration
Laboratory at bca.breathtest@state.mn.us

REMARKS:
Subject was compliant.  No BBV witnessed during
15 minute observation by arresting officer.
Mouth checked at 0137 hours revealed no foreign
substance.  Breath 1:  Long, steady, and
consistent.  Breath sample came back as an
Interference.
```

Operator Signature




DMT Test Record showing Interference on the first breath sample. This means the ratio between the filters exceeded the acceptable range. The DMT will run an air blank, the control sample and a final air blank before ending the test. A second breath sample will not be requested from the subject during this test sequence.

```
SUBJECT TEST

-------------------------
State of Minnesota
DataMaster DMT: 100554
Version: 208.206.205
-------------------------
Audit ID: 100554-2510
Date: 07/13/2019
Time: 20:02:39
Location: Todd County Sheriff's Office

Type Of Test: COURT - CORRECTIONS

SUBJECT
Name: QUICK TEST

OPERATOR
Name: DMT OPERATOR
Department: LONG PRAIRIE PD

DIAGNOSTIC CHECK           PASSED  20:02
AIR BLANK                   0.000  20:04
SUBJECT SAMPLE            Vol=3.04  20:05
  IR = 0.081
AIR BLANK                   0.000  20:06

**************************************
REPORTED VALUE IN g/210L     0.08  20:05
**************************************

REMARKS:
Subject cooperative
deep breath sample
Probation
Domestic
7-8 beers


_____
Operator Signature
```




DMT Quick Test Record. This is not an evidential test due to the lack of a control sample and a second subject sample.

# DMT Training Practice Laboratory

Instructor _____

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In this laboratory session you will run a series of exercises to familiarize yourself with how the DMT operates and practice a few of the many possible situations you may encounter when testing subjects in the field.

Navigation through the different data entry fields is as follows:

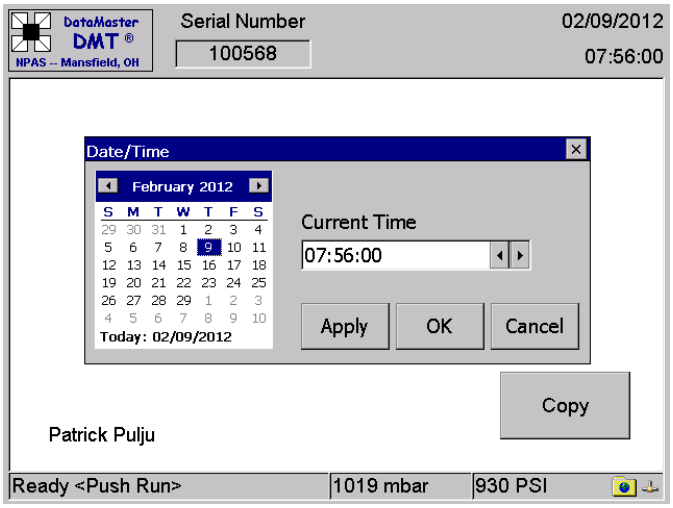
“Tab” key moves the cursor between the fields of data entry
“Enter” key selects the “Next” or “OK” buttons
Drop down fields will only allow entry of data listed – some will auto-fill data
Data fields have data validation and require valid data
Touch display allows you to move between fields and edit data in a field out of order

☐ Touch the display to bring the DMT out of screen saver mode, if necessary.

## Exercise 1 **********

**OBJECTIVE: Use the drop down menu to set the date and time.**

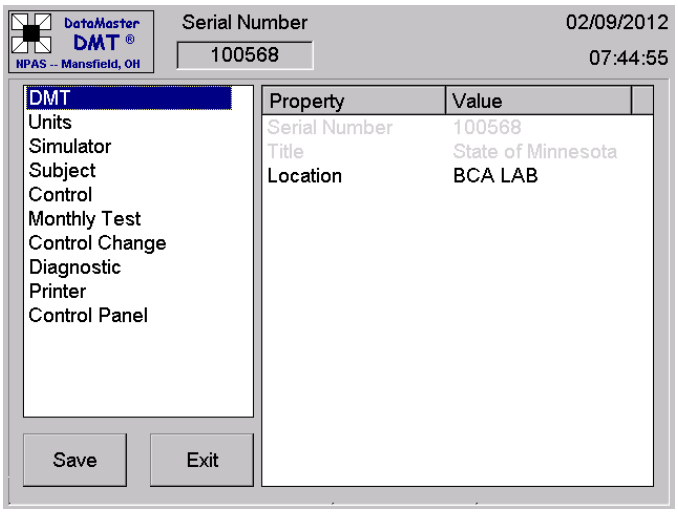
☐ Select the DMT icon in the upper left corner of the display to show the drop down menu.
☐ Select the “Functions” item in the menu.
☐ Select the “Set Date/Time” item under “Functions”.
☐ Set the date by selecting the correct day from the calendar.
☐ Set the time by entering the correct time in the time field.
☐ Select the “OK” button to set the date and time currently displayed.



## Exercise 2 **********

**OBJECTIVE: Use the drop down menu to set the instrument location that will be printed on each printout.**

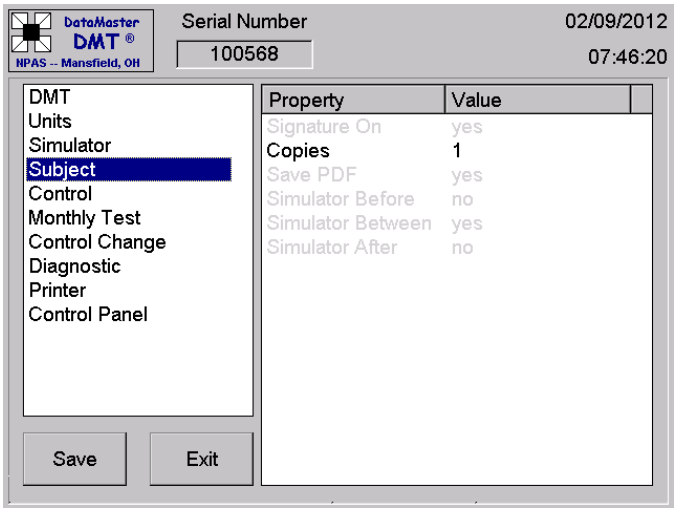
- ☐ Select the DMT icon in the upper left corner of the display to show the drop down menu.
- ☐ Select the “Setup” item in the menu.
- ☐ Select “DMT” in the left column.
- ☐ Double tap the “Location” property in the right column then type in the testing location name.
- ☐ Select the “Save” button to accept the changes made. (Note: If the “Exit” button is chosen the changes are rejected without confirmation.)




## Exercise 3 **********

**OBJECTIVE: Use the drop down menu to set the number of copies that will be printed for each subject test.**

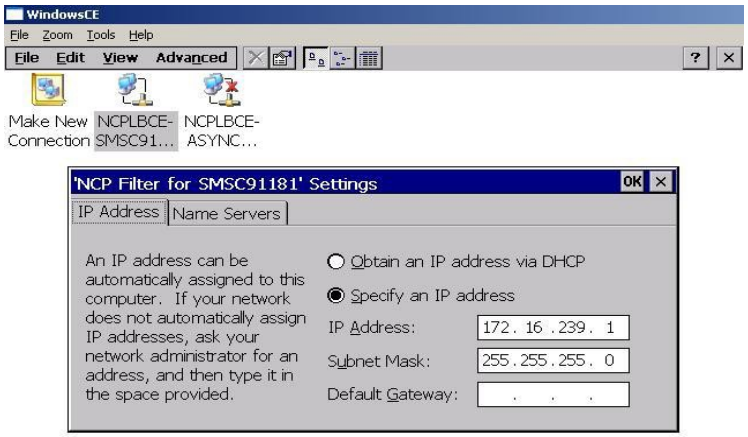
- ☐ Select the DMT icon in the upper left corner of the display to show the drop down menu.
- ☐ Select the “Setup” item in the menu.
- ☐ Select “Subject” in the left column.
- ☐ Double tap the “Copies” property in the right column then type in the quantity needed.
- ☐ Select the “Save” button to accept the changes made. (Note: If the “Exit” button is chosen the changes are rejected without confirmation.)



## Exercise 4**********

**OBJECTIVE: Enter IP Address to establish communication between the DMT and the BCA**

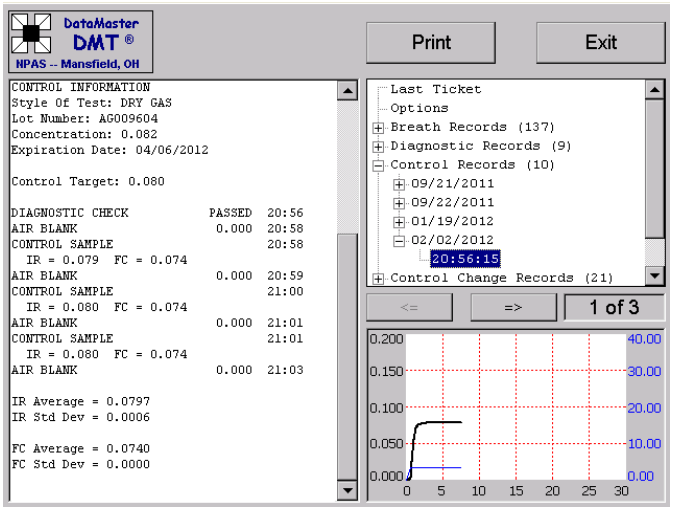
- ☐ Select the DMT icon in the upper left corner of the display to show the drop down menu.
- ☐ Select the “Functions” item in the menu
- ☐ Select “Instrument Setup”
- ☐ Verify the Instrument Location is appropriate, then select “Set Local IP”
- ☐ You will see three network icons, double click on the NCPLBCE-SMSC91181 (middle) icon
- ☐ Notice (do not change) the IP Address, Subnet Mask and Default Gateway. These are unique to each department and will need to be entered when a new DMT is installed in your department.
- ☐ Select OK, X, then Save




## Exercise 5 **********

**OBJECTIVE: Use the drop down menu to view previously run tests.**

- ☐ Select the DMT icon in the upper left corner of the display to show the drop down menu.
- ☐ Select the “Reports” item in the menu. The reports window will display the last test run.




To find a previous test:

- ☐ Expand the record type you want to view by touching the plus (+) next to the title.
- ☐ Expand the date of the test you want to view by touching the plus (+) next to the appropriate date.
- ☐ Select the test you want to view by touching the time of the test. The virtual test record will appear on the left side of the display and the associated graphs will appear in the lower right.
- ☐ Select the “Print” button to print the test record.
- ☐ Select the “Exit” button to close the reports window. (Note: The report window will automatically close after 5 minutes of no activity.)

## Exercise 6 **********

**OBJECTIVE: Observe the effect of an incomplete driver's license swipe.**

- ☐ Select the "Run" button on the display. The test can also be started by pressing the F1 key on the keyboard or selecting the DMT icon in the upper left corner of the display to show the drop down menu then choosing the "Subject Test" item from the menu.
- ☐ Select Scan as the method of data entry for the subject information.
- ☐ Use the magnetic stripe reader on the keyboard to automatically fill the subject information.
- ☐ Observe that the data entry review begins on the second data entry screen.
- ☐ Select the "Previous" button on the bottom of the display to return to the first data entry screen and observe the incorrectly captured data.
- ☐ Select Cancel

## Exercise 7 **********

**OBJECTIVE: Run a Minnesota Test Sequence (DABACABA).**

- ☐ Select the "Run" button on the display. The test can also be started by pressing the F1 key on the keyboard or selecting the DMT icon in the upper left corner of the display to show the drop down menu then choosing the "Subject Test" item from the menu.
- ☐ Select the method of data entry for the subject information:
  - Scan – Use the 2-D bar code scanner on the left side of the DMT to automatically fill the subject information through the date of birth.
  - Swipe – Use the magnetic stripe reader on the keyboard to automatically fill the subject information through the gender.
  - Manual – Use the keyboard to type the information.

| Data Entry Field | Operator Response |
|---|---|
| Last | Enter and review the subject's last name. |
| First | Enter and review the subject's first name. |
| Middle | Enter and review the subject's middle name. |
| Driver's License Number | Enter and review the subject's DL number. |
| State of Issue | Enter and review the DL State of issue. |
| Date of Birth | Enter and review the subject's date of birth. |
| Height – ft. | Enter and review the foot portion of the subject's height. |
| Height – in. | Enter and review the inch portion of the subject's height. |
| Weight | Enter and review the subject's weight. |
| Gender | Enter and review the subject's gender. |
| Race | Enter the subject's ethnicity. |

- ☐ Select the "Next" button to move to the next page.

| Data Entry Field | Operator Response |
|---|---|
| Certification Number | Review – This is taken from your log in and cannot be changed. |
| Operator Last Name | Review – This is taken from your log in and cannot be changed. |
| Operator First Name | Review – This is taken from your log in and cannot be changed. |
| Operator Department | Review – This is taken from your log in but can be changed. |
| Same As Operator | Selecting this box will copy the operator information to the arresting officer fields. |
| Arresting Officer Last Name | Enter or review the arresting officer's last name. |
| Arresting Officer First Name | Enter or review the arresting officer's first name. |
| Arresting Department | Enter or review the arresting department's name. |
| Arr. Dept ORI | Enter the arresting department's ORI. |
| County | Enter or review the county of arrest. |

☐ Select the “Next” button to move to the next page.

| Data Entry Field | Operator Response |
|---|---|
| Type of Test | Enter or select the reason for the test being performed. |
| PBT Result | Enter the roadside PBT result if known. |
| Date of Stop | Enter the date of the stop or first contact. |
| Time of Stop | Enter the time of the stop or first contact. |
| Case or ICR Number | Enter the ICR or case number assigned to this test. |
| Commercial Vehicle | Enter whether the stop involved a commercial vehicle. |
| Observation Start Time | Enter the time the observation period began. |
| Observed By | Enter the name or identifying information of the person performing the observation period. |

☐ Select the “Okay” button to move to the next page.

| Display | Operator Response |
|---|---|
| Diagnostic checks | Observe all diagnostic checks pass |
| Air blank – Virtual test record | Observe blank |
| Breath sample – Real time graph of subject sample | Attach mouthpiece and have subject provide an adequate sample. Remove the mouthpiece after the subject has finished providing the sample. |
| Air blank – Virtual test record | Observe blank |
| Control sample – Virtual test record | Observe control sample |
| Air blank – Virtual test record | Observe blank |
| Breath sample – Real time graph of subject sample | Attach mouthpiece and have subject provide an adequate sample. Remove the mouthpiece after the subject has finished providing the sample. |
| Air blank – Virtual test record | Observe blank |
| Remarks | Enter observations of subject behavior and sample delivery along with other remarks. |
| Signature | Sign the record on the display using the stylus. |
| Printing | Observe test record printing |

## Exercise 8**********

**OBJECTIVE: Print a test record after a printer error.**

☐ Correct the printer problem then select “Copy” on the DMT display.

*(Note: Printing a test record with the “copy” button applies only to the last test run.)*

## Exercise 9 **********

**OBJECTIVE: Run a test with a deficient first sample.**

☐ Press the “Run” button on the display to start a Minnesota Test Sequence.

☐ Enter information as requested by the DMT. At the "scan/swipe/manual" option, select “manual” and enter the subject’s information manually through the keyboard.

*SUBJECT SAMPLE 1*

☐ Blow into the DMT until tone starts and the volume and AC is displayed then **stop** blowing when the volume bar displayed is 1/3 filled.

☐ Allow the DMT to timeout a "Deficient Sample". This will take three minutes. Acknowledge the deficient sample when the message box appears on the display.

*CONTROL*

☐ Observe the Control.

*SUBJECT SAMPLE 2*

☐ Because the first sample was deficient there will be no request for a second sample.

## Exercise 10 **********

**OBJECTIVE: Log out of the DMT.**

☐ Press the “DMT icon” on the display to show the drop down menu.

☐ Select ‘Security’ then ‘Logout’. Your name should no longer appear in the lower left portion of the display.

**The next four (4) exercises will be run at stations 1, 2, 3, and 4. Beginning at the instrument you are currently at, follow the instructions for that station. When the person working at the station to your left has completed their work, advance clockwise around the instrument pod to the next station. Read the instructions for each station's exercise before you begin doing the exercise.**

## STATION 1 **********

**OBJECTIVE: Observe the effect of two samples outside of .02 agreement.**

☐ Log into the DMT using your operator credentials.

☐ Press the F1 key or 'RUN' button to start a test.

☐ Enter the data the DMT requests.

*SUBJECT SAMPLE 1*

☐ When the display reads "PLEASE BLOW", connect the 0.08 AC simulator to the breath tube and put your mouthpiece in the piece of tubing on the simulator inlet tube.

☐ Blow an adequate sample through the simulator into the DMT.

☐ **As soon as you complete blowing this sample, disconnect the simulator from the breath tube and discard the mouthpiece.**

*CONTROL*

☐ Observe the control.

*SUBJECT SAMPLE 2*

☐ When the display reads "PLEASE BLOW", connect a new mouthpiece to the breath tube and blow an adequate sample.

☐ The DMT will display "*.02 agreement not met*" at the end of the test and acknowledge that a new test is required.

☐ Log off of the DMT.

## STATION 2 **********

**OBJECTIVE: Observe the effect of acetone in a subject sample.**

☐ Log into the DMT using your operator credentials.

☐ Press the F1 key or 'RUN' button to start a test.

☐ Enter the data the DMT requests.

*SUBJECT SAMPLE 1*

☐ When the display reads "PLEASE BLOW", connect the "acetone" simulator to the breath tube and place your mouthpiece in the piece of tubing on the simulator inlet tube.

☐ Blow an adequate sample into the DMT through the simulator containing acetone. The DMT will display "*Interference*" instead of the AC result.

☐ **As soon as you complete blowing this sample, disconnect the simulator from the breath tube and discard the mouthpiece.**

*CONTROL*

☐ Observe the Control.

*SUBJECT SAMPLE 2*

☐ Note: The above situation will result in no request for a second sample.

☐ Log off of the DMT.

## STATION 3 **********

**OBJECTIVE: Observe the effect of ethanol introduced during an air blank.**

☐ Log into the DMT using your operator credentials.

☐ Press the F1 key or 'RUN' button to start a test.

☐ Enter the data the DMT requests.

*SUBJECT SAMPLE 1*

☐ When the display reads "PLEASE BLOW", place your mouthpiece in the breath tube and blow an adequate sample.

☐ **As soon as you complete blowing this sample, remove and discard the mouthpiece from the breath tube and place the open container next to the breath tube.**

☐ **During the air blank the instrument will draw in the ambient alcohol from around the container and display 'blank error'.**

*CONTROL*

☐ Note: The above situation will result in no control sample and no request for a second sample.

☐ Log off of the DMT.

## STATION 4 **********

**OBJECTIVE: Observe the effect of mouth alcohol on a subject sample.**

☐ Swish your mouth with alcohol provided.

☐ Log into the DMT using your operator credentials.

☐ Press the F1 key or 'RUN' button to start a test.

☐ Enter the data the DMT requests.

*SUBJECT SAMPLE 1*

☐ When the display reads "PLEASE BLOW", place your mouthpiece in the breath tube and blow an adequate sample.

☐ **As soon as you complete blowing this sample, remove your mouthpiece from the breath tube and discard.**

☐ Acknowledge the "Invalid sample" when the message box appears on the display.

*CONTROL*

☐ Observe the Control.

*SUBJECT SAMPLE 2*

☐ Note: The above situation will result in no request for a second sample.

☐ Log off of the DMT.

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# Pharmacology and Toxicology of Alcohol

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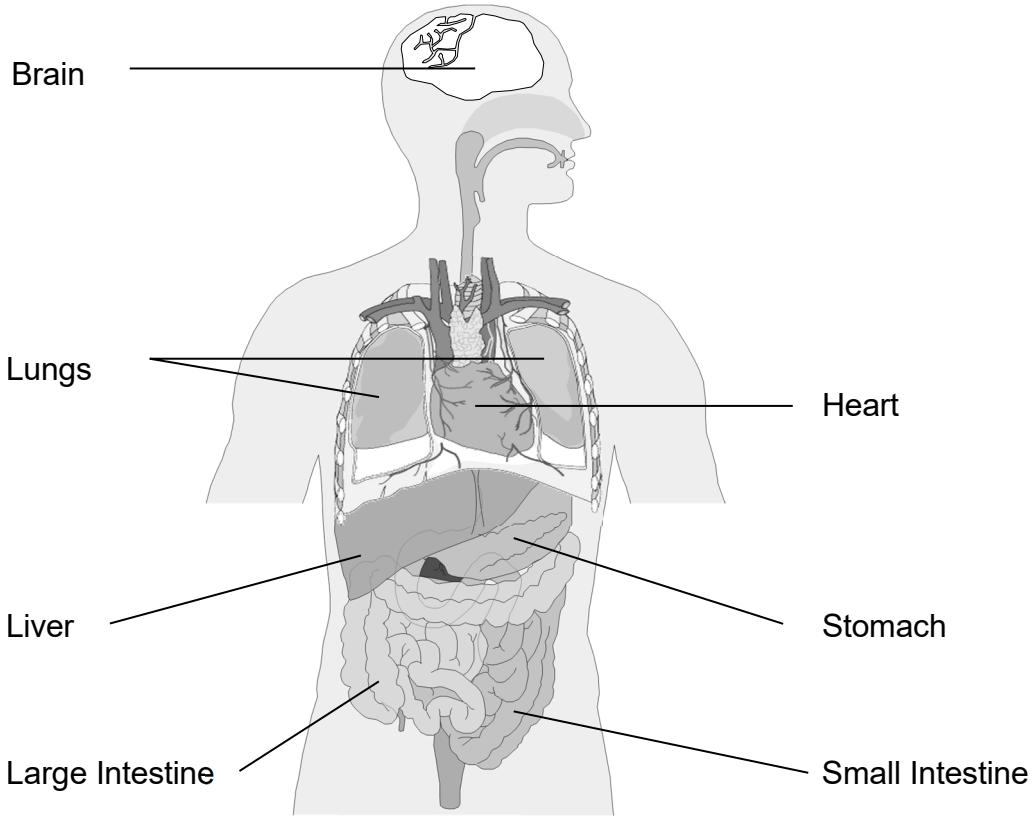
## Absorption of Alcohol

Ethanol can enter the human body in several different ways: injection, inhalation, and ingestion. Ethanol has not been observed to accumulate in the body as a result of absorption through the skin. Injection of ethanol directly into the body is an extremely dangerous procedure because it produces a localized concentration of ethanol that can severely affect the heart and other vital organs (this phenomenon is referred to as the "bolus effect").

Ethanol can also enter the body through inhalation of alcoholic vapors. When the alcoholic vapors come into contact with the lungs and mucous membranes lining the nasal passages and throat, the ethanol can diffuse through these membranes into the blood. However, extended exposure to a severely irritating environment is required to reach a significant alcohol concentration. It is, therefore, very unlikely any individual would become intoxicated in this manner.

The usual method for alcohol to enter the body is by ingestion of an alcoholic beverage. Ethanol is not digested, but absorbed unchanged. Absorption of ethyl alcohol begins immediately following the introduction of an alcoholic beverage into the digestive system. Ethanol is readily absorbed through all mucosal surfaces, including the oral cavity and gastrointestinal tract.

Ethyl alcohol can be absorbed through the lining of the mouth; however, the amount is normally insignificant since fluid leaves the mouth rapidly. A mouth rinsed with liquor will be free of residual alcohol in less than 15 minutes. About 20 to 30 percent of the alcohol is absorbed through the stomach wall. The remainder, about 70 to 80 percent, is absorbed from the duodenum, the first 8 to 10 inches of the small intestine.



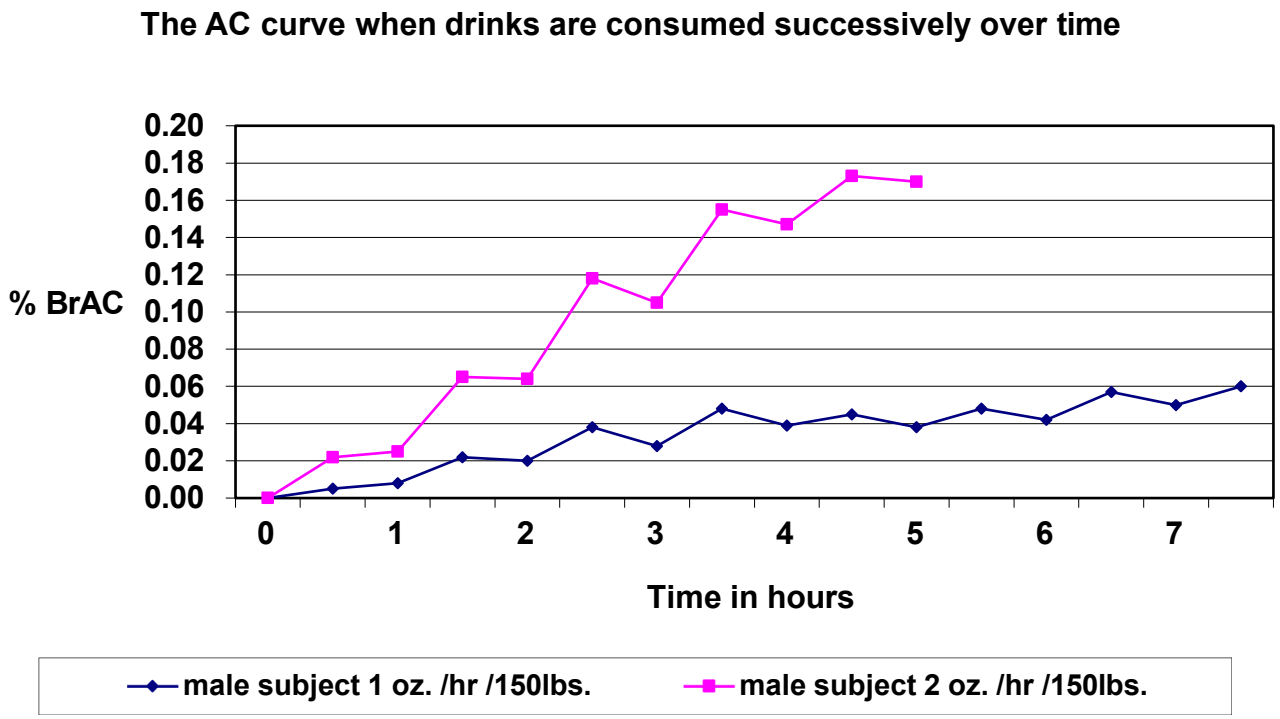
**Brain and Internal Organs**

## Rate of Absorption

Absorption rates vary somewhat from person to person. Individual absorption rates can also vary depending on the condition of the body. Ethyl alcohol begins to pass into the blood stream within one to two minutes after it is consumed. Most of it is absorbed within 15 minutes, nearly 90 percent within one hour, and the rest within about two hours.

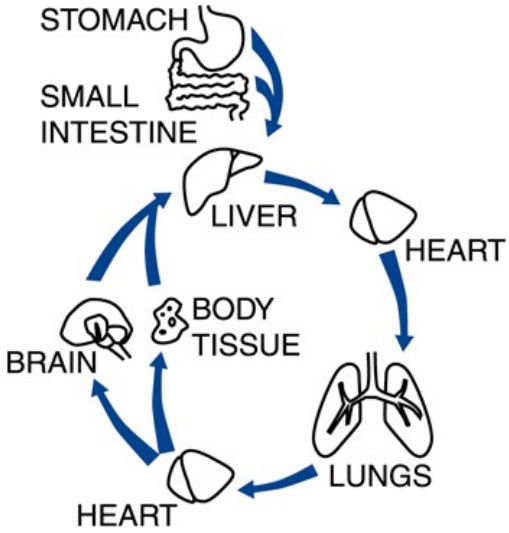
A portion of the ethyl alcohol can be absorbed into the blood through the walls of the stomach. The length of time the ethanol remains in the stomach before being passed on to the remainder of the gastrointestinal tract can vary due to several factors. The most significant factor is the amount of food in the stomach. The pyloric sphincter controls the passage of material from the stomach to the small intestine. On a full stomach, the pyloric sphincter remains closed longer. Ethanol remains in the stomach for a longer period of time delaying its absorption. Slowing alcohol absorption decreases the peak alcohol concentration and may prolong the time to reach the peak concentration.

If a male weighing 150-pounds consumed 1-ounce of 50 percent by volume whiskey every hour, their alcohol concentration (AC) would rise slowly, reaching approximately 0.05 after 7 hours. If the dose was doubled their AC would rise rapidly, reaching approximately 0.12 in less than 2.5 hours. The following graph represents this scenario:



## Distribution of Alcohol

Once ethanol has been absorbed, it travels via the blood stream from the stomach and small intestine to the liver, then to the right heart, lungs, left heart, and then to the brain and the rest of the body.



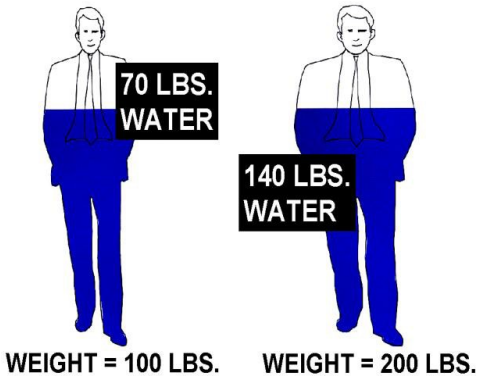

Alcohol has an affinity, or attraction, for water so alcohol distributes into body tissues and fluids according to their water content. The distribution ratios below are average values for alcohol in tissues and fluids compared to alcohol in whole blood, which has been assigned a value of 1.0.

| | | | | | |
|---|---|---|---|---|---|
| Breath | 0.00043 | Blood Serum | 1.2 | Liver | 0.9 |
| Urine | 1.3 | Blood Clot | 0.8 | Fat | 0.02 |
| Brain | 0.8 | Saliva | 1.1 | Whole body – male | 0.67 |
| Blood Plasma | 1.2 | Vitreous Humor | 1.2 | Whole body – female | 0.55 |

During early absorption phases of drinking, the alcohol concentration in arterial blood can exceed the alcohol concentration in peripheral venous blood. At all times, however, the blood as it passes through the lungs and the brain is similar in alcohol content.

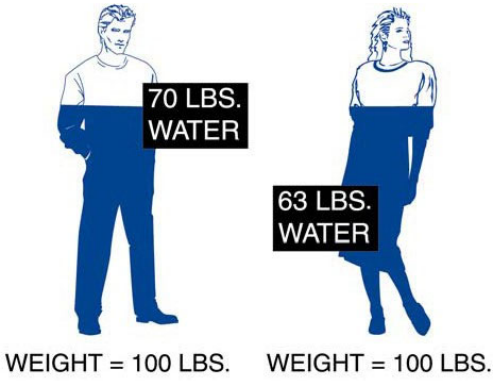
## Body Type and Total Body Water

The total amount of water in the body can vary from one individual to another based upon the weight (mass) of the person. Assuming the same body type, a 200 pound man must consume more ethanol than a 100 pound man to reach the same alcohol concentration. This is because the 200 pound man has more body water to dilute the alcohol. The amount of fat tissue also affects the total amount of body water. Fat tissue has very little water and therefore does not absorb ethyl alcohol. A 200 pound obese person will have less body water to dilute the alcohol than a 200 pound lean person.




## Sex

Total body water content also varies according to gender. On average, women have less body water than men do on a per pound basis due to differences in body composition. The same ethanol intake will typically result in a higher alcohol concentration in women than in men of the same weight. For example, a 100 pound man would have to consume more alcohol than a 100 pound woman to achieve the same concentration, because the man has more water in his body with which to dilute the ethyl alcohol.

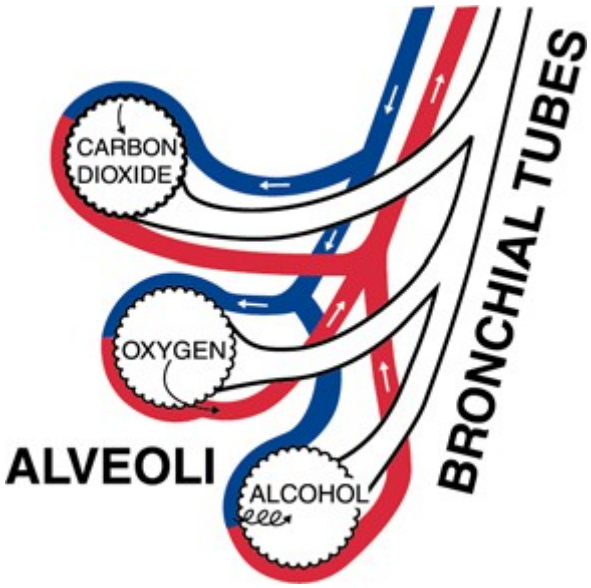


## Elimination of Alcohol

Alcohol is removed or eliminated from the body by metabolism and excretion. Between 90 to 98 percent of alcohol is metabolized by the liver through oxidation. As the alcohol is transported through the body by the blood, the liver continually metabolizes it using the enzyme Alcohol Dehydrogenase (ADH). The ethanol is oxidized to simpler compounds such as acetaldehyde and acetic acid. These are then further broken down by other processes into carbon dioxide and water.

An individual's rate of metabolism is relatively constant, however the *elimination* rate can vary from person to person. The average rate of elimination is **0.015 AC per hour** and the typical range of reported elimination rates varies from about 0.010-0.025 AC per hour. Higher rates can occur in individuals with alcohol dependence or chronic alcohol use. Elimination is time dependent. Any attempt to eliminate alcohol through increased perspiration, urine output, or drinking coffee has little or no effect.

Since ethyl alcohol is miscible with water, between two and ten percent of ethanol is excreted unchanged in urine, sweat, and breath. Excretion of ethanol in the breath is the basis of the breath alcohol test. The exchange of oxygen and carbon dioxide occurs in the small tissue sacs of the lungs called the *alveoli*. The lungs contain about 300 million alveoli. Blood vessels in the lungs end in capillaries in the walls of the alveoli. Alcohol from the blood enters the alveolar (deep lung) air through the alveoli. Alcohol in the alveolar air is in equilibrium with alcohol in the blood, and the accepted ratio of alcohol in the alveolar air to alcohol in the blood is 2100 to 1.




**Lung Alveoli**

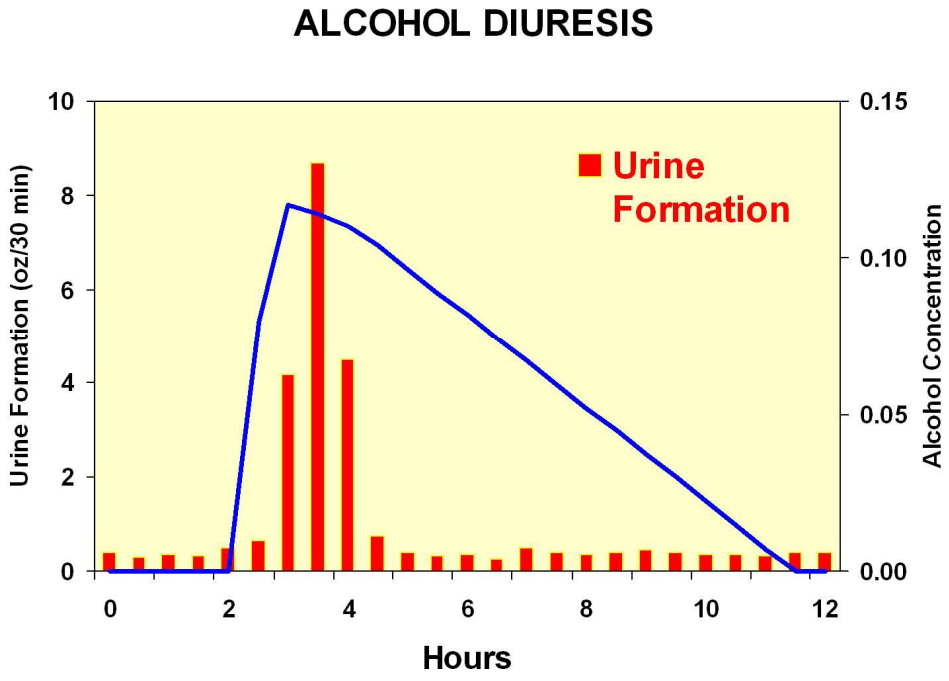
## Effects on the Body

*Skin.* Alcohol is an antiseptic. It imparts a cool and soothing feeling when rubbed on skin. Following absorption, alcohol enlarges the capillary blood vessels near the skin, which increases circulation and causes the flushed appearance of the drinker.

*Circulation.* A single drinking episode has little effect on the circulatory system, other than the effect on the skin described above. At ACs of 0.45 or higher, death may result from respiratory arrest.

*Liver.* Alcohol can interfere with the oxidative metabolism of other drugs, potentially causing liver toxicity. Chronic alcohol use can cause a buildup of fatty tissue in the liver, inflammation, and cirrhosis.

*Kidney.* Alcohol is a mild diuretic (it increases urine output).




## Effects on the Central Nervous System

*Ethanol is a central nervous system depressant.* Initially ethanol produces exhilaration due to a depression of the inhibitory processes. As the AC rises a progression of deterioration that affects concentration, decision-making abilities, coordination, and vision is followed by a loss of self-restraint until finally automatic body functions, such as breathing, are affected.

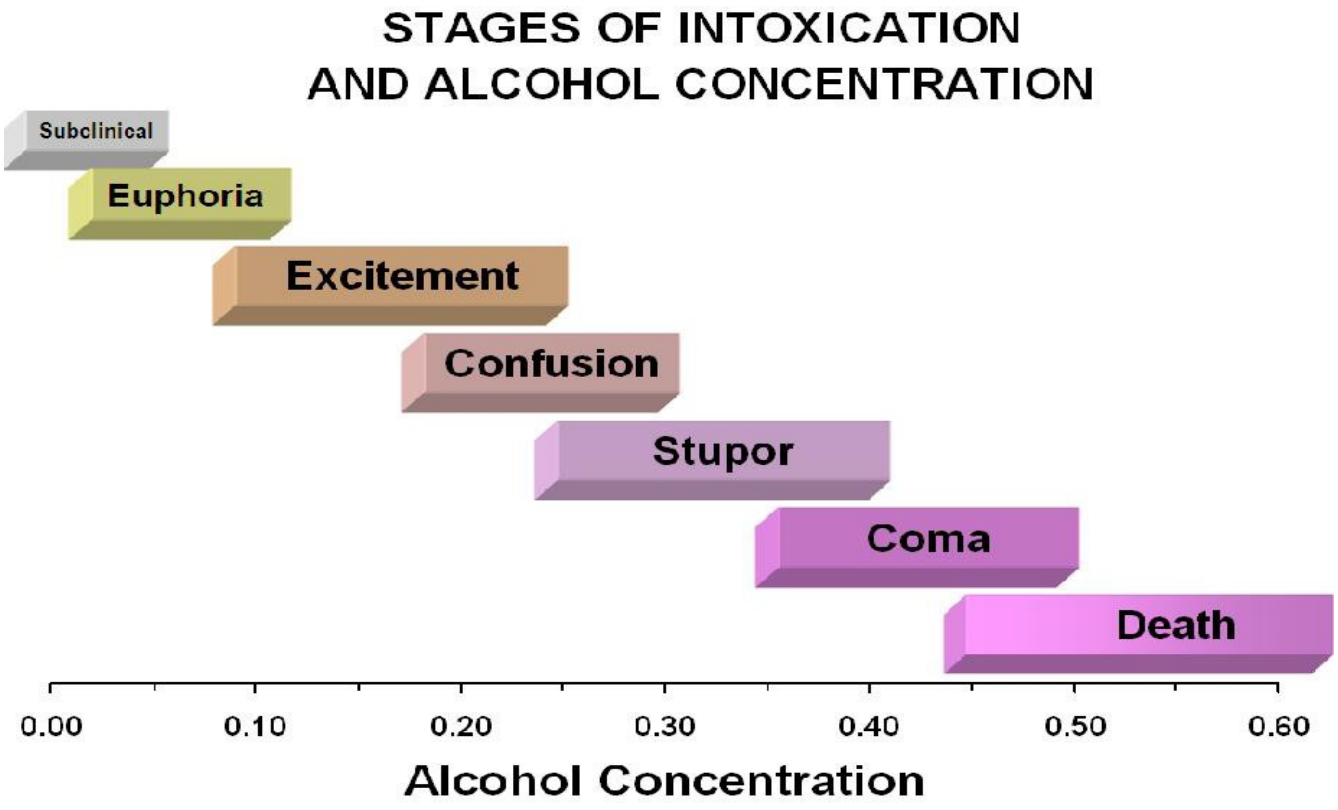
*Divided attention.* Ethanol impairs divided attention skills (the ability to perform more than one task at the same time) at ACs as low as 0.005.

*Mental processes.* Information processing and short-term memory are affected at an AC of 0.01. Inhibitions are reduced at 0.02, the ability to concentrate is affected at 0.03, and judgment and reasoning are affected at 0.04.

*Vision.* Tracking ability is affected starting at an AC of 0.01. Visual focus and scanning ability are affected at 0.02. Horizontal gaze nystagmus begins to appear at 0.04. At 0.06 diplopia (double vision) ensues, at 0.08 visual acuity is impaired, and at 0.09 glare recovery is affected.

*Reaction time and coordination.* Complex reaction time is affected at an AC of 0.02. Muscular coordination and balance are affected at 0.04.

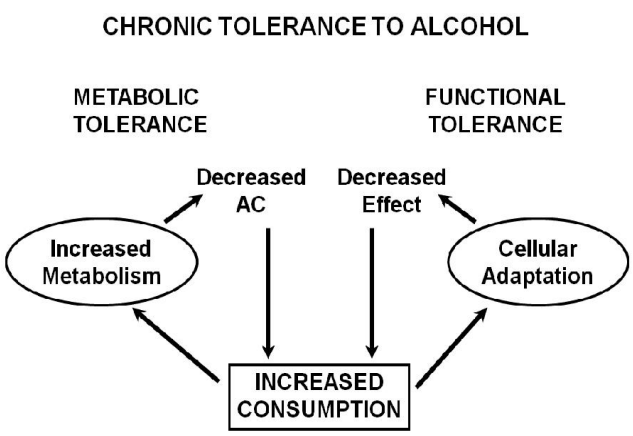
*Driving.* Evidence strongly suggests impairment of some driving-related skills begins at ACs below 0.01. By 0.05 most individuals show impairment of driving skills, and at 0.08 all drivers exhibit impairment of driving skills.

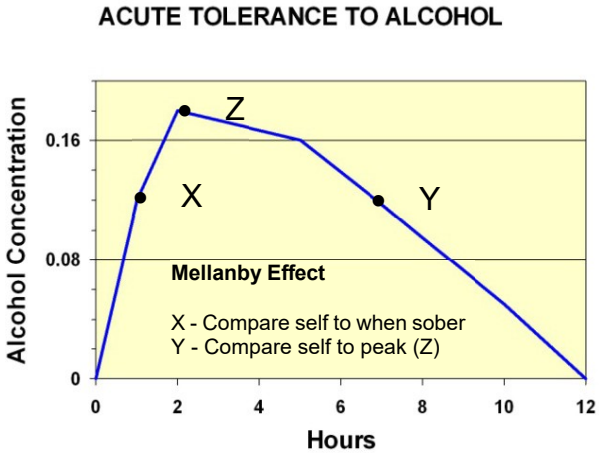


## Tolerance

*Chronic tolerance.* Frequent, heavy consumption of ethanol can cause an individual to develop a rate of elimination up to three times the normal rate, as well as have greater tolerance to the effects of alcohol.

*Acute tolerance.* Tolerance can also be acquired over the course of a single drinking episode. Individuals can learn to compensate for some of the effects of ethanol during a drinking episode (for example, by standing with their feet farther apart to minimize swaying).




## Symptoms of Alcoholic Influence

Common symptoms of alcoholic influence include:

| | |
|---|---|
| Odor of alcoholic beverages on the breath | Confusion |
| Flushed appearance | Unusual mental changes |
| Muscular incoordination | Unsteady gait |
| Disorderly or out of the ordinary conduct | Sleepiness |
| Speech difficulties, such as slurred | Nausea |
| Horizontal gaze nystagmus | Dizziness |
| Impairment of attention or memory | Tremors |
| Impaired social functioning | Stupor or coma |
| Impaired judgment | Vomiting |

Any one symptom or combination of symptoms does not necessarily mean the subject is intoxicated, as some illnesses or injuries can produce similar symptoms. A low alcohol concentration may indicate the abnormal behavior of a subject is due to the presence of other drugs.

## Blood versus Urine

*Blood advantages*. Drugs detected in blood may indicate more recent drug exposure. Blood tests may also offer additional insight into the use of prescribed medications.

*Urine advantages.* Urine is easier to obtain than blood. Drugs tend to be present in greater amounts in urine than in blood, and they are usually detectable for longer periods following exposure.

## Other Considerations

Endogenous alcohol refers to alcohol that is normally in the body, and it is generally at an AC of less than 0.0001.

Not all drugs can be detected in both blood and urine. Refer to the testing capabilities of the Toxicology laboratory to determine the best specimen for the suspected drug.

## Alcohol Calculations

*Widmark Formula*

Erik M. P. Widmark, a Swedish scientist and pioneer in alcohol research, developed the means of estimating the amount of alcohol in a person's body that produces a given alcohol concentration (AC), referred to as the Widmark Formula. This formula has been standardized and is used by and accepted in the scientific community as a means to:

- estimate a person's AC when the amount and type of alcohol consumed is known; or
- estimate the amount of alcohol in the body when the AC is known.

A scientist from the Breath Alcohol Calibration Laboratory or Toxicology Section of the BCA may be called to testify in the event of an alleged post driving consumption defense. The formula can be used to estimate the contribution of the ethanol consumed after driving. It can also be used to substantiate or refute the amount of alcohol a person claims to have consumed before driving.

In cases of suspected or reported post-driving consumption, it is important to obtain information about the reported drinking history, including the drinking timeline and the type and amount of alcohol consumed. Additionally, operators should observe whether the subject's intoxication level appears to be increasing or decreasing, as this may help support or refute claims of post-driving consumption. Evidence such as receipts, witness statements, and documentation of any containers or glassware may also be useful when investigating post-driving claims.

*Retrograde Extrapolation*

Retrograde extrapolation is a calculation used to estimate an individual's alcohol concentration (AC) at a prior point in time. This calculation is standardized and is used and accepted by the scientific community when:

- An evidentiary breath test or blood draw is conducted more than two hours after the time of driving

A scientist from the Breath Alcohol Calibration Laboratory or Toxicology Section of the BCA may perform these calculations based on a known breath or blood alcohol level and typical rates of alcohol elimination. These estimations cannot be performed using urine results

# Definitions

Instructor _____

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**0.02 AGREEMENT NOT MET - DEFICIENT TEST**

The subject provided two adequate breath samples, however the results between the two breath samples differed by more than 0.020 g/210L. This can be caused by mouth alcohol, but is more commonly a result of the subject providing the two samples in an inconsistent manner. If mouth alcohol may be the cause, conduct a new observation period before beginning a new test.

**0.02 AGREEMENT NOT MET – SECOND DEFICIENT TEST**

The subject provided two adequate breath samples, however the results between the two breath samples differed by more than 0.020 g/210L. This can be caused by mouth alcohol, but is more commonly a result of the subject providing the two samples in an inconsistent manner. This has occurred on two consecutive tests and may serve as a basis for statutory refusal.

**ADJUSTMENT** The portion of the certification procedure used when calibration criteria are not met. This process is performed by authorized BCA personnel in the laboratory.

**AMBIENT FAIL** The DMT was unable to establish a zero alcohol reference when measuring the air around the instrument during the initial air blank. This can be caused by a poorly ventilated room that does not allow for sufficient clearing of alcohol vapors, a breath tube pointed toward a subject, room deodorizers or hand sanitizers, etc. If possible, remove the source of ambient alcohol or move it farther away from the instrument and begin a new test.

**BLANK ERROR** The DMT was unable to establish the same zero alcohol reference when measuring the air around the instrument compared to the previous air blank. This can be caused by a poorly ventilated room that does not allow for sufficient clearing of alcohol vapors, a breath tube pointed towards a subject, room deodorizers or hand sanitizers, etc. If possible, remove the source of ambient alcohol or move it farther away from the instrument and begin a new test.

**BREATH TUBE TEMP INVALID**

The temperature of the breath tube is outside the proper range of 38°C to 50°C. This can be caused by not plugging in the power cord, plugging it into the wrong receptacle or damage to the breath tube or wires. Verify the power cord is properly plugged in. After a sufficient warm up period begin a new test. If the message persists contact the BCA.

**CALIBRATION** The procedure that verifies the accuracy of the adjustment and linearity of the DMT.

**CERTIFICATION** The procedure performed on a DMT prior to being used in the field. This includes instrument maintenance, adjustment (if needed) and calibration followed by technical and administrative reviews.

**CONTROL** A material of known alcohol concentration that is analyzed to evaluate the accuracy of the analytical procedure. The DMT uses dry gas standards at approximately 0.08 g/210 L as the control.

**CONTROL OUT OF RANGE**

The result of the Control test is outside the acceptable range of .005 g/210L from the target alcohol concentration.

**DEFICIENT** See Deficient Sample

**DEFICIENT SAMPLE**

One or more of the acceptance criteria for a breath sample was not met. The subject must blow at a flow rate at or above 2.87 Liters per minute, must meet or exceed the minimum breath volume of 1.5 liters, the alcohol concentration slope must be level as determined by the DMT, and the flow rate must drop below 2.87 Liters per minute. Each of these criteria must be met in a single attempt during the three minute time limit.

**DEFICIENT TEST** See 0.02 Agreement Not Met

**DEPRIVATION PERIOD**

See Observation Period

**DETECTOR OVERFLOW**

The DMT measured an alcohol concentration above the operating range of 0.600 g/210L. This could be the result of mouth alcohol. Conduct a new observation period and begin a new test.

**FC** See FUEL CELL

**FILTER WHEEL ERROR**

A misalignment of the filter wheel was detected. Begin a new test. If the same message occurs, call the BCA Breath Alcohol Calibration Laboratory.

**FILTER (1, 2 OR 3) WON'T ZERO**

The DMT is unable to obtain a zero reference value at filter noted. Begin a new test. If the same message occurs, call the BCA Breath Alcohol Calibration Laboratory.

**FUEL CELL** Fuel cell is a technology used to measure the alcohol concentration on a person's breath. The fuel cell has two platinum electrodes with a porous acid-electrolyte material between them. As the breath from the subject flows past one side of the fuel cell, the platinum oxidizes the alcohol in the breath and produces acetic acid, protons and electrons. The electrons flow through a wire from the platinum electrode. The protons move through the lower portion of the fuel cell and combine with oxygen and the electrons on the other side to form water. The more alcohol oxidized, the greater the electrical current. The subject's alcohol concentration is calculated based on the current measured.

**GAS FLOW ERROR**

The DMT is not detecting gas flow from the dry gas cylinder. This can occur when air flow from the dry gas cylinder is blocked or the tank has low pressure. Begin another test. If the same message occurs call the BCA Breath Alcohol Calibration Laboratory.

**GASTROESOPHAGEAL REFLUX DISEASE (GERD)**

A digestive disease that occurs when stomach acid flows back (refluxes) into the esophagus. It is commonly alleged to be the source of mouth alcohol during a breath test. See Observation Period.

**GERD** See Gastroesophageal Reflux Disease

**INFRARED (IR)** A type of radiant energy that is invisible to the human eye. The DMT uses a specific range of wavelengths (3.37 – 3.50um) where ethanol is known to absorb infrared light.

**INFRARED ABSORPTION**

The technology used by the DMT to measure the alcohol concentration on a person's breath. Infrared light is directed through the sample chamber and onto the detector. When breath containing ethanol is introduced into the sample chamber, the ethanol absorbs some of the light passing through the chamber and less light falls on the detector. This change in light intensity is measured by the instrument and used to determine the concentration of alcohol in the breath sample.

**INTERFERENCE** The ratios between the filters has exceeded the acceptable range. The breath sample submitted may contain a substance other than ethanol or a combination of ethanol and an interfering substance. Obtain a warrant to collect blood or urine for analysis.

**INTERNAL STANDARD**

A quartz plate that simulates a known alcohol concentration is inserted into the light path. This is used to verify the accuracy of the calibration of the instrument. The value of the quartz standard is established during adjustment and each subsequent diagnostic check must be within four percent (4%) of the target.

**INTERNAL STANDARD ERROR**

The measurement of the quartz standard is outside of four percent (4%) of the value established during the previous adjustment. Restart the test. If the same message occurs, call the BCA Breath Alcohol Calibration Laboratory.

**INVALID** The DMT detected a declining alcohol concentration during a subject's breath sample. This can be the result of mouth alcohol, however it can also be the result of irregular blowing patterns by the subject. If mouth alcohol is suspected to be the cause, conduct a new observation period before beginning a new test.

**IR** See INFRARED

**MOUTH ALCOHOL**

Alcohol vapors from recent ingestion can remain in the mouth for as long as 15 minutes or be reintroduced into the mouth from actions such as belching or regurgitating stomach contents into the mouth. A 15 minute observation period should be conducted to verify the alcohol concentration in the breath being measured is not falsely elevated due to mouth alcohol.

**OBSERVATION PERIOD**

Recent alcohol ingestion or reintroduction of alcohol into the mouth from actions such as belching, regurgitating or refluxing stomach contents into the mouth are possible sources of mouth alcohol. Alcohol vapors can remain in the mouth for as long as 15 minutes. A test subject should be observed for a minimum of 15 minutes prior to administering a breath test to ensure nothing is placed in the mouth and nothing erupts into the mouth.

**PUMP ERROR** The DMT did not detect proper air flow through the instrument during an air blank. This can be caused by a problem with the pump or an obstruction of the breath path. Remove the mouthpiece from the breath tube during air blanks to prevent this from occurring. Ensure the screen at the end of the breath tube is clear. Begin a new test. If the same message occurs, call the BCA Breath Alcohol Calibration Laboratory.

**QUARTZ STANDARD**

**See INTERNAL STANDARD**

**RADIO FREQUENCY INTERFERENCE**

High levels of radio frequencies have been detected and ended the test. This can be caused by keying a radio in the vicinity of the instrument or a static discharge to the breath tube that holds the RFI antenna. Turn off radios and restart the test.

**RFI** See RADIO FREQUENCY INTERFERENCE

**STABILITY FAIL** During the diagnostic check the instrument detected a shift in the detector voltage. This is usually caused by ambient alcohol around the instrument. Also see AMBIENT FAIL and BLANK ERROR. If possible, remove the source of ambient alcohol or move it farther away from the instrument and begin a new test.

**TANK PRESSURE LOW**

The pressure in the dry gas cylinder is below 200 pounds per square inch (PSI). This is a notification to the operator to ensure a new dry gas cylinder is available for installation.

**TANK PRESSURE INVALID**

The pressure in the dry gas cylinder is below 25 pounds per square inch (PSI). Contact the BCA to arrange for a replacement DMT.

**VERIFICATION** The procedure that verifies the accuracy of the adjustment and linearity of the DMT.

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# Portable Breath Test (PBT) Instruments

Instructor _____

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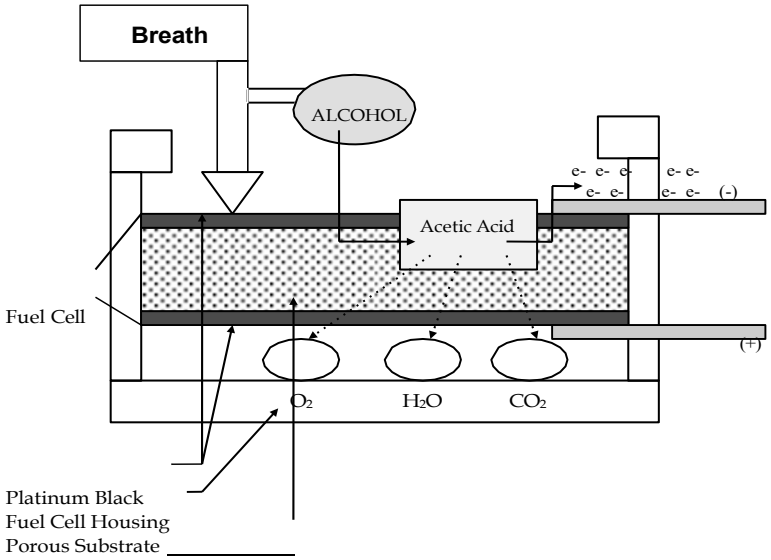
# Electrochemical Fuel Cell

Fuel Cell Diagram




The fuel cell is a porous disk coated with a thin layer of platinum black on both faces and saturated with an electrolyte. As a subject's breath passes the upper surface of the cell the platinum oxidizes the alcohol in the breath and produces acetic acid, protons and electrons. This is known as an oxidation reaction. The electrons flow through a wire from the platinum electrode. The protons move through the lower portion of the fuel cell and combine with oxygen and the electrons on the other side to form water. The more alcohol oxidized, the greater the electrical current. The resulting electric current is translated into a breath alcohol concentration and is digitally displayed. If there is no alcohol present in the breath sample, no oxidation will occur. Because no electrons will be released, no current will be generated and the result will be a zero reading.

The fuel cell is selective in what it reacts with (just alcohols) and it will not respond to acetone, which may be present in the breath of diabetics, dieters or highly exercised individuals. It has no significant cross sensitivity to any known substance that might be found in a living human subject after a 15 minute deprivation period.

## Dry Gas Cylinder Purchase

The State of Minnesota has a contract for the purchase of dry gas for PBT calibration. Contract prices are available to State agencies and members of the State's Cooperative Purchasing Venture. Contact the BCA Breath Alcohol Calibration Laboratory to determine the current contract price. Vendors and contract numbers may be found on the BCA Breath Testing webpage.

## Dry Gas Cylinder Disposal

There are penalties for improper disposal or misuse of pressurized cylinders. Do NOT place cylinders in the garbage. Completely drain the dry gas cylinder and contact your local refuse company to determine the proper disposal procedure.

A dry gas cylinder draining tool can be used to drain and disable the valve of certain brands of dry gas cylinders. If the tank is no longer pressurized the cylinder is recyclable. See Appendix 9 for further information and purchasing details.

# ALCO-SENSOR III

## Power

A nine-volt alkaline battery powers the measuring circuit of the Alco-Sensor III. The battery is accessible through a sliding cover on the bottom of the unit.

## Temperature

The operating temperature range is 15°C to 36°C (59°F - 97°F). A liquid crystal thermometer on its back indicates the instrument's temperature (serial numbers above 1200000 have a built in electronic thermometer that indicates the instrument's temperature).

## Controls

The Alco-Sensor has two controls, the "SET" button and the "READ" button. The "SET" button, when fully depressed, will expel 1 ml of air or breath sample from the fuel cell chamber. It locks in its fully depressed position. The "READ" button has two functions. When pressed slightly it releases the "SET" button allowing the instrument to draw in a sample. When fully depressed, it turns on the instrument's measuring circuit to provide a reading on the digital display.

## Indicators

The Alco-Sensor has a three digit digital display.

## Test procedure

1. Check the instrument temperature. If the temperature is between 22°C to 36°C, proceed to step 2. If the instrument is cold, place it in a pocket next to the body for two minutes and then recheck its temperature.
2. Depress and hold the "READ" button to observe 0.000 on the display and proceed to step 3. If any other reading, clear the chamber by fully depressing the "SET" button. Wait 1 – 2 minutes and repeat this step.
3. Press the "SET" button until it locks.
4. Place a mouthpiece on the sample port.
5. Ask the subject to blow steadily into the mouthpiece.
6. After allowing the subject to blow into the mouthpiece long enough to obtain deep lung air (no less than three (3) seconds), press the "READ" button to take a sample. This must be done while the subject is blowing.
7. Hold the "READ" button down for forty (40) to seventy (70) seconds after taking the sample to allow the fuel cell to reach its peak. Note the highest reading obtained as this is the subject's breath alcohol result. (with serial numbers above 1200000 the read button does not need to be held and the final result will be brightly illuminated)

8. Press the “SET” button to clear the fuel cell. If running another test, wait 1 to 2 minutes. If testing is complete, store the instrument with the “SET” button depressed.

## Calibration check

This check eliminates the need to recalibrate the unit if it is within specifications. The operator can check the calibration by using the following procedure.

1. Check the temperature (22 - 36°C).
2. Check zero reference (depress and hold the “READ” button to observe 0.000).
3. Depress the “SET” button.
4. Attach Alco-Sensor III to dry gas cylinder with regulator.
5. Depress the dry gas regulator button for five (5) seconds and press the “ON” button at Four (4) seconds.
6. Hold the “READ” button down and observe the display for the peak reading (no change in AC for 5 seconds). If peak reading is greater than ± 0.005 from the known value of the dry gas, proceed to Alco-Sensor III Calibration. (with serial numbers above 1200000 the read button does not need to be held)
7. Depress “SET” button, and remove the mouth piece.

## Calibration procedure

If the PBT result is greater than ± 0.005, it should be recalibrated by using the following procedure.

Calibration requires the following:

Dry gas cylinder with regulator

Alco-Sensor mouthpiece

Small screwdriver or trim potentiometer tool

***(for serial numbers below 1200000)***

1. Check temperature (22 - 36 degrees C).
2. Turn calibration screw 1 full turn (360 degrees) **clockwise** (CW).
3. Check **zero** reference (depress and hold **READ** button to observe .000).
4. Depress **SET** button.
5. Attach Alco-Sensor III to the dry gas cylinder with a mouthpiece.
6. Depress the regulator button for five (5) seconds and push **READ** button at four (4) seconds.
7. **Calibrate** by turning the Calibration Screw **counterclockwise** (CCW) when the display value exceeds the known value of the dry gas until you reach the value of the dry gas. Repeat until the value on the display does not change for 5 seconds. Example: AC on the dry gas

cylinder Label = 0.082. When display value = 0.083, turn Calibration Screw CCW until display reads 0.082.

8. Depress **SET** button.
9. After a 2 minute wait, use a **NEW** mouthpiece to run a **CALIBRATION CHECK** with the same dry gas to confirm the calibration. **THE RESULT SHOULD BE WITHIN (±0.005) OF THE TARGET READING.**

***(for serial numbers above 1200000)***

1. Check the unit's temperature by pressing both the **READ** and **SET** buttons. (15 - 36 °C).
2. To enter into the calibration mode, depress and hold the **SET** button and depress then release the **READ** button. When the temperature is being displayed, depress and release the **READ** button three times within two seconds. "**CAL**" should be displayed followed by "**bLn**" .
3. Depress the **READ** button to perform the blank test. A moving dash "**-**" should be displayed followed by "**Set**" if the blank test is successful.
4. Depress **SET** button and "**CAL**" will be displayed.
5. Attach Alco-Sensor III to the dry gas cylinder with a mouthpiece.
6. Depress the regulator button for five (5) seconds and push **READ** button at four (4) seconds.
7. A moving dash "**-**" should be displayed followed by a calibration result. **Calibrate** by turning the Calibration Screw until the value matches the value of the dry gas. Example: Simulated Breath AC on dry gas Label = 0.082. If display value = 0.083, turn Calibration Screw until display reads 0.082.
8. Depress **SET** button.
9. After a 3 minute wait, use a **NEW** mouthpiece to run a **CALIBRATION CHECK** with the same dry gas to confirm the calibration. **THE RESULT SHOULD BE WITHIN (±0.003) OF THE TARGET READING.**

## Mouthpieces

Mouthpieces for the Alco-Sensor are packaged individually and are available through the manufacturer, Intoximeters, Inc., 2081 Craig Rd, St. Louis, Missouri 63146, telephone is (314) 429-4000 or (800) 451-8639.

# ALCO-SENSOR IV

## Power

A nine-volt alkaline battery powers the measuring circuit of the Alco-Sensor. The battery is accessible through a sliding cover on the front of the unit.

## Temperature

The operating temperature range is 10°C to 40°C (50°F - 104°F). Warmer temperatures improve the performance of the instrument and prevent condensation within the detector. The unit has a built in electronic thermometer that indicates the instrument's temperature.

## Controls

The Alco-Sensor IV has two controls, the "SET" button and the "Manual" button. The "SET" button, when fully depressed, will expel 1 ml of air or breath sample from the fuel cell chamber. It locks in its fully depressed position. The "Manual" button will allow the operator to manually take a sample.

## Indicators

The Alco-Sensor has a three digit digital display.

## Test procedure

1. Place a mouthpiece into the sample port.
2. Check the instrument temperature; if any temperature between 10°C to 40°C is indicated, proceed to step 3. If the instrument is cold, place it in a pocket next to the body for two minutes and then recheck its temperature.
3. After the "blank" check, press the "SET" button until it locks.
4. After "TEST" is displayed, ask the subject to blow steadily into the mouthpiece.
5. After unit takes the sample it will analyze it and display the AC result.
6. Press the "SET" button to clear the fuel cell.
7. Press the red eject button to eject the used mouthpiece, never pull it out. If running another test, wait 1 to 2 minutes. If testing is complete, store the instrument with the "SET" button depressed.

## Calibration Check procedure

1. Place a mouthpiece into the sample port.
2. Check the instrument temperature, if any temperature between 10°C to 40°C is indicated proceed to step 3. If the instrument is cold, place it in a pocket next to the body for two minutes and then recheck its temperature.
3. After the "blank" check, press the "SET" button until it locks.

4. After “TEST” is displayed, connect unit to dry gas cylinder. Depress the regulator button for seven (7) seconds and at five (5) seconds press the **MANUAL BUTTON**.
5. After unit takes the sample it will analyze it and display the AC result. If the result is greater than ± 0.005 from the known value of the dry gas cylinder AC, proceed to the Alco Sensor IV Calibration procedure.
6. Press the “SET” button to clear the fuel cell.
7. Press the red eject button to eject the used mouthpiece, never pull it out.

## Calibration procedure

When a unit does not read a simulator solution within acceptable limits (± 0.005) it must be re-calibrated by the following procedure. The unit must be calibrated when its temperature is between 23ºC - 27ºC. If the temperature is not within the required range, the unit will not permit a calibration.

Calibration requires the following:

Dry gas cylinder

Alco-Sensor IV mouthpiece

Calibration tool

1. Remove battery cover to expose calibration switch access holes.
2. Insert a new mouthpiece and follow standard operation until ALCO-SENSOR IV displays a blank reading of **“.000”.**
3. While **“.000”** is still being displayed, press **BUTTON #3** and hold down until **“.XXX”** is displayed (The actual number will be that used for the last calibration that was run). When **“.XXX”** display appears, release button. If the temperature is not in the range of 23ºC - 27ºC, instead of **“.XXX”** the display will be **“Tmp>”** or **“Tmp<”** and the unit will **“Void”.** Remove the mouthpiece and correct temperature before trying again.
4. If, after a few seconds, the display goes to **“Set”**, the **SET BUTTON** should be depressed to cock sample pump. **“.XXX”** will return to the display.
5. With **”.XXX”** shown on the display, if necessary, adjust the number up **(BUTTON #1)** or down **(BUTTON #2)** until the value of the dry gas being use is displayed.
6. Push **BUTTON #3** again and display will read **“Cal”.** This is the equivalent of **“Test”** in a normal sequence.
7. Connect unit to dry gas. Depress the regulator button for seven (7) seconds and at five (5) seconds press **MANUAL BUTTON**. The microprocessor will analyze the output from the **FUEL CELL** and will automatically accept the number that was programmed in Step 5.
8. Conclude the test as usual by pressing the **SET BUTTON** when **“SET”** appears. Remove the mouthpiece at the intermittent **BEEP**.
9. After a 2 minute wait, use a **NEW** mouthpiece to run a **CALIBRATION CHECK** test with the same dry gas to confirm the calibration. **IT SHOULD BE WITHIN (± 0.003) OF THE TARGET READING.**

# Alco-Sensor IV MN (650A)

## Subject Test Operation

1. **Attach New Mouthpiece -** Insert mouthpiece and the AS-IV will power ON when the mouthpiece locks into place.

2. **Instrument ON LED display sequence –** With power ON the instrument will display and the Operator should observe the following displays: Temperature, Date, Time and Test Number

3. **Blank Cycle** - The LED display will display:

   3.1 **">", "<"** (alternating) – indicating checking baselines
   3.2 **"Wait"** (sometimes) – indicating baselines settling
   3.3 **"Blnk" -** followed by AS-IV sampling system opening (Click) to take a sample from mouthpiece and manifold to verify they are free of alcohol.
   3.4 **">", "<"** (alternating) –analyzing blank sample
   3.5 **".000"** – confirming the blank sample has no alcohol in it.
   3.6 "Set" – Requiring the Operator to press the "SET" button to reset the sample system for the subject sample
   3.7 **">", "<"** (alternating) – indicating checking baselines

4. **Subject Sample**
   4.1 "Test"-- When "TEST" appears, instruct subject on how to provide a breath sample.
   **"Take a deep breath and blow steadily into the mouthpiece for as long as you can"**
   4.2 **">", "<" (**alternating) –analyzing subject sample
   4.3 **".088 %BAC"** (Twice) –Result of sample analysis. **Note the Subject's Result.**
   4.4 **"RECALL" –** Press "RECALL" to display test result if required.
   4.5 **Press "SET" button** to reset sample system
   4.6 **Press RED button to eject the Mouthpiece.** Ends subject test sequence.

## Accuracy Check Operation

1. **Attach New Mouthpiece -** Insert mouthpiece, the AS-IV will power ON when the mouthpiece locks into place.
2. NOTE: If Accuracy Check is required because 30-day lockout has been exceeded – press and hold down F1 when inserting mouthpiece - four □□□□ are displayed.
3. **Instrument ON LED display sequence –** The instrument will display Temperature, Date, Time and Test Number.
4. AS-IV MN will continue with Subject Test sequence until:
5. "TEST" is displayed – Then Press the "RECALL" button
   5.1 "CHK?" is displayed.
   5.2 Press "MANUAL" -- CHEK is displayed briefly
   5.3 4-digits displayed e.g. "0081". This is the last accuracy check target value entered E.G "0081"=0.081 %BAC.
   5.4 Press "RECALL" to increase expected value and "MANUAL" to decrease expected value
   5.5 Press F3 to confirm target value.
   5.6 Displays flashing "CHECK"
   5.7 Introduce standard gas sample 4 seconds press "MANUAL" while continuing flow for 1-second longer.

5.8 Press “RECALL to redisplay result before ejecting mouthpiece. Note display result.
5.9 Press Red Button to eject the mouthpiece and Power OFF.

## Calibration Operation

1. **Attach New Mouthpiece -** Insert mouthpiece while holding down F1.
2. AS-IV will power ON displaying four □□□□ when the mouthpiece locks into place.
3. **LED display sequence –** the instrument will display Temperature, Date, Time and Test Number
4. AS-IV MN will continue with Subject Test sequence until:
   **“.000”** – confirming the blank sample has no alcohol in it.
5. When “.000” is displayed, press and hold down “F3”.
6. When “Set” is displayed, press the “SET” button to reset the sample system for the subject sample.
7. 4-digits displayed e.g. “0081”. This is the last target Calibration value entered “0081”=0.081 %BAC.
   7.1 Press “RECALL” to increase expected value and “MANUAL” to decrease expected value.
   7.2 Press F3 to confirm target value.
   7.3 Displays flashing “CAL”
   7.4 Introduce standard gas sample. Press “MANUAL” at 4 seconds while flow continues until 6 seconds.
   7.5 Display will show the Calibration value.
8. After Calibration AS-IV will display “ACC CHK REQUIRED”
   8.1 When mouthpiece is inserted AS-IV will automatically go to step 5.3 of Accuracy Check procedure.

## Mouthpieces

Mouthpieces for the Alco-Sensor are packaged individually and are available through the manufacturer, Intoximeters, Inc., 2081 Craig Rd, St. Louis, Missouri 63146, telephone is (314) 429-4000 or (800) 451-8639.

# ALCO-SENSOR FST

## Power

Two AA batteries power the FST. The batteries are accessible through a sliding cover on the base of the unit.

## Temperature

The operating temperature range is 0°C to 50°C (32°F - 122°F).

## Controls

The FST has two control buttons, the “ON” button and the “OFF” button. The “ON” button turns the instrument on and also allows the operator to capture a manual sample. The “OFF” button powers the instrument down and is also used to select several other features of the instrument.

## Indicators

The Alco-Sensor FST has a three digit digital display.

## Test Procedure

1. Place a mouthpiece into the sample port.
2. Press the power on button and hold for 1 second.
3. Check the instrument temperature, if any temperature between 0°C and 50°C is indicated proceed to step 4. If the instrument is cold, place it in a pocket next to the body for two minutes and then recheck its temperature.
4. After the “blank” check, “blo” will be displayed. Ask the subject to blow steadily into the mouthpiece.
5. After unit takes the sample it will analyze it and display the AC result for 15 second before the instrument will power itself off.

## Calibration Check Procedure

1. Insert a new mouthpiece and turn the instrument on by pressing the “OFF” and “ON” buttons simultaneously. Depress the “ON” button until the displayed message reads “ACC” and then depress the “OFF” button.
2. Connect unit to dry gas cylinder. Depress the regulator button for 7 seconds and press the “ON” button (larger button opposite the display) at 5 seconds. The unit will analyze the output from the fuel cell and will display an alcohol concentration (AC). If result is outside of the acceptable target AC, the unit must be calibrated.
3. Remove the mouthpiece.

## Calibration Procedure

When a unit does not read a dry gas cylinder within acceptable limits (± 0.005) it must be re-calibrated using the following procedure. The unit must be calibrated when its temperature is between 15ºC - 35ºC. If the temperature is not within the required range, the unit will not permit a calibration.

Calibration requires the following:

Dry gas cylinder

Alco-Sensor FST mouthpiece

1. Press and hold the “OFF” button while turning the unit on. Press the “ON” button multiple times until the unit displays “CAL”. Press and release the “OFF” button. The FST will perform an air blank sample then display “CAL” (flashing).
2. Insert a new mouthpiece and connect unit to dry gas cylinder. Depress the regulator button for 5 seconds and press “ON” button at 4 seconds. The unit will analyze the output from the fuel cell and will display the last alcohol concentration that was used.
3. Set the display to the alcohol concentration you provided. To change the value press the “ON” button until the number you want is displayed, then press the “OFF” button to move to the next digit. Repeat until the desired value is displayed. After the third digit is accepted, the display will flash three times and store the calibration.
4. Turn the unit off. After a 2 minute wait, use a new mouthpiece to run a verification test with the same dry gas cylinder to confirm the calibration. If result is outside +/- 0.005 of the target AC the unit must be recalibrated.

## Mouthpieces

Mouthpieces for the Alco-Sensor are packaged individually and are available through the manufacturer, Intoximeters, Inc., 2081 Craig Rd, St. Louis, Missouri 63146 , telephone is (314) 429-4000 or (800) 451-8639.

# FC10 / FC20

## Power

Four AA 3 volt alkaline batteries power the measuring circuits of the FC10 / FC20. The battery is accessible through a sliding cover on the back of the unit.

## Temperature

The operating temperature range is 10°C to 40°C (50°F - 104°F). Warmer temperatures improve the performance of the instrument and prevent condensation within the detector. The unit has a built in electronic thermometer that indicates the instrument's temperature.

## Controls

The FC10 / FC20 have two controls, the "Execute" button and the "Function" button. The "Execute" button will allow the operator to manually take a sample. The "Function" button allows the operator to choose different types of tests to run.

## Indicators

The FC10 / FC20 have a graphical LCD backlit display.

## Test procedure

1. Place a mouthpiece onto the sample port.
2. Turn on the unit. The instrument will perform a blank check and check the temperature, if temperature is outside of 10°C to 40°C no tests can be conducted. If the instrument is cold, place it in a pocket next to the body for two minutes and then recheck.
3. After "AUTO TEST" is displayed, ask the subject to blow steadily into the mouthpiece.
4. After unit takes the sample it will analyze it and display the AC result.
5. A sample can manually be activated by pressing the "Execute" button, if a subject doesn't meet the automatic sampling requirements.
6. Remove the used mouthpiece. If running another test, wait 1 to 2 minutes.

## Calibration Check procedure

1. Place a mouthpiece onto the sample port.
2. Turn on the unit. The instrument will perform a blank check and check the temperature, if temperature is outside of 10°C to 40°C no tests can be conducted. If the instrument is cold, place it in a pocket next to the body for two minutes and then recheck.
3. After "AUTO TEST" is displayed, press the "Function" button repeatedly until "Calibration" is displayed then press the "Execute" button. "WET CHECK" will be displayed, change to "DRY CHECK".
4. Attach FC10/ FC 20 to the dry gas cylinder with a mouthpiece.

5. Depress the regulator button for five (5) seconds and push **READ** button at four (4) seconds.
6. A graph should be displayed followed by a result. If the result is greater than ± 0.005 from the known value of the dry gas cylinder, proceed to the FC10 / FC 20 Calibration procedure.
7. Remove the used mouthpiece.

## Calibration procedure

When a unit does not read a dry gas alcohol concentration within acceptable limits (± 0.005), it must be re-calibrated using the following procedure. The unit must be calibrated when its temperature is between 19ºC - 37ºC. If the temperature is not within the required range, the unit will not permit a calibration.

Calibration requires the following:

Dry gas cylinder

FC10 / FC20 mouthpiece

1. Place a mouthpiece onto the sample port.
2. Press the “Function” button repeatedly until “Calibration” is displayed then press the “Execute” button. Press the “Function” button until” DRY CHECK” is displayed. If the value on the display and the dry gas AC matches, proceed to step 4.
3. Press the “Function” button until “CAL SETTINGS” is displayed, then press the “Execute” button. Adjust the value on the display to match the dry gas concentration by pressing the “+” or “-“ buttons. Press the “Function” button until “EXIT” is displayed then press the “Execute” button. Press the “Function” button until “DRY CALIBRATE” is displayed.
4. Connect the unit to dry gas. Depress the regulator button for five (5) seconds and at four (4) seconds press the “Execute” button. The microprocessor will analyze the output from the fuel cell and will automatically accept the number that was programmed in Step 3.
5. Remove the mouthpiece.
6. After a 2 minute wait, use a new mouthpiece to run a Calibration Check test with the same dry gas to confirm the calibration. It should read within ±0.005 of the target reading.

## Mouthpieces

Mouthpieces for the FC10 / FC20 are packaged individually and are available through the manufacturer, LifeLoc Technologies Inc., 12441 West 49th Avenue Suite #4, Wheat Ridge, Colorado 80033, telephone is (800) 722-4872

Instructor _____

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# Appendices

Instructor _____

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# Appendices

# Appendix 1
## DMT Data Review

**Sample chamber:**
Length = 54 cm
Volume = 23 ml
Temperature = 48°C±4°C

**IR Source:** Kanthal Infrared Source Lamp

**Infrared wavelengths:**
3.37 microns
3.44 microns
3.50 microns

**Detector:** Lead selenide element electronically cooled to ≈ 0°C.

**Internal tubing:** 3/8" ID

**Reading updates:** Infrared AC measurement is updated approximately four times a second.

**Sample acceptance:**
1. A minimum breath flow of 2.87 L/min.,
2. A minimum volume of 1.5 Liters of breath.
3. A level slope, as determined by the DMT.
4. The flow rate must drop below 2.87 L/min.

All four acceptance criteria must be met within a single breath within the three minute window.

**Dry Gas:** The control target will vary depending on the barometric pressure. The range of acceptable readings is ±0.005 from the control target printed on the test record. The DMT monitors the expiration date and will not allow a test to run if the cylinder has expired or is less than 25 psi.

**.02 agreement calculation:** Using all results, subtract the lowest reading from the highest reading. If the result is greater than .020, the test is not acceptable.

**Reported Value:** The reported value is obtained by truncating the third digit of the lowest reading of alcohol concentration from an accepted sample and is reported with the time from which it is derived. If the values are identical, the first result will be the basis for the reported value.

**Test sequence:**
1) **D**iagnostics
2) **A**ir blank
3) **B**reath sample
4) **A**ir blank
5) **C**ontrol
6) **A**ir blank
7) **B**reath sample
8) **A**ir blank

**Internal standard:** A quartz plate is inserted into the IR light path during diagnostics. The absorbance is compared to the value obtained during adjustment. These values must be within 4%.

**Printer:**
Hewlett Packard P1606 DN

**Physiological data:**
Average rate of alcohol elimination: 0.015 AC/hour

Alcohol Concentration or AC = grams of alcohol per:
210 liters of breath
100 mL of blood
67 mL of urine

Absorption – Alcohol is primarily absorbed in the small intestine.
Distribution – Alcohol distributes into body tissues and fluids according to their water content.

Elimination – Most alcohol is eliminated by the liver.

Observation period – Alcohol deprivation time of 15 minutes.

Mouth alcohol – Dissipates at an exponential rate and is no longer present within 15 minutes of last exposure to alcohol.

**Ethanol Basics:**
Percent by volume is the most common way to measure alcohol.
Percent by weight is used mainly for taxation purposes and beer liquor control.
Fermentation produces ethanol when a sugar and yeast are mixed. (14% by volume)
Distillation purifies the fermented product. (up to 95% by volume)
Fortification is mixing fermented and distilled products. (0-95% by volume)

Appendix 2

## Minnesota Counties by Number

| # | NAME |
|---|---|
| 01 | Aitkin |
| 02 | Anoka |
| 03 | Becker |
| 04 | Beltrami |
| 05 | Benton |
| 06 | Big Stone |
| 07 | Blue Earth |
| 08 | Brown |
| 09 | Carlton |
| 10 | Carver |
| 11 | Cass |
| 12 | Chippewa |
| 13 | Chisago |
| 14 | Clay |
| 15 | Clearwater |
| 16 | Cook |
| 17 | Cottonwood |
| 18 | Crow Wing |
| 19 | Dakota |
| 20 | Dodge |
| 21 | Douglas |
| 22 | Faribault |
| 23 | Fillmore |
| 24 | Freeborn |
| 25 | Goodhue |
| 26 | Grant |
| 27 | Hennepin |
| 28 | Houston |
| 29 | Hubbard |
| 30 | Isanti |
| 31 | Itasca |
| 32 | Jackson |
| 33 | Kanabec |
| 34 | Kandiyohi |
| 35 | Kittson |
| 36 | Koochiching |
| 37 | Lac Qui Parle |
| 38 | Lake |
| 39 | Lake Of The Woods |
| 40 | Le Sueur |
| 41 | Lincoln |
| 42 | Lyon |
| 43 | McLeod |
| 44 | Mahnomen |
| 45 | Marshall |
| 46 | Martin |
| 47 | Meeker |
| 48 | Mille Lacs |
| 49 | Morrison |
| 50 | Mower |
| 51 | Murray |
| 52 | Nicollet |
| 53 | Nobles |
| 54 | Norman |
| 55 | Olmsted |
| 56 | Ottertail |
| 57 | Pennington |
| 58 | Pine |
| 59 | Pipestone |
| 60 | Polk |
| 61 | Pope |
| 62 | Ramsey |
| 63 | Red Lake |
| 64 | Redwood |
| 65 | Renville |
| 66 | Rice |
| 67 | Rock |
| 68 | Roseau |
| 69 | St. Louis |
| 70 | Scott |
| 71 | Sherburne |
| 72 | Sibley |
| 73 | Stearns |
| 74 | Steele |
| 75 | Stevens |
| 76 | Swift |
| 77 | Todd |
| 78 | Traverse |
| 79 | Wabasha |
| 80 | Wadena |
| 81 | Waseca |
| 82 | Washington |
| 83 | Watonwan |
| 84 | Wilkin |
| 85 | Winona |
| 86 | Wright |
| 87 | Yellow Medicine |

## State Abbreviations

| AB | State |
|---|---|
| AL | Alabama |
| AK | Alaska |
| AZ | Arizona |
| AR | Arkansas |
| CA | California |
| CO | Colorado |
| CT | Connecticut |
| DE | Delaware |
| DC | District of Columbia |
| FL | Florida |
| GA | Georgia |
| HI | Hawaii |
| ID | Idaho |
| IL | Illinois |
| IN | Indiana |
| IA | Iowa |
| KS | Kansas |
| KY | Kentucky |
| LA | Louisiana |
| ME | Maine |
| MD | Maryland |
| MA | Massachusetts |
| MI | Michigan |
| MN | Minnesota |
| MS | Mississippi |
| MO | Missouri |
| MT | Montana |
| NE | Nebraska |
| NV | Nevada |
| NH | New Hampshire |
| NJ | New Jersey |
| NM | New Mexico |
| NY | New York |
| NC | North Carolina |
| ND | North Dakota |
| OH | Ohio |
| OK | Oklahoma |
| OR | Oregon |
| PA | Pennsylvania |
| RI | Rhode Island |
| SC | South Carolina |
| SD | South Dakota |
| TN | Tennessee |
| TX | Texas |
| UT | Utah |
| VT | Vermont |
| VA | Virginia |
| WA | Washington |
| WV | West Virginia |
| WI | Wisconsin |
| WY | Wyoming |

| AB | Canadian Prov. |
|---|---|
| AB | Alberta |
| BC | British Columbia |
| MB | Manitoba |
| NK | New Brunswick |
| NF | Newfoundland |
| NS | Nova Scotia |
| NT | Northwest Terr. |
| ON | Ontario |
| PE | Prince Edward Is. |
| PQ | Quebec |
| SK | Saskatchewan |
| YT | Yukon |
| NA | Not Available |

# Appendix 3

## DMT testing locations

Aitkin County S.O.
Aitkin Police Dept.
Anoka County S.O. - Andover
Anoka County S.O.
Anoka Police Dept.
Apple Valley Police Dept.
Appleton Police Dept.
Becker County S.O.
Belle Plaine Police Dept.
Beltrami County L.E.C.
Bemidji Police Dept.
Benton County S.O.
Big Lake Police Dept.
Big Stone County S.O.
Blaine Police Dept.
Bloomington Police Dept.
Blue Earth County L.E.C.
Breckenridge Police Dept.
Breezy Point Police Dept.
Breitung Police Dept.
Brooklyn Center Police Dept.
Brooklyn Park Police Dept.
Brown County L.E.C.
Burnsville Police Dept.
Canby Police Dept.
Cannon Falls Police Dept.
Carlton County S.O.
Carver County S.O.
Cass County L.E.C.
Centennial Lakes P.D.
Champlin Police Dept.
Chatfield Police Dept.
Chippewa County S.O.
Chisholm Police Dept.
Clay County S.O.
Clearwater County L.E.C.
Columbia Heights Police Dept.
Cook County S.O.
Coon Rapids Police Dept.
Corcoran Police Dept.
Cottage Grove Police Dept.
Cottonwood County L.E.C.
Crookston Police Dept.
Crosby-Ironton Police Dept.
Crow Wing County S.O.
Crystal Police Dept.
Dakota County S.O.
Deephaven Police Dept.
Dodge County S.O.
Douglas County S.O.
Duluth Police Dept.
Duluth Police Dept. - West
Eagan Police Dept.
East Grand Forks Police Dept.
East Range Police Dept.
Eden Prairie Police Dept.
Edina Police Dept.
Elko New Market Police Dept.
Ely Police Dept.
Faribault County S.O.
Farmington Police Dept.
Fillmore County S.O.
Floodwood Police Dept.
Forest Lake Police Dept.
Freeborn County L.E.C.
Fridley Police Dept.
Golden Valley Police Dept.
Goodhue County S.O.
Grant County S.O.
Hennepin County S.O. - Brooklyn Park
Hennepin County S.O. - Water Patrol
Hermantown Police Dept.
Hibbing Police Dept.
Hopkins Police Dept.
Houston County S.O.
Hubbard County L.E.C.
Hutchinson Police Dept.
International Airport P.D.
International Falls P.D.
Inver Grove Heights P.D.
Isanti County S.O.
Itasca County S.O.
Jackson County L.E.C.
Jordan Police Dept.
Kanabec County S.O.
Kittson County S.O.
La Crescent Police Dept.
Lac Qui Parle County S.O.
Lake City Police Dept.
Lake County L.E.C.
Lake of the Woods County S.O.
Lakes Area Police Dept.
Lakeville Police Dept.
Leech Lake Tribal Police Dept.
Le Sueur County S.O.
Le Sueur Police Dept.
Lincoln County S.O.
Lino Lakes Police Dept.
Mahnomen County S.O.
Maple Grove Police Dept.
Maplewood Police Dept.
Marshall County L.E.C.
Marshall Police Dept.
Martin County L.E.C.
McLeod County S.O.
Medina Police Dept.
Meeker County L.E.C.
Melrose Police Dept.
Mendota Heights Police Dept.
Mille Lacs County S.O.
Mille Lacs Tribal Police Dept.
Minneapolis Police Dept.
Minnetonka Police Dept.
Minnetrista Police Dept.
Morrison County S.O.
Mounds View Police Dept.
Mower County L.E.C.
MSP East Metro
MSP Golden Valley
MSP Hennepin Co
MSP Olmsted Co
Murray County L.E.C.
New Brighton Police Dept.
New Hope Police Dept.
New Prague Police Dept.

Nicollet County S.O.
Nobles County L.E.C.
Norman County S.O.
North Mankato Police Dept.
North St. Paul Police Dept.
Northfield Police Dept.
Olmsted County S.O.
Orono Police Dept.
Osseo Police Dept.
Otter Tail County Adult Detention Center
Otter Tail Co S.O. - Ottertail
Paynesville Police Dept.
Pelican Rapids Police Dept.
Pennington County L.E.C.
Perham Police Dept.
Pine County S.O.
Pipestone County S.O.
Plainview Police Dept.
Plymouth Police Dept.
Polk County S.O. - Fosston
Pope County S.O.
Princeton Police Dept.
Prior Lake Police Dept.
Ramsey County S.O.
Ramsey Police Dept.
Red Lake Tribal Police Dept.
Red Lake County S.O.
Redwood County L.E.C.
Renville County S.O.
Rice County S.O.
Richfield Police Dept.
Robbinsdale Police Dept.
Rochester Police Dept.
Rock County S.O.
Rogers Police Dept.
Roseau County S.O.
Rosemount Police Dept.
Roseville Police Dept.
Sartell Police Dept.
Sauk Centre Police Dept.
Sauk Rapids Police Dept.
Savage Police Dept.
Scott County S.O.
Shakopee Police Dept.
Sherburne County S.O.
Sibley County S.O.
Silver Bay Police Dept.
South Lake Minnetonka P.D.
South St. Paul Police Dept.
Spring Lake Park Police Dept.
St. Anthony Police Dept.
St. Charles Police Dept.
St. Cloud Police Dept.
St. Francis Police Dept.
St. Joseph Police Dept.
St. Louis County S.O. - Cook
St. Louis County S.O. – Duluth Jail
St. Louis County S.O. – Virginia Jail
St. Louis Park Police Dept.
St. Paul Police Dept.
Staples Police Dept.
Steele County S.O.
Stevens County S.O.
Swift County S.O.
Todd County S.O.
Traverse County S.O.
U of M Police Dept. - Twin Cities
Wabasha County S.O.
Wadena County S.O.
Waite Park Police Dept.
Waseca County S.O.
Washington County S.O.
Watonwan County S.O.
Wayzata Police Dept.
West Hennepin P.S.D.
West St. Paul Police Dept.
White Bear Lake Police Dept.
Willmar Police Dept.
Winona County L.E.C.
Woodbury Police Dept.
Wright County L.E.C.
Yellow Medicine County S.O.
Zumbrota Police Dept.

Replacement units available at these locations:

BCA Laboratory – St. Paul
MSP 2100 Rochester
MSP 2200 Mankato
MSP 2300 Marshall
MSP 2600 St. Cloud
MSP 2700 Duluth
MSP 2800 Brainerd
MSP 2900 Detroit Lakes
MSP 3100 Virginia
MSP 3200 Thief River Falls

# Appendix 4

## Forced Vital Capacity Tables – General Information

The following tables were sourced from the Occupational Safety and Health Administration manual titled 'Spirometry Testing in Occupational Health Programs - Best Practices for Healthcare Professions,' Appendix A (see OSHA.gov). The table values were derived from the National Health and Nutrition Examination Survey (NHANES) III study, which conducted spirometry tests on a diverse U.S. population that included 8 to 80-year-old male and female non-smoking Caucasians, African Americans and Mexican Americans living in various locations across the United States.

Please Note: these tables are provided for reference only and determination of fitness to provide a DMT breath sample is left to the operator's discretion based on the totality of the circumstances.

Forced Vital Capacity (FVC) is the total volume of air expired after a full inspiration. The Lower Limit of the Normal Range (LLN) is defined so that 95 percent of a "normal" nonsmoking population will have values above the LLN and only 5 percent of a "normal" population will have values below the LLN.

Tables 1 through 12 on pages 135 through 140 list the average predicted FVC and the average LLN for FVC for Caucasian Males, African American Males, Mexican American Males, Caucasian Females, African American Females, and Mexican American Females, respectively.

To find the average predicted FVC and LLN values for Asian Americans, multiply values for Caucasians by 0.88.

Example:

What is the average predicted FVC for a 30-year-old, 5'2" (62 in.) tall Asian American female?

Convert the average predicted FVC from Caucasian American Female to Asian American Female:

→ 3.54 (average predicted FVC for a female Caucasian of the same age and height) x .88 (conversion factor)

→= approximately 3.1152 liters

Table 1

## Predicted FVC (L) - Caucasian Males - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 58.0 | 3.40 | 3.76 | 3.74 | 3.71 | 3.69 | 3.66 | 3.63 | 3.60 | 3.56 | 3.53 | 3.49 | 3.45 | 3.40 | 3.36 | 3.31 | 3.26 | 3.21 | 3.16 | 3.10 | 3.04 | 2.98 | 2.92 | 2.86 | 2.79 | 2.72 | 2.65 | 2.58 |
| 59.0 | 3.54 | 3.90 | 3.88 | 3.85 | 3.83 | 3.80 | 3.77 | 3.74 | 3.70 | 3.67 | 3.63 | 3.59 | 3.55 | 3.50 | 3.45 | 3.40 | 3.35 | 3.30 | 3.24 | 3.19 | 3.13 | 3.06 | 3.00 | 2.93 | 2.86 | 2.79 | 2.72 |
| 60.0 | 3.68 | 4.04 | 4.02 | 4.00 | 3.97 | 3.94 | 3.91 | 3.88 | 3.85 | 3.81 | 3.77 | 3.73 | 3.69 | 3.64 | 3.60 | 3.55 | 3.50 | 3.44 | 3.39 | 3.33 | 3.27 | 3.21 | 3.14 | 3.08 | 3.01 | 2.94 | 2.86 |
| 61.0 | 3.83 | 4.19 | 4.17 | 4.14 | 4.12 | 4.09 | 4.06 | 4.03 | 3.99 | 3.96 | 3.92 | 3.88 | 3.83 | 3.79 | 3.74 | 3.69 | 3.64 | 3.59 | 3.53 | 3.47 | 3.41 | 3.35 | 3.29 | 3.22 | 3.15 | 3.08 | 3.01 |
| 62.0 | 3.97 | 4.34 | 4.31 | 4.29 | 4.26 | 4.24 | 4.21 | 4.17 | 4.14 | 4.10 | 4.07 | 4.03 | 3.98 | 3.94 | 3.89 | 3.84 | 3.79 | 3.74 | 3.68 | 3.62 | 3.56 | 3.50 | 3.44 | 3.37 | 3.30 | 3.23 | 3.16 |
| 63.0 | 4.12 | 4.49 | 4.46 | 4.44 | 4.42 | 4.39 | 4.36 | 4.33 | 4.29 | 4.25 | 4.22 | 4.18 | 4.13 | 4.09 | 4.04 | 3.99 | 3.94 | 3.89 | 3.83 | 3.77 | 3.71 | 3.65 | 3.59 | 3.52 | 3.45 | 3.38 | 3.31 |
| 64.0 | 4.28 | 4.64 | 4.62 | 4.59 | 4.57 | 4.54 | 4.51 | 4.48 | 4.44 | 4.41 | 4.37 | 4.33 | 4.29 | 4.24 | 4.19 | 4.14 | 4.09 | 4.04 | 3.98 | 3.93 | 3.87 | 3.80 | 3.74 | 3.67 | 3.60 | 3.53 | 3.46 |
| 65.0 | 4.43 | 4.79 | 4.77 | 4.75 | 4.72 | 4.70 | 4.67 | 4.63 | 4.60 | 4.56 | 4.52 | 4.48 | 4.44 | 4.40 | 4.35 | 4.30 | 4.25 | 4.19 | 4.14 | 4.08 | 4.02 | 3.96 | 3.89 | 3.83 | 3.76 | 3.69 | 3.61 |
| 66.0 | 4.59 | 4.95 | 4.93 | 4.91 | 4.88 | 4.85 | 4.82 | 4.79 | 4.76 | 4.72 | 4.68 | 4.64 | 4.60 | 4.55 | 4.51 | 4.46 | 4.41 | 4.35 | 4.30 | 4.24 | 4.18 | 4.12 | 4.05 | 3.98 | 3.92 | 3.85 | 3.77 |
| 67.0 | 4.75 | 5.11 | 5.09 | 5.07 | 5.04 | 5.01 | 4.98 | 4.95 | 4.92 | 4.88 | 4.84 | 4.80 | 4.76 | 4.71 | 4.67 | 4.62 | 4.57 | 4.51 | 4.46 | 4.40 | 4.34 | 4.28 | 4.21 | 4.14 | 4.08 | 4.01 | 3.93 |
| 68.0 | 4.91 | 5.27 | 5.25 | 5.23 | 5.20 | 5.18 | 5.15 | 5.11 | 5.08 | 5.04 | 5.00 | 4.96 | 4.92 | 4.88 | 4.83 | 4.78 | 4.73 | 4.67 | 4.62 | 4.56 | 4.50 | 4.44 | 4.37 | 4.31 | 4.24 | 4.17 | 4.09 |
| 69.0 | 5.08 | 5.44 | 5.42 | 5.39 | 5.37 | 5.34 | 5.31 | 5.28 | 5.24 | 5.21 | 5.17 | 5.13 | 5.09 | 5.04 | 4.99 | 4.94 | 4.89 | 4.84 | 4.78 | 4.73 | 4.66 | 4.60 | 4.54 | 4.47 | 4.40 | 4.33 | 4.26 |
| 70.0 | 5.24 | 5.61 | 5.58 | 5.56 | 5.53 | 5.51 | 5.48 | 5.44 | 5.41 | 5.37 | 5.34 | 5.30 | 5.25 | 5.21 | 5.16 | 5.11 | 5.06 | 5.01 | 4.95 | 4.89 | 4.83 | 4.77 | 4.71 | 4.64 | 4.57 | 4.50 | 4.43 |
| 71.0 | 5.41 | 5.77 | 5.75 | 5.73 | 5.70 | 5.68 | 5.65 | 5.61 | 5.58 | 5.54 | 5.51 | 5.46 | 5.42 | 5.38 | 5.33 | 5.28 | 5.23 | 5.18 | 5.12 | 5.06 | 5.00 | 4.94 | 4.88 | 4.81 | 4.74 | 4.67 | 4.60 |
| 72.0 | 5.58 | 5.95 | 5.93 | 5.90 | 5.88 | 5.85 | 5.82 | 5.79 | 5.75 | 5.72 | 5.68 | 5.64 | 5.59 | 5.55 | 5.50 | 5.45 | 5.40 | 5.35 | 5.29 | 5.23 | 5.17 | 5.11 | 5.05 | 4.98 | 4.91 | 4.84 | 4.77 |
| 73.0 | 5.76 | 6.12 | 6.10 | 6.08 | 6.05 | 6.02 | 5.99 | 5.96 | 5.93 | 5.89 | 5.85 | 5.81 | 5.77 | 5.72 | 5.68 | 5.63 | 5.58 | 5.52 | 5.47 | 5.41 | 5.35 | 5.29 | 5.22 | 5.16 | 5.09 | 5.02 | 4.94 |
| 74.0 | 5.94 | 6.30 | 6.28 | 6.25 | 6.23 | 6.20 | 6.17 | 6.14 | 6.10 | 6.07 | 6.03 | 5.99 | 5.95 | 5.90 | 5.85 | 5.80 | 5.75 | 5.70 | 5.64 | 5.58 | 5.52 | 5.46 | 5.40 | 5.33 | 5.26 | 5.19 | 5.12 |
| 75.0 | 6.12 | 6.48 | 6.46 | 6.43 | 6.41 | 6.38 | 6.35 | 6.32 | 6.28 | 6.25 | 6.21 | 6.17 | 6.12 | 6.08 | 6.03 | 5.98 | 5.93 | 5.88 | 5.82 | 5.76 | 5.70 | 5.64 | 5.58 | 5.51 | 5.44 | 5.37 | 5.30 |
| 76.0 | 6.30 | 6.66 | 6.64 | 6.61 | 6.59 | 6.56 | 6.53 | 6.50 | 6.46 | 6.43 | 6.39 | 6.35 | 6.31 | 6.26 | 6.21 | 6.16 | 6.11 | 6.06 | 6.00 | 5.95 | 5.89 | 5.82 | 5.76 | 5.69 | 5.62 | 5.55 | 5.48 |
| 77.0 | 6.48 | 6.84 | 6.82 | 6.80 | 6.77 | 6.74 | 6.71 | 6.68 | 6.65 | 6.61 | 6.57 | 6.53 | 6.49 | 6.44 | 6.40 | 6.35 | 6.30 | 6.24 | 6.19 | 6.13 | 6.07 | 6.01 | 5.94 | 5.88 | 5.81 | 5.74 | 5.66 |
| 78.0 | 6.67 | 7.03 | 7.01 | 6.98 | 6.96 | 6.93 | 6.90 | 6.87 | 6.83 | 6.80 | 6.76 | 6.72 | 6.68 | 6.63 | 6.58 | 6.53 | 6.48 | 6.43 | 6.37 | 6.32 | 6.26 | 6.19 | 6.13 | 6.06 | 5.99 | 5.92 | 5.85 |
| 79.0 | 6.86 | 7.22 | 7.20 | 7.17 | 7.15 | 7.12 | 7.09 | 7.06 | 7.02 | 6.99 | 6.95 | 6.91 | 6.87 | 6.82 | 6.77 | 6.72 | 6.67 | 6.62 | 6.56 | 6.51 | 6.45 | 6.38 | 6.32 | 6.25 | 6.18 | 6.11 | 6.04 |
| 80.0 | 7.05 | 7.41 | 7.39 | 7.36 | 7.34 | 7.31 | 7.28 | 7.25 | 7.21 | 7.18 | 7.14 | 7.10 | 7.06 | 7.01 | 6.96 | 6.91 | 6.86 | 6.81 | 6.75 | 6.70 | 6.64 | 6.57 | 6.51 | 6.44 | 6.37 | 6.30 | 6.23 |

Table 2

## LLN for FVC (L) - Caucasian Males - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 58.0 | 2.76 | 3.12 | 3.10 | 3.07 | 3.05 | 3.02 | 2.99 | 2.96 | 2.92 | 2.89 | 2.85 | 2.81 | 2.77 | 2.72 | 2.67 | 2.62 | 2.57 | 2.52 | 2.46 | 2.41 | 2.35 | 2.28 | 2.22 | 2.15 | 2.08 | 2.01 | 1.94 |
| 59.0 | 2.87 | 3.24 | 3.22 | 3.19 | 3.17 | 3.14 | 3.11 | 3.08 | 3.04 | 3.01 | 2.97 | 2.93 | 2.88 | 2.84 | 2.79 | 2.74 | 2.69 | 2.64 | 2.58 | 2.52 | 2.46 | 2.40 | 2.34 | 2.27 | 2.20 | 2.13 | 2.06 |
| 60.0 | 3.00 | 3.36 | 3.34 | 3.31 | 3.29 | 3.26 | 3.23 | 3.20 | 3.16 | 3.13 | 3.09 | 3.05 | 3.00 | 2.96 | 2.91 | 2.86 | 2.81 | 2.76 | 2.70 | 2.64 | 2.58 | 2.52 | 2.46 | 2.39 | 2.32 | 2.25 | 2.18 |
| 61.0 | 3.12 | 3.48 | 3.46 | 3.43 | 3.41 | 3.38 | 3.35 | 3.32 | 3.29 | 3.25 | 3.21 | 3.17 | 3.13 | 3.08 | 3.03 | 2.99 | 2.93 | 2.88 | 2.82 | 2.77 | 2.71 | 2.64 | 2.58 | 2.51 | 2.44 | 2.37 | 2.30 |
| 62.0 | 3.24 | 3.60 | 3.58 | 3.56 | 3.53 | 3.51 | 3.48 | 3.44 | 3.41 | 3.37 | 3.33 | 3.29 | 3.25 | 3.21 | 3.16 | 3.11 | 3.06 | 3.00 | 2.95 | 2.89 | 2.83 | 2.77 | 2.70 | 2.64 | 2.57 | 2.50 | 2.43 |
| 63.0 | 3.37 | 3.73 | 3.71 | 3.69 | 3.66 | 3.63 | 3.60 | 3.57 | 3.54 | 3.50 | 3.46 | 3.42 | 3.38 | 3.33 | 3.29 | 3.24 | 3.19 | 3.13 | 3.08 | 3.02 | 2.96 | 2.90 | 2.83 | 2.76 | 2.70 | 2.63 | 2.55 |
| 64.0 | 3.50 | 3.86 | 3.84 | 3.81 | 3.79 | 3.76 | 3.73 | 3.70 | 3.67 | 3.63 | 3.59 | 3.55 | 3.51 | 3.46 | 3.41 | 3.37 | 3.31 | 3.26 | 3.20 | 3.15 | 3.09 | 3.02 | 2.96 | 2.89 | 2.82 | 2.75 | 2.68 |
| 65.0 | 3.63 | 3.99 | 3.97 | 3.95 | 3.92 | 3.89 | 3.86 | 3.83 | 3.80 | 3.76 | 3.72 | 3.68 | 3.64 | 3.59 | 3.55 | 3.50 | 3.44 | 3.39 | 3.34 | 3.28 | 3.22 | 3.15 | 3.09 | 3.02 | 2.96 | 2.88 | 2.81 |
| 66.0 | 3.76 | 4.12 | 4.10 | 4.08 | 4.05 | 4.02 | 3.99 | 3.96 | 3.93 | 3.89 | 3.85 | 3.81 | 3.77 | 3.72 | 3.68 | 3.63 | 3.58 | 3.52 | 3.47 | 3.41 | 3.35 | 3.29 | 3.22 | 3.16 | 3.09 | 3.02 | 2.94 |
| 67.0 | 3.90 | 4.26 | 4.24 | 4.21 | 4.19 | 4.16 | 4.13 | 4.10 | 4.06 | 4.03 | 3.99 | 3.95 | 3.90 | 3.86 | 3.81 | 3.76 | 3.71 | 3.66 | 3.60 | 3.54 | 3.48 | 3.42 | 3.36 | 3.29 | 3.22 | 3.15 | 3.08 |
| 68.0 | 4.03 | 4.39 | 4.37 | 4.35 | 4.32 | 4.30 | 4.27 | 4.23 | 4.20 | 4.16 | 4.12 | 4.08 | 4.04 | 4.00 | 3.95 | 3.90 | 3.85 | 3.79 | 3.74 | 3.68 | 3.62 | 3.56 | 3.49 | 3.43 | 3.36 | 3.29 | 3.22 |
| 69.0 | 4.17 | 4.53 | 4.51 | 4.49 | 4.46 | 4.43 | 4.40 | 4.37 | 4.34 | 4.30 | 4.26 | 4.22 | 4.18 | 4.13 | 4.09 | 4.04 | 3.99 | 3.93 | 3.88 | 3.82 | 3.76 | 3.70 | 3.63 | 3.57 | 3.50 | 3.43 | 3.35 |
| 70.0 | 4.31 | 4.67 | 4.65 | 4.63 | 4.60 | 4.58 | 4.55 | 4.51 | 4.48 | 4.44 | 4.40 | 4.36 | 4.32 | 4.28 | 4.23 | 4.18 | 4.13 | 4.07 | 4.02 | 3.96 | 3.90 | 3.84 | 3.77 | 3.71 | 3.64 | 3.57 | 3.50 |
| 71.0 | 4.45 | 4.82 | 4.79 | 4.77 | 4.75 | 4.72 | 4.69 | 4.66 | 4.62 | 4.59 | 4.55 | 4.51 | 4.46 | 4.42 | 4.37 | 4.32 | 4.27 | 4.22 | 4.16 | 4.10 | 4.04 | 3.98 | 3.92 | 3.85 | 3.78 | 3.71 | 3.64 |
| 72.0 | 4.60 | 4.96 | 4.94 | 4.92 | 4.89 | 4.86 | 4.83 | 4.80 | 4.77 | 4.73 | 4.69 | 4.65 | 4.61 | 4.56 | 4.52 | 4.47 | 4.42 | 4.36 | 4.31 | 4.25 | 4.19 | 4.13 | 4.06 | 4.00 | 3.93 | 3.86 | 3.78 |
| 73.0 | 4.75 | 5.11 | 5.09 | 5.06 | 5.04 | 5.01 | 4.98 | 4.95 | 4.91 | 4.88 | 4.84 | 4.80 | 4.76 | 4.71 | 4.66 | 4.61 | 4.56 | 4.51 | 4.45 | 4.39 | 4.33 | 4.27 | 4.21 | 4.14 | 4.07 | 4.00 | 3.93 |
| 74.0 | 4.89 | 5.26 | 5.24 | 5.21 | 5.19 | 5.16 | 5.13 | 5.10 | 5.06 | 5.03 | 4.99 | 4.95 | 4.90 | 4.86 | 4.81 | 4.76 | 4.71 | 4.66 | 4.60 | 4.54 | 4.48 | 4.42 | 4.36 | 4.29 | 4.22 | 4.15 | 4.08 |
| 75.0 | 5.05 | 5.41 | 5.39 | 5.36 | 5.34 | 5.31 | 5.28 | 5.25 | 5.21 | 5.18 | 5.14 | 5.10 | 5.05 | 5.01 | 4.96 | 4.91 | 4.86 | 4.81 | 4.75 | 4.69 | 4.63 | 4.57 | 4.51 | 4.44 | 4.37 | 4.30 | 4.23 |
| 76.0 | 5.20 | 5.56 | 5.54 | 5.52 | 5.49 | 5.46 | 5.43 | 5.40 | 5.37 | 5.33 | 5.29 | 5.25 | 5.21 | 5.16 | 5.12 | 5.07 | 5.01 | 4.96 | 4.91 | 4.85 | 4.79 | 4.73 | 4.66 | 4.59 | 4.53 | 4.46 | 4.38 |
| 77.0 | 5.35 | 5.72 | 5.69 | 5.67 | 5.65 | 5.62 | 5.59 | 5.56 | 5.52 | 5.48 | 5.45 | 5.41 | 5.36 | 5.32 | 5.27 | 5.22 | 5.17 | 5.12 | 5.06 | 5.00 | 4.94 | 4.88 | 4.82 | 4.75 | 4.68 | 4.61 | 4.54 |
| 78.0 | 5.51 | 5.87 | 5.85 | 5.83 | 5.80 | 5.77 | 5.74 | 5.71 | 5.68 | 5.64 | 5.60 | 5.56 | 5.52 | 5.47 | 5.43 | 5.38 | 5.33 | 5.27 | 5.22 | 5.16 | 5.10 | 5.04 | 4.97 | 4.91 | 4.84 | 4.77 | 4.69 |
| 79.0 | 5.67 | 6.03 | 6.01 | 5.99 | 5.96 | 5.93 | 5.90 | 5.87 | 5.84 | 5.80 | 5.76 | 5.72 | 5.68 | 5.63 | 5.59 | 5.54 | 5.49 | 5.43 | 5.38 | 5.32 | 5.26 | 5.20 | 5.13 | 5.07 | 5.00 | 4.93 | 4.85 |
| 80.0 | 5.83 | 6.19 | 6.17 | 6.15 | 6.12 | 6.09 | 6.06 | 6.03 | 6.00 | 5.96 | 5.92 | 5.88 | 5.84 | 5.79 | 5.75 | 5.70 | 5.65 | 5.59 | 5.54 | 5.48 | 5.42 | 5.36 | 5.29 | 5.23 | 5.16 | 5.09 | 5.01 |

Table 3

## Predicted FVC (L) - African American Males - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 60.0 | 3.07 | 3.35 | 3.31 | 3.28 | 3.24 | 3.20 | 3.17 | 3.13 | 3.09 | 3.06 | 3.02 | 2.99 | 2.95 | 2.91 | 2.88 | 2.84 | 2.80 | 2.77 | 2.73 | 2.69 | 2.66 | 2.62 | 2.58 | 2.55 | 2.51 | 2.48 | 2.44 |
| 61.0 | 3.20 | 3.48 | 3.44 | 3.41 | 3.37 | 3.33 | 3.30 | 3.26 | 3.22 | 3.19 | 3.15 | 3.12 | 3.08 | 3.04 | 3.01 | 2.97 | 2.93 | 2.90 | 2.86 | 2.82 | 2.79 | 2.75 | 2.71 | 2.68 | 2.64 | 2.61 | 2.57 |
| 62.0 | 3.34 | 3.61 | 3.58 | 3.54 | 3.50 | 3.47 | 3.43 | 3.39 | 3.36 | 3.32 | 3.28 | 3.25 | 3.21 | 3.17 | 3.14 | 3.10 | 3.07 | 3.03 | 2.99 | 2.96 | 2.92 | 2.88 | 2.85 | 2.81 | 2.77 | 2.74 | 2.70 |
| 63.0 | 3.47 | 3.75 | 3.71 | 3.67 | 3.64 | 3.60 | 3.56 | 3.53 | 3.49 | 3.45 | 3.42 | 3.38 | 3.35 | 3.31 | 3.27 | 3.24 | 3.20 | 3.16 | 3.13 | 3.09 | 3.05 | 3.02 | 2.98 | 2.94 | 2.91 | 2.87 | 2.84 |
| 64.0 | 3.61 | 3.88 | 3.85 | 3.81 | 3.77 | 3.74 | 3.70 | 3.66 | 3.63 | 3.59 | 3.55 | 3.52 | 3.48 | 3.45 | 3.41 | 3.37 | 3.34 | 3.30 | 3.26 | 3.23 | 3.19 | 3.15 | 3.12 | 3.08 | 3.04 | 3.01 | 2.97 |
| 65.0 | 3.75 | 4.02 | 3.98 | 3.95 | 3.91 | 3.87 | 3.84 | 3.80 | 3.77 | 3.73 | 3.69 | 3.66 | 3.62 | 3.58 | 3.55 | 3.51 | 3.47 | 3.44 | 3.40 | 3.37 | 3.33 | 3.29 | 3.26 | 3.22 | 3.18 | 3.15 | 3.11 |
| 66.0 | 3.89 | 4.16 | 4.12 | 4.09 | 4.05 | 4.02 | 3.98 | 3.94 | 3.91 | 3.87 | 3.83 | 3.80 | 3.76 | 3.72 | 3.69 | 3.65 | 3.62 | 3.58 | 3.54 | 3.51 | 3.47 | 3.43 | 3.40 | 3.36 | 3.32 | 3.29 | 3.25 |
| 67.0 | 4.03 | 4.30 | 4.27 | 4.23 | 4.19 | 4.16 | 4.12 | 4.09 | 4.05 | 4.01 | 3.98 | 3.94 | 3.90 | 3.87 | 3.83 | 3.79 | 3.76 | 3.72 | 3.68 | 3.65 | 3.61 | 3.58 | 3.54 | 3.50 | 3.47 | 3.43 | 3.39 |
| 68.0 | 4.17 | 4.45 | 4.41 | 4.38 | 4.34 | 4.30 | 4.27 | 4.23 | 4.19 | 4.16 | 4.12 | 4.08 | 4.05 | 4.01 | 3.98 | 3.94 | 3.90 | 3.87 | 3.83 | 3.79 | 3.76 | 3.72 | 3.68 | 3.65 | 3.61 | 3.57 | 3.54 |
| 69.0 | 4.32 | 4.60 | 4.56 | 4.52 | 4.49 | 4.45 | 4.41 | 4.38 | 4.34 | 4.30 | 4.27 | 4.23 | 4.20 | 4.16 | 4.12 | 4.09 | 4.05 | 4.01 | 3.98 | 3.94 | 3.90 | 3.87 | 3.83 | 3.79 | 3.76 | 3.72 | 3.69 |
| 70.0 | 4.47 | 4.75 | 4.71 | 4.67 | 4.64 | 4.60 | 4.56 | 4.53 | 4.49 | 4.45 | 4.42 | 4.38 | 4.34 | 4.31 | 4.27 | 4.24 | 4.20 | 4.16 | 4.13 | 4.09 | 4.05 | 4.02 | 3.98 | 3.94 | 3.91 | 3.87 | 3.83 |
| 71.0 | 4.62 | 4.90 | 4.86 | 4.82 | 4.79 | 4.75 | 4.71 | 4.68 | 4.64 | 4.61 | 4.57 | 4.53 | 4.50 | 4.46 | 4.42 | 4.39 | 4.35 | 4.31 | 4.28 | 4.24 | 4.20 | 4.17 | 4.13 | 4.10 | 4.06 | 4.02 | 3.99 |
| 72.0 | 4.77 | 5.05 | 5.01 | 4.98 | 4.94 | 4.90 | 4.87 | 4.83 | 4.80 | 4.76 | 4.72 | 4.69 | 4.65 | 4.61 | 4.58 | 4.54 | 4.50 | 4.47 | 4.43 | 4.39 | 4.36 | 4.32 | 4.29 | 4.25 | 4.21 | 4.18 | 4.14 |
| 73.0 | 4.93 | 5.21 | 5.17 | 5.13 | 5.10 | 5.06 | 5.02 | 4.99 | 4.95 | 4.91 | 4.88 | 4.84 | 4.81 | 4.77 | 4.73 | 4.70 | 4.66 | 4.62 | 4.59 | 4.55 | 4.51 | 4.48 | 4.44 | 4.40 | 4.37 | 4.33 | 4.30 |
| 74.0 | 5.09 | 5.36 | 5.33 | 5.29 | 5.25 | 5.22 | 5.18 | 5.15 | 5.11 | 5.07 | 5.04 | 5.00 | 4.96 | 4.93 | 4.89 | 4.85 | 4.82 | 4.78 | 4.74 | 4.71 | 4.67 | 4.64 | 4.60 | 4.56 | 4.53 | 4.49 | 4.45 |
| 75.0 | 5.25 | 5.52 | 5.49 | 5.45 | 5.41 | 5.38 | 5.34 | 5.31 | 5.27 | 5.23 | 5.20 | 5.16 | 5.12 | 5.09 | 5.05 | 5.01 | 4.98 | 4.94 | 4.90 | 4.87 | 4.83 | 4.80 | 4.76 | 4.72 | 4.69 | 4.65 | 4.61 |
| 76.0 | 5.41 | 5.69 | 5.65 | 5.61 | 5.58 | 5.54 | 5.50 | 5.47 | 5.43 | 5.39 | 5.36 | 5.32 | 5.29 | 5.25 | 5.21 | 5.18 | 5.14 | 5.10 | 5.07 | 5.03 | 4.99 | 4.96 | 4.92 | 4.88 | 4.85 | 4.81 | 4.78 |
| 77.0 | 5.57 | 5.85 | 5.81 | 5.78 | 5.74 | 5.70 | 5.67 | 5.63 | 5.60 | 5.56 | 5.52 | 5.49 | 5.45 | 5.41 | 5.38 | 5.34 | 5.30 | 5.27 | 5.23 | 5.19 | 5.16 | 5.12 | 5.09 | 5.05 | 5.01 | 4.98 | 4.94 |
| 78.0 | 5.74 | 6.02 | 5.98 | 5.94 | 5.91 | 5.87 | 5.83 | 5.80 | 5.76 | 5.73 | 5.69 | 5.65 | 5.62 | 5.58 | 5.54 | 5.51 | 5.47 | 5.43 | 5.40 | 5.36 | 5.32 | 5.29 | 5.25 | 5.22 | 5.18 | 5.14 | 5.11 |
| 79.0 | 5.91 | 6.19 | 6.15 | 6.11 | 6.08 | 6.04 | 6.00 | 5.97 | 5.93 | 5.89 | 5.86 | 5.82 | 5.78 | 5.75 | 5.71 | 5.68 | 5.64 | 5.60 | 5.57 | 5.53 | 5.49 | 5.46 | 5.42 | 5.38 | 5.35 | 5.31 | 5.27 |

Table 4

## LLN for FVC (L) - African American Males - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 60.0 | 2.38 | 2.66 | 2.62 | 2.59 | 2.55 | 2.51 | 2.48 | 2.44 | 2.40 | 2.37 | 2.33 | 2.29 | 2.26 | 2.22 | 2.19 | 2.15 | 2.11 | 2.08 | 2.04 | 2.00 | 1.97 | 1.93 | 1.89 | 1.86 | 1.82 | 1.78 | 1.75 |
| 61.0 | 2.49 | 2.77 | 2.73 | 2.69 | 2.66 | 2.62 | 2.58 | 2.55 | 2.51 | 2.47 | 2.44 | 2.40 | 2.37 | 2.33 | 2.29 | 2.26 | 2.22 | 2.18 | 2.15 | 2.11 | 2.07 | 2.04 | 2.00 | 1.96 | 1.93 | 1.89 | 1.86 |
| 62.0 | 2.60 | 2.87 | 2.84 | 2.80 | 2.76 | 2.73 | 2.69 | 2.66 | 2.62 | 2.58 | 2.55 | 2.51 | 2.47 | 2.44 | 2.40 | 2.36 | 2.33 | 2.29 | 2.26 | 2.22 | 2.18 | 2.15 | 2.11 | 2.07 | 2.04 | 2.00 | 1.96 |
| 63.0 | 2.71 | 2.98 | 2.95 | 2.91 | 2.88 | 2.84 | 2.80 | 2.77 | 2.73 | 2.69 | 2.66 | 2.62 | 2.58 | 2.55 | 2.51 | 2.47 | 2.44 | 2.40 | 2.37 | 2.33 | 2.29 | 2.26 | 2.22 | 2.18 | 2.15 | 2.11 | 2.07 |
| 64.0 | 2.82 | 3.10 | 3.06 | 3.02 | 2.99 | 2.95 | 2.91 | 2.88 | 2.84 | 2.81 | 2.77 | 2.73 | 2.70 | 2.66 | 2.62 | 2.59 | 2.55 | 2.51 | 2.48 | 2.44 | 2.40 | 2.37 | 2.33 | 2.30 | 2.26 | 2.22 | 2.19 |
| 65.0 | 2.93 | 3.21 | 3.17 | 3.14 | 3.10 | 3.06 | 3.03 | 2.99 | 2.96 | 2.92 | 2.88 | 2.85 | 2.81 | 2.77 | 2.74 | 2.70 | 2.66 | 2.63 | 2.59 | 2.55 | 2.52 | 2.48 | 2.45 | 2.41 | 2.37 | 2.34 | 2.30 |
| 66.0 | 3.05 | 3.33 | 3.29 | 3.25 | 3.22 | 3.18 | 3.14 | 3.11 | 3.07 | 3.03 | 3.00 | 2.96 | 2.93 | 2.89 | 2.85 | 2.82 | 2.78 | 2.74 | 2.71 | 2.67 | 2.63 | 2.60 | 2.56 | 2.52 | 2.49 | 2.45 | 2.42 |
| 67.0 | 3.17 | 3.44 | 3.41 | 3.37 | 3.33 | 3.30 | 3.26 | 3.22 | 3.19 | 3.15 | 3.12 | 3.08 | 3.04 | 3.01 | 2.97 | 2.93 | 2.90 | 2.86 | 2.82 | 2.79 | 2.75 | 2.71 | 2.68 | 2.64 | 2.61 | 2.57 | 2.53 |
| 68.0 | 3.29 | 3.56 | 3.53 | 3.49 | 3.45 | 3.42 | 3.38 | 3.34 | 3.31 | 3.27 | 3.23 | 3.20 | 3.16 | 3.13 | 3.09 | 3.05 | 3.02 | 2.98 | 2.94 | 2.91 | 2.87 | 2.83 | 2.80 | 2.76 | 2.72 | 2.69 | 2.65 |
| 69.0 | 3.41 | 3.68 | 3.65 | 3.61 | 3.57 | 3.54 | 3.50 | 3.46 | 3.43 | 3.39 | 3.36 | 3.32 | 3.28 | 3.25 | 3.21 | 3.17 | 3.14 | 3.10 | 3.06 | 3.03 | 2.99 | 2.95 | 2.92 | 2.88 | 2.85 | 2.81 | 2.77 |
| 70.0 | 3.53 | 3.81 | 3.77 | 3.73 | 3.70 | 3.66 | 3.62 | 3.59 | 3.55 | 3.51 | 3.48 | 3.44 | 3.40 | 3.37 | 3.33 | 3.30 | 3.26 | 3.22 | 3.19 | 3.15 | 3.11 | 3.08 | 3.04 | 3.00 | 2.97 | 2.93 | 2.90 |
| 71.0 | 3.65 | 3.93 | 3.89 | 3.86 | 3.82 | 3.78 | 3.75 | 3.71 | 3.67 | 3.64 | 3.60 | 3.57 | 3.53 | 3.49 | 3.46 | 3.42 | 3.38 | 3.35 | 3.31 | 3.27 | 3.24 | 3.20 | 3.17 | 3.13 | 3.09 | 3.06 | 3.02 |
| 72.0 | 3.78 | 4.06 | 4.02 | 3.98 | 3.95 | 3.91 | 3.87 | 3.84 | 3.80 | 3.76 | 3.73 | 3.69 | 3.66 | 3.62 | 3.58 | 3.55 | 3.51 | 3.47 | 3.44 | 3.40 | 3.36 | 3.33 | 3.29 | 3.25 | 3.22 | 3.18 | 3.15 |
| 73.0 | 3.91 | 4.18 | 4.15 | 4.11 | 4.07 | 4.04 | 4.00 | 3.97 | 3.93 | 3.89 | 3.86 | 3.82 | 3.78 | 3.75 | 3.71 | 3.67 | 3.64 | 3.60 | 3.56 | 3.53 | 3.49 | 3.46 | 3.42 | 3.38 | 3.35 | 3.31 | 3.27 |
| 74.0 | 4.04 | 4.31 | 4.28 | 4.24 | 4.20 | 4.17 | 4.13 | 4.10 | 4.06 | 4.02 | 3.99 | 3.95 | 3.91 | 3.88 | 3.84 | 3.80 | 3.77 | 3.73 | 3.69 | 3.66 | 3.62 | 3.59 | 3.55 | 3.51 | 3.48 | 3.44 | 3.40 |
| 75.0 | 4.17 | 4.44 | 4.41 | 4.37 | 4.34 | 4.30 | 4.26 | 4.23 | 4.19 | 4.15 | 4.12 | 4.08 | 4.04 | 4.01 | 3.97 | 3.94 | 3.90 | 3.86 | 3.83 | 3.79 | 3.75 | 3.72 | 3.68 | 3.64 | 3.61 | 3.57 | 3.53 |
| 76.0 | 4.30 | 4.58 | 4.54 | 4.51 | 4.47 | 4.43 | 4.40 | 4.36 | 4.32 | 4.29 | 4.25 | 4.21 | 4.18 | 4.14 | 4.10 | 4.07 | 4.03 | 4.00 | 3.96 | 3.92 | 3.89 | 3.85 | 3.81 | 3.78 | 3.74 | 3.70 | 3.67 |
| 77.0 | 4.44 | 4.71 | 4.68 | 4.64 | 4.60 | 4.57 | 4.53 | 4.49 | 4.46 | 4.42 | 4.39 | 4.35 | 4.31 | 4.28 | 4.24 | 4.20 | 4.17 | 4.13 | 4.09 | 4.06 | 4.02 | 3.98 | 3.95 | 3.91 | 3.88 | 3.84 | 3.80 |
| 78.0 | 4.57 | 4.85 | 4.81 | 4.78 | 4.74 | 4.70 | 4.67 | 4.63 | 4.59 | 4.56 | 4.52 | 4.49 | 4.45 | 4.41 | 4.38 | 4.34 | 4.30 | 4.27 | 4.23 | 4.19 | 4.16 | 4.12 | 4.08 | 4.05 | 4.01 | 3.98 | 3.94 |
| 79.0 | 4.71 | 4.99 | 4.95 | 4.92 | 4.88 | 4.84 | 4.81 | 4.77 | 4.73 | 4.70 | 4.66 | 4.62 | 4.59 | 4.55 | 4.51 | 4.48 | 4.44 | 4.41 | 4.37 | 4.33 | 4.30 | 4.26 | 4.22 | 4.19 | 4.15 | 4.11 | 4.08 |

Table 5

## Predicted FVC (L) - Mexican American Males - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 56.0 | 3.28 | 3.59 | 3.56 | 3.52 | 3.49 | 3.45 | 3.41 | 3.37 | 3.33 | 3.29 | 3.24 | 3.20 | 3.15 | 3.10 | 3.05 | 3.00 | 2.94 | 2.89 | 2.83 | 2.77 | 2.71 | 2.65 | 2.59 | 2.53 | 2.46 | 2.40 | 2.33 |
| 57.0 | 3.41 | 3.72 | 3.69 | 3.65 | 3.62 | 3.58 | 3.54 | 3.50 | 3.46 | 3.42 | 3.37 | 3.33 | 3.28 | 3.23 | 3.18 | 3.13 | 3.07 | 3.02 | 2.96 | 2.90 | 2.84 | 2.78 | 2.72 | 2.66 | 2.59 | 2.53 | 2.46 |
| 58.0 | 3.54 | 3.85 | 3.82 | 3.79 | 3.75 | 3.71 | 3.67 | 3.63 | 3.59 | 3.55 | 3.50 | 3.46 | 3.41 | 3.36 | 3.31 | 3.26 | 3.21 | 3.15 | 3.09 | 3.04 | 2.98 | 2.92 | 2.85 | 2.79 | 2.72 | 2.66 | 2.59 |
| 59.0 | 3.68 | 3.99 | 3.96 | 3.92 | 3.89 | 3.85 | 3.81 | 3.77 | 3.73 | 3.68 | 3.64 | 3.59 | 3.55 | 3.50 | 3.45 | 3.39 | 3.34 | 3.28 | 3.23 | 3.17 | 3.11 | 3.05 | 2.99 | 2.92 | 2.86 | 2.79 | 2.72 |
| 60.0 | 3.81 | 4.13 | 4.09 | 4.06 | 4.02 | 3.98 | 3.95 | 3.91 | 3.86 | 3.82 | 3.78 | 3.73 | 3.68 | 3.63 | 3.58 | 3.53 | 3.48 | 3.42 | 3.37 | 3.31 | 3.25 | 3.19 | 3.13 | 3.06 | 3.00 | 2.93 | 2.86 |
| 61.0 | 3.95 | 4.27 | 4.23 | 4.20 | 4.16 | 4.12 | 4.09 | 4.04 | 4.00 | 3.96 | 3.91 | 3.87 | 3.82 | 3.77 | 3.72 | 3.67 | 3.62 | 3.56 | 3.50 | 3.45 | 3.39 | 3.33 | 3.26 | 3.20 | 3.14 | 3.07 | 3.00 |
| 62.0 | 4.09 | 4.41 | 4.37 | 4.34 | 4.30 | 4.27 | 4.23 | 4.19 | 4.14 | 4.10 | 4.06 | 4.01 | 3.96 | 3.91 | 3.86 | 3.81 | 3.76 | 3.70 | 3.65 | 3.59 | 3.53 | 3.47 | 3.41 | 3.34 | 3.28 | 3.21 | 3.14 |
| 63.0 | 4.24 | 4.55 | 4.52 | 4.48 | 4.45 | 4.41 | 4.37 | 4.33 | 4.29 | 4.24 | 4.20 | 4.15 | 4.11 | 4.06 | 4.01 | 3.95 | 3.90 | 3.85 | 3.79 | 3.73 | 3.67 | 3.61 | 3.55 | 3.49 | 3.42 | 3.35 | 3.29 |
| 64.0 | 4.38 | 4.70 | 4.66 | 4.63 | 4.59 | 4.56 | 4.52 | 4.48 | 4.43 | 4.39 | 4.35 | 4.30 | 4.25 | 4.20 | 4.15 | 4.10 | 4.05 | 3.99 | 3.94 | 3.88 | 3.82 | 3.76 | 3.70 | 3.63 | 3.57 | 3.50 | 3.43 |
| 65.0 | 4.53 | 4.84 | 4.81 | 4.78 | 4.74 | 4.70 | 4.66 | 4.62 | 4.58 | 4.54 | 4.49 | 4.45 | 4.40 | 4.35 | 4.30 | 4.25 | 4.20 | 4.14 | 4.08 | 4.03 | 3.97 | 3.91 | 3.84 | 3.78 | 3.71 | 3.65 | 3.58 |
| 66.0 | 4.68 | 5.00 | 4.96 | 4.93 | 4.89 | 4.85 | 4.82 | 4.77 | 4.73 | 4.69 | 4.65 | 4.60 | 4.55 | 4.50 | 4.45 | 4.40 | 4.35 | 4.29 | 4.23 | 4.18 | 4.12 | 4.06 | 3.99 | 3.93 | 3.87 | 3.80 | 3.73 |
| 67.0 | 4.84 | 5.15 | 5.12 | 5.08 | 5.04 | 5.01 | 4.97 | 4.93 | 4.89 | 4.84 | 4.80 | 4.75 | 4.70 | 4.65 | 4.60 | 4.55 | 4.50 | 4.44 | 4.39 | 4.33 | 4.27 | 4.21 | 4.15 | 4.08 | 4.02 | 3.95 | 3.88 |
| 68.0 | 4.99 | 5.30 | 5.27 | 5.24 | 5.20 | 5.16 | 5.12 | 5.08 | 5.04 | 5.00 | 4.95 | 4.91 | 4.86 | 4.81 | 4.76 | 4.71 | 4.65 | 4.60 | 4.54 | 4.48 | 4.43 | 4.36 | 4.30 | 4.24 | 4.17 | 4.11 | 4.04 |
| 69.0 | 5.15 | 5.46 | 5.43 | 5.39 | 5.36 | 5.32 | 5.28 | 5.24 | 5.20 | 5.16 | 5.11 | 5.06 | 5.02 | 4.97 | 4.92 | 4.87 | 4.81 | 4.76 | 4.70 | 4.64 | 4.58 | 4.52 | 4.46 | 4.40 | 4.33 | 4.26 | 4.20 |
| 70.0 | 5.31 | 5.62 | 5.59 | 5.55 | 5.52 | 5.48 | 5.44 | 5.40 | 5.36 | 5.32 | 5.27 | 5.22 | 5.18 | 5.13 | 5.08 | 5.02 | 4.97 | 4.92 | 4.86 | 4.80 | 4.74 | 4.68 | 4.62 | 4.56 | 4.49 | 4.42 | 4.36 |
| 71.0 | 5.47 | 5.78 | 5.75 | 5.72 | 5.68 | 5.64 | 5.60 | 5.56 | 5.52 | 5.48 | 5.43 | 5.39 | 5.34 | 5.29 | 5.24 | 5.19 | 5.13 | 5.08 | 5.02 | 4.96 | 4.91 | 4.84 | 4.78 | 4.72 | 4.65 | 4.59 | 4.52 |
| 72.0 | 5.63 | 5.95 | 5.91 | 5.88 | 5.84 | 5.81 | 5.77 | 5.73 | 5.69 | 5.64 | 5.60 | 5.55 | 5.50 | 5.45 | 5.40 | 5.35 | 5.30 | 5.24 | 5.19 | 5.13 | 5.07 | 5.01 | 4.95 | 4.88 | 4.82 | 4.75 | 4.68 |
| 73.0 | 5.80 | 6.11 | 6.08 | 6.05 | 6.01 | 5.97 | 5.93 | 5.89 | 5.85 | 5.81 | 5.76 | 5.72 | 5.67 | 5.62 | 5.57 | 5.52 | 5.46 | 5.41 | 5.35 | 5.30 | 5.24 | 5.18 | 5.11 | 5.05 | 4.98 | 4.92 | 4.85 |
| 74.0 | 5.97 | 6.28 | 6.25 | 6.22 | 6.18 | 6.14 | 6.10 | 6.06 | 6.02 | 5.98 | 5.93 | 5.89 | 5.84 | 5.79 | 5.74 | 5.69 | 5.63 | 5.58 | 5.52 | 5.46 | 5.41 | 5.34 | 5.28 | 5.22 | 5.15 | 5.09 | 5.02 |
| 75.0 | 6.14 | 6.45 | 6.42 | 6.39 | 6.35 | 6.31 | 6.27 | 6.23 | 6.19 | 6.15 | 6.10 | 6.06 | 6.01 | 5.96 | 5.91 | 5.86 | 5.81 | 5.75 | 5.69 | 5.64 | 5.58 | 5.52 | 5.45 | 5.39 | 5.32 | 5.26 | 5.19 |
| 76.0 | 6.32 | 6.63 | 6.60 | 6.56 | 6.52 | 6.49 | 6.45 | 6.41 | 6.37 | 6.32 | 6.28 | 6.23 | 6.18 | 6.13 | 6.08 | 6.03 | 5.98 | 5.92 | 5.87 | 5.81 | 5.75 | 5.69 | 5.63 | 5.56 | 5.50 | 5.43 | 5.36 |
| 77.0 | 6.49 | 6.80 | 6.77 | 6.74 | 6.70 | 6.66 | 6.62 | 6.58 | 6.54 | 6.50 | 6.45 | 6.41 | 6.36 | 6.31 | 6.26 | 6.21 | 6.15 | 6.10 | 6.04 | 5.99 | 5.93 | 5.87 | 5.80 | 5.74 | 5.67 | 5.61 | 5.54 |
| 78.0 | 6.67 | 6.98 | 6.95 | 6.91 | 6.88 | 6.84 | 6.80 | 6.76 | 6.72 | 6.68 | 6.63 | 6.59 | 6.54 | 6.49 | 6.44 | 6.39 | 6.33 | 6.28 | 6.22 | 6.16 | 6.10 | 6.04 | 5.98 | 5.92 | 5.85 | 5.79 | 5.72 |

Table 6

## LLN for FVC (L) - Mexican American Males - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 56.0 | 2.70 | 3.01 | 2.98 | 2.94 | 2.91 | 2.87 | 2.83 | 2.79 | 2.75 | 2.71 | 2.66 | 2.61 | 2.57 | 2.52 | 2.47 | 2.41 | 2.36 | 2.31 | 2.25 | 2.19 | 2.13 | 2.07 | 2.01 | 1.95 | 1.88 | 1.81 | 1.75 |
| 57.0 | 2.81 | 3.12 | 3.09 | 3.05 | 3.02 | 2.98 | 2.94 | 2.90 | 2.86 | 2.81 | 2.77 | 2.72 | 2.68 | 2.63 | 2.58 | 2.52 | 2.47 | 2.42 | 2.36 | 2.30 | 2.24 | 2.18 | 2.12 | 2.05 | 1.99 | 1.92 | 1.86 |
| 58.0 | 2.92 | 3.23 | 3.20 | 3.16 | 3.13 | 3.09 | 3.05 | 3.01 | 2.97 | 2.92 | 2.88 | 2.83 | 2.79 | 2.74 | 2.69 | 2.63 | 2.58 | 2.53 | 2.47 | 2.41 | 2.35 | 2.29 | 2.23 | 2.17 | 2.10 | 2.03 | 1.97 |
| 59.0 | 3.03 | 3.34 | 3.31 | 3.28 | 3.24 | 3.20 | 3.16 | 3.12 | 3.08 | 3.04 | 2.99 | 2.95 | 2.90 | 2.85 | 2.80 | 2.75 | 2.69 | 2.64 | 2.58 | 2.52 | 2.47 | 2.40 | 2.34 | 2.28 | 2.21 | 2.15 | 2.08 |
| 60.0 | 3.15 | 3.46 | 3.43 | 3.39 | 3.35 | 3.32 | 3.28 | 3.24 | 3.20 | 3.15 | 3.11 | 3.06 | 3.01 | 2.96 | 2.91 | 2.86 | 2.81 | 2.75 | 2.70 | 2.64 | 2.58 | 2.52 | 2.46 | 2.39 | 2.33 | 2.26 | 2.19 |
| 61.0 | 3.26 | 3.57 | 3.54 | 3.51 | 3.47 | 3.43 | 3.39 | 3.35 | 3.31 | 3.27 | 3.22 | 3.18 | 3.13 | 3.08 | 3.03 | 2.98 | 2.93 | 2.87 | 2.81 | 2.76 | 2.70 | 2.64 | 2.57 | 2.51 | 2.44 | 2.38 | 2.31 |
| 62.0 | 3.38 | 3.69 | 3.66 | 3.63 | 3.59 | 3.55 | 3.51 | 3.47 | 3.43 | 3.39 | 3.34 | 3.30 | 3.25 | 3.20 | 3.15 | 3.10 | 3.04 | 2.99 | 2.93 | 2.87 | 2.82 | 2.75 | 2.69 | 2.63 | 2.56 | 2.50 | 2.43 |
| 63.0 | 3.50 | 3.81 | 3.78 | 3.75 | 3.71 | 3.67 | 3.63 | 3.59 | 3.55 | 3.51 | 3.46 | 3.42 | 3.37 | 3.32 | 3.27 | 3.22 | 3.16 | 3.11 | 3.05 | 3.00 | 2.94 | 2.88 | 2.81 | 2.75 | 2.68 | 2.62 | 2.55 |
| 64.0 | 3.62 | 3.94 | 3.90 | 3.87 | 3.83 | 3.80 | 3.76 | 3.72 | 3.67 | 3.63 | 3.59 | 3.54 | 3.49 | 3.44 | 3.39 | 3.34 | 3.29 | 3.23 | 3.18 | 3.12 | 3.06 | 3.00 | 2.94 | 2.87 | 2.81 | 2.74 | 2.67 |
| 65.0 | 3.75 | 4.06 | 4.03 | 3.99 | 3.96 | 3.92 | 3.88 | 3.84 | 3.80 | 3.76 | 3.71 | 3.66 | 3.62 | 3.57 | 3.52 | 3.46 | 3.41 | 3.36 | 3.30 | 3.24 | 3.18 | 3.12 | 3.06 | 3.00 | 2.93 | 2.86 | 2.80 |
| 66.0 | 3.87 | 4.19 | 4.15 | 4.12 | 4.08 | 4.05 | 4.01 | 3.97 | 3.92 | 3.88 | 3.84 | 3.79 | 3.74 | 3.69 | 3.64 | 3.59 | 3.54 | 3.48 | 3.43 | 3.37 | 3.31 | 3.25 | 3.19 | 3.12 | 3.06 | 2.99 | 2.92 |
| 67.0 | 4.00 | 4.32 | 4.28 | 4.25 | 4.21 | 4.17 | 4.14 | 4.09 | 4.05 | 4.01 | 3.97 | 3.92 | 3.87 | 3.82 | 3.77 | 3.72 | 3.67 | 3.61 | 3.55 | 3.50 | 3.44 | 3.38 | 3.31 | 3.25 | 3.19 | 3.12 | 3.05 |
| 68.0 | 4.13 | 4.45 | 4.41 | 4.38 | 4.34 | 4.30 | 4.27 | 4.23 | 4.18 | 4.14 | 4.10 | 4.05 | 4.00 | 3.95 | 3.90 | 3.85 | 3.80 | 3.74 | 3.68 | 3.63 | 3.57 | 3.51 | 3.44 | 3.38 | 3.32 | 3.25 | 3.18 |
| 69.0 | 4.26 | 4.58 | 4.54 | 4.51 | 4.47 | 4.44 | 4.40 | 4.36 | 4.32 | 4.27 | 4.23 | 4.18 | 4.13 | 4.08 | 4.03 | 3.98 | 3.93 | 3.87 | 3.82 | 3.76 | 3.70 | 3.64 | 3.58 | 3.51 | 3.45 | 3.38 | 3.31 |
| 70.0 | 4.40 | 4.71 | 4.68 | 4.64 | 4.61 | 4.57 | 4.53 | 4.49 | 4.45 | 4.41 | 4.36 | 4.32 | 4.27 | 4.22 | 4.17 | 4.12 | 4.06 | 4.01 | 3.95 | 3.89 | 3.83 | 3.77 | 3.71 | 3.65 | 3.58 | 3.52 | 3.45 |
| 71.0 | 4.53 | 4.85 | 4.81 | 4.78 | 4.74 | 4.71 | 4.67 | 4.63 | 4.59 | 4.54 | 4.50 | 4.45 | 4.40 | 4.35 | 4.30 | 4.25 | 4.20 | 4.14 | 4.09 | 4.03 | 3.97 | 3.91 | 3.85 | 3.78 | 3.72 | 3.65 | 3.58 |
| 72.0 | 4.67 | 4.99 | 4.95 | 4.92 | 4.88 | 4.84 | 4.81 | 4.77 | 4.72 | 4.68 | 4.64 | 4.59 | 4.54 | 4.49 | 4.44 | 4.39 | 4.34 | 4.28 | 4.22 | 4.17 | 4.11 | 4.05 | 3.98 | 3.92 | 3.86 | 3.79 | 3.72 |
| 73.0 | 4.81 | 5.13 | 5.09 | 5.06 | 5.02 | 4.98 | 4.95 | 4.90 | 4.86 | 4.82 | 4.78 | 4.73 | 4.68 | 4.63 | 4.58 | 4.53 | 4.48 | 4.42 | 4.36 | 4.31 | 4.25 | 4.19 | 4.12 | 4.06 | 4.00 | 3.93 | 3.86 |
| 74.0 | 4.95 | 5.27 | 5.23 | 5.20 | 5.16 | 5.13 | 5.09 | 5.05 | 5.00 | 4.96 | 4.92 | 4.87 | 4.82 | 4.77 | 4.72 | 4.67 | 4.62 | 4.56 | 4.51 | 4.45 | 4.39 | 4.33 | 4.27 | 4.20 | 4.14 | 4.07 | 4.00 |
| 75.0 | 5.10 | 5.41 | 5.38 | 5.34 | 5.31 | 5.27 | 5.23 | 5.19 | 5.15 | 5.11 | 5.06 | 5.01 | 4.97 | 4.92 | 4.87 | 4.81 | 4.76 | 4.71 | 4.65 | 4.59 | 4.53 | 4.47 | 4.41 | 4.35 | 4.28 | 4.21 | 4.15 |
| 76.0 | 5.24 | 5.56 | 5.52 | 5.49 | 5.45 | 5.42 | 5.38 | 5.34 | 5.29 | 5.25 | 5.21 | 5.16 | 5.11 | 5.06 | 5.01 | 4.96 | 4.91 | 4.85 | 4.80 | 4.74 | 4.68 | 4.62 | 4.56 | 4.49 | 4.43 | 4.36 | 4.29 |
| 77.0 | 5.39 | 5.70 | 5.67 | 5.64 | 5.60 | 5.56 | 5.52 | 5.48 | 5.44 | 5.40 | 5.35 | 5.31 | 5.26 | 5.21 | 5.16 | 5.11 | 5.05 | 5.00 | 4.94 | 4.89 | 4.83 | 4.77 | 4.70 | 4.64 | 4.57 | 4.51 | 4.44 |
| 78.0 | 5.54 | 5.85 | 5.82 | 5.79 | 5.75 | 5.71 | 5.67 | 5.63 | 5.59 | 5.55 | 5.50 | 5.46 | 5.41 | 5.36 | 5.31 | 5.26 | 5.20 | 5.15 | 5.09 | 5.03 | 4.98 | 4.91 | 4.85 | 4.79 | 4.72 | 4.66 | 4.59 |

Table 7

## Predicted FVC (L) - Caucasian Females - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 57.0 | 2.96 | 2.97 | 2.98 | 2.98 | 2.98 | 2.97 | 2.97 | 2.96 | 2.94 | 2.93 | 2.91 | 2.89 | 2.86 | 2.83 | 2.80 | 2.77 | 2.73 | 2.69 | 2.65 | 2.60 | 2.55 | 2.50 | 2.44 | 2.38 | 2.32 | 2.25 | 2.19 |
| 58.0 | 3.07 | 3.08 | 3.09 | 3.09 | 3.09 | 3.08 | 3.08 | 3.07 | 3.05 | 3.04 | 3.02 | 3.00 | 2.97 | 2.94 | 2.91 | 2.88 | 2.84 | 2.80 | 2.76 | 2.71 | 2.66 | 2.61 | 2.55 | 2.49 | 2.43 | 2.36 | 2.30 |
| 59.0 | 3.18 | 3.19 | 3.20 | 3.20 | 3.20 | 3.20 | 3.19 | 3.18 | 3.17 | 3.15 | 3.13 | 3.11 | 3.08 | 3.05 | 3.02 | 2.99 | 2.95 | 2.91 | 2.87 | 2.82 | 2.77 | 2.72 | 2.66 | 2.60 | 2.54 | 2.48 | 2.41 |
| 60.0 | 3.30 | 3.31 | 3.31 | 3.31 | 3.31 | 3.31 | 3.30 | 3.29 | 3.28 | 3.26 | 3.24 | 3.22 | 3.20 | 3.17 | 3.14 | 3.10 | 3.06 | 3.02 | 2.98 | 2.93 | 2.88 | 2.83 | 2.78 | 2.72 | 2.66 | 2.59 | 2.52 |
| 61.0 | 3.41 | 3.42 | 3.43 | 3.43 | 3.43 | 3.42 | 3.42 | 3.41 | 3.39 | 3.38 | 3.36 | 3.34 | 3.31 | 3.28 | 3.25 | 3.22 | 3.18 | 3.14 | 3.10 | 3.05 | 3.00 | 2.95 | 2.89 | 2.83 | 2.77 | 2.71 | 2.64 |
| 62.0 | 3.53 | 3.54 | 3.54 | 3.55 | 3.55 | 3.54 | 3.54 | 3.53 | 3.51 | 3.50 | 3.48 | 3.45 | 3.43 | 3.40 | 3.37 | 3.34 | 3.30 | 3.26 | 3.21 | 3.17 | 3.12 | 3.06 | 3.01 | 2.95 | 2.89 | 2.82 | 2.76 |
| 63.0 | 3.65 | 3.66 | 3.66 | 3.67 | 3.67 | 3.66 | 3.65 | 3.64 | 3.63 | 3.62 | 3.60 | 3.57 | 3.55 | 3.52 | 3.49 | 3.46 | 3.42 | 3.38 | 3.33 | 3.29 | 3.24 | 3.18 | 3.13 | 3.07 | 3.01 | 2.94 | 2.87 |
| 64.0 | 3.77 | 3.78 | 3.79 | 3.79 | 3.79 | 3.78 | 3.78 | 3.77 | 3.75 | 3.74 | 3.72 | 3.70 | 3.67 | 3.64 | 3.61 | 3.58 | 3.54 | 3.50 | 3.45 | 3.41 | 3.36 | 3.31 | 3.25 | 3.19 | 3.13 | 3.06 | 3.00 |
| 65.0 | 3.90 | 3.90 | 3.91 | 3.91 | 3.91 | 3.91 | 3.90 | 3.89 | 3.88 | 3.86 | 3.84 | 3.82 | 3.79 | 3.77 | 3.73 | 3.70 | 3.66 | 3.62 | 3.58 | 3.53 | 3.48 | 3.43 | 3.37 | 3.31 | 3.25 | 3.19 | 3.12 |
| 66.0 | 4.02 | 4.03 | 4.03 | 4.04 | 4.04 | 4.03 | 4.02 | 4.01 | 4.00 | 3.99 | 3.97 | 3.94 | 3.92 | 3.89 | 3.86 | 3.82 | 3.79 | 3.75 | 3.70 | 3.66 | 3.61 | 3.55 | 3.50 | 3.44 | 3.38 | 3.31 | 3.24 |
| 67.0 | 4.15 | 4.16 | 4.16 | 4.16 | 4.16 | 4.16 | 4.15 | 4.14 | 4.13 | 4.11 | 4.09 | 4.07 | 4.05 | 4.02 | 3.99 | 3.95 | 3.91 | 3.87 | 3.83 | 3.78 | 3.73 | 3.68 | 3.63 | 3.57 | 3.50 | 3.44 | 3.37 |
| 68.0 | 4.28 | 4.28 | 4.29 | 4.29 | 4.29 | 4.29 | 4.28 | 4.27 | 4.26 | 4.24 | 4.22 | 4.20 | 4.18 | 4.15 | 4.12 | 4.08 | 4.04 | 4.00 | 3.96 | 3.91 | 3.86 | 3.81 | 3.75 | 3.70 | 3.63 | 3.57 | 3.50 |
| 69.0 | 4.41 | 4.42 | 4.42 | 4.42 | 4.42 | 4.42 | 4.41 | 4.40 | 4.39 | 4.37 | 4.35 | 4.33 | 4.31 | 4.28 | 4.25 | 4.21 | 4.17 | 4.13 | 4.09 | 4.04 | 3.99 | 3.94 | 3.89 | 3.83 | 3.76 | 3.70 | 3.63 |
| 70.0 | 4.54 | 4.55 | 4.55 | 4.56 | 4.56 | 4.55 | 4.54 | 4.53 | 4.52 | 4.51 | 4.49 | 4.46 | 4.44 | 4.41 | 4.38 | 4.34 | 4.31 | 4.27 | 4.22 | 4.18 | 4.13 | 4.07 | 4.02 | 3.96 | 3.90 | 3.83 | 3.76 |
| 71.0 | 4.68 | 4.68 | 4.69 | 4.69 | 4.69 | 4.69 | 4.68 | 4.67 | 4.66 | 4.64 | 4.62 | 4.60 | 4.57 | 4.55 | 4.51 | 4.48 | 4.44 | 4.40 | 4.36 | 4.31 | 4.26 | 4.21 | 4.15 | 4.09 | 4.03 | 3.97 | 3.90 |
| 72.0 | 4.81 | 4.82 | 4.83 | 4.83 | 4.83 | 4.82 | 4.82 | 4.81 | 4.79 | 4.78 | 4.76 | 4.74 | 4.71 | 4.68 | 4.65 | 4.62 | 4.58 | 4.54 | 4.49 | 4.45 | 4.40 | 4.35 | 4.29 | 4.23 | 4.17 | 4.10 | 4.04 |
| 73.0 | 4.95 | 4.96 | 4.96 | 4.97 | 4.97 | 4.96 | 4.95 | 4.94 | 4.93 | 4.92 | 4.90 | 4.87 | 4.85 | 4.82 | 4.79 | 4.75 | 4.72 | 4.68 | 4.63 | 4.59 | 4.54 | 4.48 | 4.43 | 4.37 | 4.31 | 4.24 | 4.17 |
| 74.0 | 5.09 | 5.10 | 5.10 | 5.11 | 5.11 | 5.10 | 5.10 | 5.09 | 5.07 | 5.06 | 5.04 | 5.01 | 4.99 | 4.96 | 4.93 | 4.90 | 4.86 | 4.82 | 4.77 | 4.73 | 4.68 | 4.62 | 4.57 | 4.51 | 4.45 | 4.38 | 4.32 |

Table 8

## LLN for FVC (L) - Caucasian Females - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 57.0 | 2.41 | 2.42 | 2.43 | 2.43 | 2.43 | 2.42 | 2.42 | 2.41 | 2.40 | 2.38 | 2.36 | 2.34 | 2.31 | 2.28 | 2.25 | 2.22 | 2.18 | 2.14 | 2.10 | 2.05 | 2.00 | 1.95 | 1.89 | 1.83 | 1.77 | 1.71 | 1.64 |
| 58.0 | 2.50 | 2.51 | 2.52 | 2.52 | 2.52 | 2.52 | 2.51 | 2.50 | 2.49 | 2.47 | 2.45 | 2.43 | 2.40 | 2.37 | 2.34 | 2.31 | 2.27 | 2.23 | 2.19 | 2.14 | 2.09 | 2.04 | 1.98 | 1.92 | 1.86 | 1.80 | 1.73 |
| 59.0 | 2.60 | 2.60 | 2.61 | 2.61 | 2.61 | 2.61 | 2.60 | 2.59 | 2.58 | 2.56 | 2.54 | 2.52 | 2.49 | 2.47 | 2.44 | 2.40 | 2.36 | 2.32 | 2.28 | 2.23 | 2.18 | 2.13 | 2.07 | 2.02 | 1.95 | 1.89 | 1.82 |
| 60.0 | 2.69 | 2.70 | 2.70 | 2.71 | 2.71 | 2.70 | 2.69 | 2.68 | 2.67 | 2.66 | 2.64 | 2.61 | 2.59 | 2.56 | 2.53 | 2.49 | 2.46 | 2.42 | 2.37 | 2.33 | 2.28 | 2.22 | 2.17 | 2.11 | 2.05 | 1.98 | 1.91 |
| 61.0 | 2.79 | 2.79 | 2.80 | 2.80 | 2.80 | 2.80 | 2.79 | 2.78 | 2.77 | 2.75 | 2.73 | 2.71 | 2.68 | 2.66 | 2.62 | 2.59 | 2.55 | 2.51 | 2.47 | 2.42 | 2.37 | 2.32 | 2.26 | 2.20 | 2.14 | 2.08 | 2.01 |
| 62.0 | 2.88 | 2.89 | 2.90 | 2.90 | 2.90 | 2.89 | 2.89 | 2.88 | 2.86 | 2.85 | 2.83 | 2.81 | 2.78 | 2.75 | 2.72 | 2.69 | 2.65 | 2.61 | 2.56 | 2.52 | 2.47 | 2.42 | 2.36 | 2.30 | 2.24 | 2.17 | 2.11 |
| 63.0 | 2.98 | 2.99 | 2.99 | 3.00 | 3.00 | 2.99 | 2.98 | 2.97 | 2.96 | 2.95 | 2.93 | 2.90 | 2.88 | 2.85 | 2.82 | 2.78 | 2.75 | 2.71 | 2.66 | 2.62 | 2.57 | 2.51 | 2.46 | 2.40 | 2.34 | 2.27 | 2.20 |
| 64.0 | 3.08 | 3.09 | 3.09 | 3.10 | 3.10 | 3.09 | 3.08 | 3.07 | 3.06 | 3.05 | 3.03 | 3.00 | 2.98 | 2.95 | 2.92 | 2.88 | 2.85 | 2.81 | 2.76 | 2.72 | 2.67 | 2.61 | 2.56 | 2.50 | 2.44 | 2.37 | 2.30 |
| 65.0 | 3.18 | 3.19 | 3.20 | 3.20 | 3.20 | 3.19 | 3.19 | 3.18 | 3.16 | 3.15 | 3.13 | 3.11 | 3.08 | 3.05 | 3.02 | 2.99 | 2.95 | 2.91 | 2.86 | 2.82 | 2.77 | 2.72 | 2.66 | 2.60 | 2.54 | 2.47 | 2.41 |
| 66.0 | 3.28 | 3.29 | 3.30 | 3.30 | 3.30 | 3.30 | 3.29 | 3.28 | 3.27 | 3.25 | 3.23 | 3.21 | 3.18 | 3.16 | 3.12 | 3.09 | 3.05 | 3.01 | 2.97 | 2.92 | 2.87 | 2.82 | 2.76 | 2.70 | 2.64 | 2.58 | 2.51 |
| 67.0 | 3.39 | 3.40 | 3.40 | 3.41 | 3.40 | 3.40 | 3.39 | 3.38 | 3.37 | 3.35 | 3.34 | 3.31 | 3.29 | 3.26 | 3.23 | 3.19 | 3.16 | 3.12 | 3.07 | 3.03 | 2.98 | 2.92 | 2.87 | 2.81 | 2.75 | 2.68 | 2.61 |
| 68.0 | 3.50 | 3.50 | 3.51 | 3.51 | 3.51 | 3.51 | 3.50 | 3.49 | 3.48 | 3.46 | 3.44 | 3.42 | 3.39 | 3.37 | 3.33 | 3.30 | 3.26 | 3.22 | 3.18 | 3.13 | 3.08 | 3.03 | 2.97 | 2.92 | 2.85 | 2.79 | 2.72 |
| 69.0 | 3.60 | 3.61 | 3.62 | 3.62 | 3.62 | 3.61 | 3.61 | 3.60 | 3.58 | 3.57 | 3.55 | 3.53 | 3.50 | 3.47 | 3.44 | 3.41 | 3.37 | 3.33 | 3.29 | 3.24 | 3.19 | 3.14 | 3.08 | 3.02 | 2.96 | 2.90 | 2.83 |
| 70.0 | 3.71 | 3.72 | 3.73 | 3.73 | 3.73 | 3.72 | 3.72 | 3.71 | 3.69 | 3.68 | 3.66 | 3.64 | 3.61 | 3.58 | 3.55 | 3.52 | 3.48 | 3.44 | 3.40 | 3.35 | 3.30 | 3.25 | 3.19 | 3.13 | 3.07 | 3.01 | 2.94 |
| 71.0 | 3.82 | 3.83 | 3.84 | 3.84 | 3.84 | 3.84 | 3.83 | 3.82 | 3.81 | 3.79 | 3.77 | 3.75 | 3.72 | 3.69 | 3.66 | 3.63 | 3.59 | 3.55 | 3.51 | 3.46 | 3.41 | 3.36 | 3.30 | 3.24 | 3.18 | 3.12 | 3.05 |
| 72.0 | 3.94 | 3.94 | 3.95 | 3.95 | 3.95 | 3.95 | 3.94 | 3.93 | 3.92 | 3.90 | 3.88 | 3.86 | 3.84 | 3.81 | 3.78 | 3.74 | 3.70 | 3.66 | 3.62 | 3.57 | 3.52 | 3.47 | 3.41 | 3.36 | 3.29 | 3.23 | 3.16 |
| 73.0 | 4.05 | 4.06 | 4.06 | 4.07 | 4.07 | 4.06 | 4.05 | 4.04 | 4.03 | 4.02 | 4.00 | 3.97 | 3.95 | 3.92 | 3.89 | 3.86 | 3.82 | 3.78 | 3.73 | 3.69 | 3.64 | 3.58 | 3.53 | 3.47 | 3.41 | 3.34 | 3.27 |
| 74.0 | 4.17 | 4.17 | 4.18 | 4.18 | 4.18 | 4.18 | 4.17 | 4.16 | 4.15 | 4.13 | 4.11 | 4.09 | 4.06 | 4.04 | 4.01 | 3.97 | 3.93 | 3.89 | 3.85 | 3.80 | 3.75 | 3.70 | 3.64 | 3.59 | 3.52 | 3.46 | 3.39 |

Table 9

## Predicted FVC (L) - African American Females - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 53.0 | 2.17 | 2.16 | 2.15 | 2.14 | 2.12 | 2.10 | 2.08 | 2.06 | 2.04 | 2.01 | 1.98 | 1.95 | 1.92 | 1.88 | 1.85 | 1.81 | 1.77 | 1.72 | 1.68 | 1.63 | 1.58 | 1.53 | 1.48 | 1.42 | 1.36 | 1.30 | 1.24 |
| 54.0 | 2.27 | 2.26 | 2.25 | 2.23 | 2.22 | 2.20 | 2.18 | 2.16 | 2.13 | 2.11 | 2.08 | 2.05 | 2.01 | 1.98 | 1.94 | 1.90 | 1.86 | 1.82 | 1.77 | 1.72 | 1.68 | 1.62 | 1.57 | 1.51 | 1.46 | 1.39 | 1.33 |
| 55.0 | 2.36 | 2.35 | 2.34 | 2.33 | 2.31 | 2.29 | 2.27 | 2.25 | 2.23 | 2.20 | 2.17 | 2.14 | 2.11 | 2.07 | 2.04 | 2.00 | 1.96 | 1.91 | 1.87 | 1.82 | 1.77 | 1.72 | 1.67 | 1.61 | 1.55 | 1.49 | 1.43 |
| 56.0 | 2.46 | 2.45 | 2.44 | 2.42 | 2.41 | 2.39 | 2.37 | 2.35 | 2.32 | 2.30 | 2.27 | 2.24 | 2.21 | 2.17 | 2.13 | 2.10 | 2.05 | 2.01 | 1.97 | 1.92 | 1.87 | 1.82 | 1.76 | 1.71 | 1.65 | 1.59 | 1.53 |
| 57.0 | 2.56 | 2.55 | 2.54 | 2.52 | 2.51 | 2.49 | 2.47 | 2.45 | 2.42 | 2.40 | 2.37 | 2.34 | 2.31 | 2.27 | 2.23 | 2.19 | 2.15 | 2.11 | 2.06 | 2.02 | 1.97 | 1.92 | 1.86 | 1.81 | 1.75 | 1.69 | 1.62 |
| 58.0 | 2.66 | 2.65 | 2.64 | 2.63 | 2.61 | 2.59 | 2.57 | 2.55 | 2.52 | 2.50 | 2.47 | 2.44 | 2.41 | 2.37 | 2.33 | 2.30 | 2.25 | 2.21 | 2.17 | 2.12 | 2.07 | 2.02 | 1.96 | 1.91 | 1.85 | 1.79 | 1.73 |
| 59.0 | 2.76 | 2.75 | 2.74 | 2.73 | 2.71 | 2.69 | 2.67 | 2.65 | 2.63 | 2.60 | 2.57 | 2.54 | 2.51 | 2.47 | 2.44 | 2.40 | 2.36 | 2.31 | 2.27 | 2.22 | 2.17 | 2.12 | 2.07 | 2.01 | 1.95 | 1.89 | 1.83 |
| 60.0 | 2.87 | 2.86 | 2.85 | 2.83 | 2.82 | 2.80 | 2.78 | 2.76 | 2.73 | 2.71 | 2.68 | 2.65 | 2.61 | 2.58 | 2.54 | 2.50 | 2.46 | 2.42 | 2.37 | 2.33 | 2.28 | 2.22 | 2.17 | 2.11 | 2.06 | 2.00 | 1.93 |
| 61.0 | 2.97 | 2.96 | 2.95 | 2.94 | 2.92 | 2.90 | 2.88 | 2.86 | 2.84 | 2.81 | 2.78 | 2.75 | 2.72 | 2.69 | 2.65 | 2.61 | 2.57 | 2.52 | 2.48 | 2.43 | 2.38 | 2.33 | 2.28 | 2.22 | 2.16 | 2.10 | 2.04 |
| 62.0 | 3.08 | 3.07 | 3.06 | 3.05 | 3.03 | 3.01 | 2.99 | 2.97 | 2.95 | 2.92 | 2.89 | 2.86 | 2.83 | 2.79 | 2.76 | 2.72 | 2.68 | 2.63 | 2.59 | 2.54 | 2.49 | 2.44 | 2.38 | 2.33 | 2.27 | 2.21 | 2.15 |
| 63.0 | 3.19 | 3.18 | 3.17 | 3.16 | 3.14 | 3.12 | 3.10 | 3.08 | 3.06 | 3.03 | 3.00 | 2.97 | 2.94 | 2.90 | 2.87 | 2.83 | 2.79 | 2.74 | 2.70 | 2.65 | 2.60 | 2.55 | 2.49 | 2.44 | 2.38 | 2.32 | 2.26 |
| 64.0 | 3.30 | 3.29 | 3.28 | 3.27 | 3.25 | 3.23 | 3.21 | 3.19 | 3.17 | 3.14 | 3.11 | 3.08 | 3.05 | 3.01 | 2.98 | 2.94 | 2.90 | 2.85 | 2.81 | 2.76 | 2.71 | 2.66 | 2.61 | 2.55 | 2.49 | 2.43 | 2.37 |
| 65.0 | 3.42 | 3.41 | 3.39 | 3.38 | 3.37 | 3.35 | 3.33 | 3.30 | 3.28 | 3.25 | 3.23 | 3.20 | 3.16 | 3.13 | 3.09 | 3.05 | 3.01 | 2.97 | 2.92 | 2.87 | 2.82 | 2.77 | 2.72 | 2.66 | 2.60 | 2.54 | 2.48 |
| 66.0 | 3.53 | 3.52 | 3.51 | 3.50 | 3.48 | 3.46 | 3.44 | 3.42 | 3.40 | 3.37 | 3.34 | 3.31 | 3.28 | 3.24 | 3.21 | 3.17 | 3.13 | 3.08 | 3.04 | 2.99 | 2.94 | 2.89 | 2.83 | 2.78 | 2.72 | 2.66 | 2.60 |
| 67.0 | 3.65 | 3.64 | 3.63 | 3.61 | 3.60 | 3.58 | 3.56 | 3.54 | 3.51 | 3.49 | 3.46 | 3.43 | 3.39 | 3.36 | 3.32 | 3.28 | 3.24 | 3.20 | 3.15 | 3.11 | 3.06 | 3.00 | 2.95 | 2.89 | 2.84 | 2.78 | 2.71 |
| 68.0 | 3.77 | 3.76 | 3.74 | 3.73 | 3.72 | 3.70 | 3.68 | 3.66 | 3.63 | 3.60 | 3.58 | 3.55 | 3.51 | 3.48 | 3.44 | 3.40 | 3.36 | 3.32 | 3.27 | 3.22 | 3.17 | 3.12 | 3.07 | 3.01 | 2.95 | 2.89 | 2.83 |
| 69.0 | 3.89 | 3.88 | 3.86 | 3.85 | 3.84 | 3.82 | 3.80 | 3.78 | 3.75 | 3.72 | 3.70 | 3.67 | 3.63 | 3.60 | 3.56 | 3.52 | 3.48 | 3.44 | 3.39 | 3.34 | 3.29 | 3.24 | 3.19 | 3.13 | 3.07 | 3.01 | 2.95 |
| 70.0 | 4.01 | 4.00 | 3.99 | 3.97 | 3.96 | 3.94 | 3.92 | 3.90 | 3.87 | 3.85 | 3.82 | 3.79 | 3.76 | 3.72 | 3.68 | 3.64 | 3.60 | 3.56 | 3.51 | 3.47 | 3.42 | 3.36 | 3.31 | 3.25 | 3.20 | 3.14 | 3.07 |
| 71.0 | 4.13 | 4.12 | 4.11 | 4.10 | 4.08 | 4.06 | 4.04 | 4.02 | 4.00 | 3.97 | 3.94 | 3.91 | 3.88 | 3.84 | 3.81 | 3.77 | 3.73 | 3.68 | 3.64 | 3.59 | 3.54 | 3.49 | 3.43 | 3.38 | 3.32 | 3.26 | 3.20 |
| 72.0 | 4.26 | 4.25 | 4.24 | 4.22 | 4.21 | 4.19 | 4.17 | 4.15 | 4.12 | 4.10 | 4.07 | 4.04 | 4.00 | 3.97 | 3.93 | 3.89 | 3.85 | 3.81 | 3.76 | 3.72 | 3.67 | 3.61 | 3.56 | 3.50 | 3.45 | 3.39 | 3.32 |

Table 10

## LLN for FVC (L) - African American Females - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 53.0 | 1.68 | 1.68 | 1.66 | 1.65 | 1.63 | 1.62 | 1.60 | 1.57 | 1.55 | 1.52 | 1.50 | 1.46 | 1.43 | 1.40 | 1.36 | 1.32 | 1.28 | 1.24 | 1.19 | 1.14 | 1.09 | 1.04 | 0.99 | 0.93 | 0.87 | 0.81 | 0.75 |
| 54.0 | 1.76 | 1.75 | 1.74 | 1.73 | 1.71 | 1.69 | 1.67 | 1.65 | 1.63 | 1.60 | 1.57 | 1.54 | 1.51 | 1.47 | 1.44 | 1.40 | 1.36 | 1.31 | 1.27 | 1.22 | 1.17 | 1.12 | 1.06 | 1.01 | 0.95 | 0.89 | 0.83 |
| 55.0 | 1.84 | 1.83 | 1.82 | 1.80 | 1.79 | 1.77 | 1.75 | 1.73 | 1.70 | 1.68 | 1.65 | 1.62 | 1.58 | 1.55 | 1.51 | 1.47 | 1.43 | 1.39 | 1.34 | 1.30 | 1.25 | 1.19 | 1.14 | 1.08 | 1.03 | 0.97 | 0.90 |
| 56.0 | 1.92 | 1.91 | 1.89 | 1.88 | 1.86 | 1.85 | 1.83 | 1.80 | 1.78 | 1.75 | 1.73 | 1.70 | 1.66 | 1.63 | 1.59 | 1.55 | 1.51 | 1.47 | 1.42 | 1.37 | 1.32 | 1.27 | 1.22 | 1.16 | 1.10 | 1.04 | 0.98 |
| 57.0 | 1.99 | 1.99 | 1.97 | 1.96 | 1.94 | 1.93 | 1.91 | 1.88 | 1.86 | 1.83 | 1.81 | 1.77 | 1.74 | 1.71 | 1.67 | 1.63 | 1.59 | 1.55 | 1.50 | 1.45 | 1.40 | 1.35 | 1.30 | 1.24 | 1.18 | 1.12 | 1.06 |
| 58.0 | 2.08 | 2.07 | 2.05 | 2.04 | 2.03 | 2.01 | 1.99 | 1.97 | 1.94 | 1.91 | 1.89 | 1.86 | 1.82 | 1.79 | 1.75 | 1.71 | 1.67 | 1.63 | 1.58 | 1.53 | 1.48 | 1.43 | 1.38 | 1.32 | 1.26 | 1.20 | 1.14 |
| 59.0 | 2.16 | 2.15 | 2.14 | 2.12 | 2.11 | 2.09 | 2.07 | 2.05 | 2.02 | 2.00 | 1.97 | 1.94 | 1.91 | 1.87 | 1.83 | 1.79 | 1.75 | 1.71 | 1.66 | 1.62 | 1.57 | 1.52 | 1.46 | 1.41 | 1.35 | 1.29 | 1.22 |
| 60.0 | 2.24 | 2.23 | 2.22 | 2.21 | 2.19 | 2.17 | 2.15 | 2.13 | 2.11 | 2.08 | 2.05 | 2.02 | 1.99 | 1.95 | 1.92 | 1.88 | 1.84 | 1.79 | 1.75 | 1.70 | 1.65 | 1.60 | 1.55 | 1.49 | 1.43 | 1.37 | 1.31 |
| 61.0 | 2.33 | 2.32 | 2.31 | 2.29 | 2.28 | 2.26 | 2.24 | 2.22 | 2.19 | 2.17 | 2.14 | 2.11 | 2.07 | 2.04 | 2.00 | 1.96 | 1.92 | 1.88 | 1.83 | 1.79 | 1.74 | 1.68 | 1.63 | 1.57 | 1.52 | 1.46 | 1.39 |
| 62.0 | 2.41 | 2.40 | 2.39 | 2.38 | 2.36 | 2.35 | 2.33 | 2.30 | 2.28 | 2.25 | 2.22 | 2.19 | 2.16 | 2.13 | 2.09 | 2.05 | 2.01 | 1.97 | 1.92 | 1.87 | 1.82 | 1.77 | 1.72 | 1.66 | 1.60 | 1.54 | 1.48 |
| 63.0 | 2.50 | 2.49 | 2.48 | 2.47 | 2.45 | 2.43 | 2.41 | 2.39 | 2.37 | 2.34 | 2.31 | 2.28 | 2.25 | 2.21 | 2.18 | 2.14 | 2.10 | 2.05 | 2.01 | 1.96 | 1.91 | 1.86 | 1.80 | 1.75 | 1.69 | 1.63 | 1.57 |
| 64.0 | 2.59 | 2.58 | 2.57 | 2.56 | 2.54 | 2.52 | 2.50 | 2.48 | 2.46 | 2.43 | 2.40 | 2.37 | 2.34 | 2.30 | 2.27 | 2.23 | 2.19 | 2.14 | 2.10 | 2.05 | 2.00 | 1.95 | 1.89 | 1.84 | 1.78 | 1.72 | 1.66 |
| 65.0 | 2.68 | 2.67 | 2.66 | 2.65 | 2.63 | 2.61 | 2.59 | 2.57 | 2.55 | 2.52 | 2.49 | 2.46 | 2.43 | 2.39 | 2.36 | 2.32 | 2.28 | 2.23 | 2.19 | 2.14 | 2.09 | 2.04 | 1.99 | 1.93 | 1.87 | 1.81 | 1.75 |
| 66.0 | 2.77 | 2.77 | 2.75 | 2.74 | 2.72 | 2.71 | 2.69 | 2.66 | 2.64 | 2.61 | 2.58 | 2.55 | 2.52 | 2.49 | 2.45 | 2.41 | 2.37 | 2.33 | 2.28 | 2.23 | 2.18 | 2.13 | 2.08 | 2.02 | 1.96 | 1.90 | 1.84 |
| 67.0 | 2.87 | 2.86 | 2.85 | 2.83 | 2.82 | 2.80 | 2.78 | 2.76 | 2.73 | 2.71 | 2.68 | 2.65 | 2.62 | 2.58 | 2.54 | 2.50 | 2.46 | 2.42 | 2.37 | 2.33 | 2.28 | 2.23 | 2.17 | 2.12 | 2.06 | 2.00 | 1.93 |
| 68.0 | 2.96 | 2.95 | 2.94 | 2.93 | 2.91 | 2.89 | 2.87 | 2.85 | 2.83 | 2.80 | 2.77 | 2.74 | 2.71 | 2.68 | 2.64 | 2.60 | 2.56 | 2.51 | 2.47 | 2.42 | 2.37 | 2.32 | 2.27 | 2.21 | 2.15 | 2.09 | 2.03 |
| 69.0 | 3.06 | 3.05 | 3.04 | 3.03 | 3.01 | 2.99 | 2.97 | 2.95 | 2.92 | 2.90 | 2.87 | 2.84 | 2.81 | 2.77 | 2.73 | 2.70 | 2.65 | 2.61 | 2.57 | 2.52 | 2.47 | 2.42 | 2.36 | 2.31 | 2.25 | 2.19 | 2.13 |
| 70.0 | 3.16 | 3.15 | 3.14 | 3.12 | 3.11 | 3.09 | 3.07 | 3.05 | 3.02 | 3.00 | 2.97 | 2.94 | 2.90 | 2.87 | 2.83 | 2.79 | 2.75 | 2.71 | 2.66 | 2.62 | 2.57 | 2.51 | 2.46 | 2.40 | 2.35 | 2.29 | 2.22 |
| 71.0 | 3.26 | 3.25 | 3.24 | 3.22 | 3.21 | 3.19 | 3.17 | 3.15 | 3.12 | 3.10 | 3.07 | 3.04 | 3.00 | 2.97 | 2.93 | 2.89 | 2.85 | 2.81 | 2.76 | 2.72 | 2.67 | 2.61 | 2.56 | 2.50 | 2.45 | 2.39 | 2.32 |
| 72.0 | 3.36 | 3.35 | 3.34 | 3.32 | 3.31 | 3.29 | 3.27 | 3.25 | 3.22 | 3.20 | 3.17 | 3.14 | 3.10 | 3.07 | 3.03 | 2.99 | 2.95 | 2.91 | 2.86 | 2.82 | 2.77 | 2.71 | 2.66 | 2.60 | 2.55 | 2.49 | 2.42 |

Table 11

## Predicted FVC (L) - Mexican American Females - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 53.0 | 2.68 | 2.67 | 2.66 | 2.64 | 2.62 | 2.60 | 2.58 | 2.56 | 2.53 | 2.51 | 2.48 | 2.45 | 2.41 | 2.38 | 2.34 | 2.30 | 2.26 | 2.22 | 2.18 | 2.13 | 2.08 | 2.03 | 1.98 | 1.93 | 1.87 | 1.82 | 1.76 |
| 54.0 | 2.78 | 2.77 | 2.75 | 2.74 | 2.72 | 2.70 | 2.68 | 2.66 | 2.63 | 2.60 | 2.58 | 2.54 | 2.51 | 2.48 | 2.44 | 2.40 | 2.36 | 2.32 | 2.28 | 2.23 | 2.18 | 2.13 | 2.08 | 2.03 | 1.97 | 1.91 | 1.85 |
| 55.0 | 2.88 | 2.87 | 2.85 | 2.84 | 2.82 | 2.80 | 2.78 | 2.76 | 2.73 | 2.70 | 2.68 | 2.64 | 2.61 | 2.58 | 2.54 | 2.50 | 2.46 | 2.42 | 2.38 | 2.33 | 2.28 | 2.23 | 2.18 | 2.13 | 2.07 | 2.01 | 1.95 |
| 56.0 | 2.98 | 2.97 | 2.96 | 2.94 | 2.92 | 2.90 | 2.88 | 2.86 | 2.83 | 2.81 | 2.78 | 2.75 | 2.71 | 2.68 | 2.64 | 2.60 | 2.56 | 2.52 | 2.48 | 2.43 | 2.38 | 2.33 | 2.28 | 2.23 | 2.17 | 2.12 | 2.06 |
| 57.0 | 3.09 | 3.07 | 3.06 | 3.04 | 3.03 | 3.01 | 2.99 | 2.96 | 2.94 | 2.91 | 2.88 | 2.85 | 2.82 | 2.78 | 2.75 | 2.71 | 2.67 | 2.63 | 2.58 | 2.54 | 2.49 | 2.44 | 2.39 | 2.33 | 2.28 | 2.22 | 2.16 |
| 58.0 | 3.19 | 3.18 | 3.17 | 3.15 | 3.13 | 3.11 | 3.09 | 3.07 | 3.04 | 3.02 | 2.99 | 2.96 | 2.92 | 2.89 | 2.85 | 2.81 | 2.77 | 2.73 | 2.69 | 2.64 | 2.59 | 2.54 | 2.49 | 2.44 | 2.38 | 2.33 | 2.27 |
| 59.0 | 3.30 | 3.29 | 3.27 | 3.26 | 3.24 | 3.22 | 3.20 | 3.18 | 3.15 | 3.12 | 3.09 | 3.06 | 3.03 | 3.00 | 2.96 | 2.92 | 2.88 | 2.84 | 2.80 | 2.75 | 2.70 | 2.65 | 2.60 | 2.55 | 2.49 | 2.43 | 2.37 |
| 60.0 | 3.41 | 3.40 | 3.38 | 3.37 | 3.35 | 3.33 | 3.31 | 3.29 | 3.26 | 3.23 | 3.20 | 3.17 | 3.14 | 3.11 | 3.07 | 3.03 | 2.99 | 2.95 | 2.90 | 2.86 | 2.81 | 2.76 | 2.71 | 2.66 | 2.60 | 2.54 | 2.48 |
| 61.0 | 3.52 | 3.51 | 3.49 | 3.48 | 3.46 | 3.44 | 3.42 | 3.40 | 3.37 | 3.34 | 3.32 | 3.28 | 3.25 | 3.22 | 3.18 | 3.14 | 3.10 | 3.06 | 3.02 | 2.97 | 2.92 | 2.87 | 2.82 | 2.77 | 2.71 | 2.65 | 2.59 |
| 62.0 | 3.63 | 3.62 | 3.61 | 3.59 | 3.57 | 3.55 | 3.53 | 3.51 | 3.48 | 3.46 | 3.43 | 3.40 | 3.36 | 3.33 | 3.29 | 3.26 | 3.22 | 3.17 | 3.13 | 3.08 | 3.03 | 2.99 | 2.93 | 2.88 | 2.82 | 2.77 | 2.71 |
| 63.0 | 3.75 | 3.74 | 3.72 | 3.71 | 3.69 | 3.67 | 3.65 | 3.62 | 3.60 | 3.57 | 3.54 | 3.51 | 3.48 | 3.45 | 3.41 | 3.37 | 3.33 | 3.29 | 3.24 | 3.20 | 3.15 | 3.10 | 3.05 | 2.99 | 2.94 | 2.88 | 2.82 |
| 64.0 | 3.86 | 3.85 | 3.84 | 3.82 | 3.81 | 3.79 | 3.76 | 3.74 | 3.72 | 3.69 | 3.66 | 3.63 | 3.60 | 3.56 | 3.53 | 3.49 | 3.45 | 3.40 | 3.36 | 3.31 | 3.27 | 3.22 | 3.16 | 3.11 | 3.06 | 3.00 | 2.94 |
| 65.0 | 3.98 | 3.97 | 3.96 | 3.94 | 3.92 | 3.90 | 3.88 | 3.86 | 3.83 | 3.81 | 3.78 | 3.75 | 3.72 | 3.68 | 3.64 | 3.61 | 3.57 | 3.52 | 3.48 | 3.43 | 3.38 | 3.34 | 3.28 | 3.23 | 3.17 | 3.12 | 3.06 |
| 66.0 | 4.10 | 4.09 | 4.08 | 4.06 | 4.04 | 4.02 | 4.00 | 3.98 | 3.95 | 3.93 | 3.90 | 3.87 | 3.84 | 3.80 | 3.76 | 3.73 | 3.69 | 3.64 | 3.60 | 3.55 | 3.51 | 3.46 | 3.40 | 3.35 | 3.29 | 3.24 | 3.18 |
| 67.0 | 4.23 | 4.21 | 4.20 | 4.18 | 4.17 | 4.15 | 4.13 | 4.10 | 4.08 | 4.05 | 4.02 | 3.99 | 3.96 | 3.92 | 3.89 | 3.85 | 3.81 | 3.77 | 3.72 | 3.68 | 3.63 | 3.58 | 3.53 | 3.47 | 3.42 | 3.36 | 3.30 |
| 68.0 | 4.35 | 4.34 | 4.32 | 4.31 | 4.29 | 4.27 | 4.25 | 4.23 | 4.20 | 4.17 | 4.15 | 4.11 | 4.08 | 4.05 | 4.01 | 3.97 | 3.93 | 3.89 | 3.85 | 3.80 | 3.75 | 3.70 | 3.65 | 3.60 | 3.54 | 3.48 | 3.42 |
| 69.0 | 4.48 | 4.46 | 4.45 | 4.43 | 4.42 | 4.40 | 4.38 | 4.35 | 4.33 | 4.30 | 4.27 | 4.24 | 4.21 | 4.17 | 4.14 | 4.10 | 4.06 | 4.02 | 3.97 | 3.93 | 3.88 | 3.83 | 3.78 | 3.72 | 3.67 | 3.61 | 3.55 |

Table 12

## LLN for FVC (L) - Mexican American Females - NHANES III

| | Age | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (Inches) | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| 53.0 | 2.20 | 2.18 | 2.17 | 2.15 | 2.14 | 2.12 | 2.10 | 2.07 | 2.05 | 2.02 | 1.99 | 1.96 | 1.93 | 1.89 | 1.86 | 1.82 | 1.78 | 1.74 | 1.69 | 1.65 | 1.60 | 1.55 | 1.50 | 1.44 | 1.39 | 1.33 | 1.27 |
| 54.0 | 2.28 | 2.26 | 2.25 | 2.23 | 2.22 | 2.20 | 2.18 | 2.15 | 2.13 | 2.10 | 2.07 | 2.04 | 2.01 | 1.97 | 1.94 | 1.90 | 1.86 | 1.82 | 1.77 | 1.73 | 1.68 | 1.63 | 1.58 | 1.52 | 1.47 | 1.41 | 1.35 |
| 55.0 | 2.36 | 2.35 | 2.33 | 2.32 | 2.30 | 2.28 | 2.26 | 2.23 | 2.21 | 2.18 | 2.15 | 2.12 | 2.09 | 2.06 | 2.02 | 1.98 | 1.94 | 1.90 | 1.85 | 1.81 | 1.76 | 1.71 | 1.66 | 1.60 | 1.55 | 1.49 | 1.43 |
| 56.0 | 2.44 | 2.43 | 2.41 | 2.40 | 2.38 | 2.36 | 2.34 | 2.32 | 2.29 | 2.27 | 2.24 | 2.21 | 2.17 | 2.14 | 2.10 | 2.06 | 2.02 | 1.98 | 1.94 | 1.89 | 1.84 | 1.79 | 1.74 | 1.69 | 1.63 | 1.57 | 1.52 |
| 57.0 | 2.52 | 2.51 | 2.50 | 2.48 | 2.47 | 2.45 | 2.43 | 2.40 | 2.38 | 2.35 | 2.32 | 2.29 | 2.26 | 2.22 | 2.19 | 2.15 | 2.11 | 2.07 | 2.02 | 1.97 | 1.93 | 1.88 | 1.83 | 1.77 | 1.72 | 1.66 | 1.60 |
| 58.0 | 2.61 | 2.60 | 2.58 | 2.57 | 2.55 | 2.53 | 2.51 | 2.49 | 2.46 | 2.44 | 2.41 | 2.38 | 2.34 | 2.31 | 2.27 | 2.23 | 2.19 | 2.15 | 2.11 | 2.06 | 2.01 | 1.96 | 1.91 | 1.86 | 1.80 | 1.74 | 1.69 |
| 59.0 | 2.70 | 2.69 | 2.67 | 2.66 | 2.64 | 2.62 | 2.60 | 2.57 | 2.55 | 2.52 | 2.49 | 2.46 | 2.43 | 2.40 | 2.36 | 2.32 | 2.28 | 2.24 | 2.19 | 2.15 | 2.10 | 2.05 | 2.00 | 1.95 | 1.89 | 1.83 | 1.77 |
| 60.0 | 2.79 | 2.77 | 2.76 | 2.75 | 2.73 | 2.71 | 2.69 | 2.66 | 2.64 | 2.61 | 2.58 | 2.55 | 2.52 | 2.48 | 2.45 | 2.41 | 2.37 | 2.33 | 2.28 | 2.24 | 2.19 | 2.14 | 2.09 | 2.03 | 1.98 | 1.92 | 1.86 |
| 61.0 | 2.88 | 2.87 | 2.85 | 2.84 | 2.82 | 2.80 | 2.78 | 2.75 | 2.73 | 2.70 | 2.67 | 2.64 | 2.61 | 2.57 | 2.54 | 2.50 | 2.46 | 2.42 | 2.37 | 2.33 | 2.28 | 2.23 | 2.18 | 2.12 | 2.07 | 2.01 | 1.95 |
| 62.0 | 2.97 | 2.96 | 2.94 | 2.93 | 2.91 | 2.89 | 2.87 | 2.85 | 2.82 | 2.79 | 2.76 | 2.73 | 2.70 | 2.67 | 2.63 | 2.59 | 2.55 | 2.51 | 2.47 | 2.42 | 2.37 | 2.32 | 2.27 | 2.22 | 2.16 | 2.10 | 2.04 |
| 63.0 | 3.06 | 3.05 | 3.04 | 3.02 | 3.00 | 2.98 | 2.96 | 2.94 | 2.91 | 2.89 | 2.86 | 2.83 | 2.79 | 2.76 | 2.72 | 2.68 | 2.64 | 2.60 | 2.56 | 2.51 | 2.46 | 2.41 | 2.36 | 2.31 | 2.25 | 2.20 | 2.14 |
| 64.0 | 3.16 | 3.15 | 3.13 | 3.12 | 3.10 | 3.08 | 3.06 | 3.03 | 3.01 | 2.98 | 2.95 | 2.92 | 2.89 | 2.85 | 2.82 | 2.78 | 2.74 | 2.70 | 2.65 | 2.61 | 2.56 | 2.51 | 2.46 | 2.40 | 2.35 | 2.29 | 2.23 |
| 65.0 | 3.25 | 3.24 | 3.23 | 3.21 | 3.19 | 3.17 | 3.15 | 3.13 | 3.11 | 3.08 | 3.05 | 3.02 | 2.99 | 2.95 | 2.91 | 2.88 | 2.84 | 2.79 | 2.75 | 2.70 | 2.66 | 2.61 | 2.55 | 2.50 | 2.44 | 2.39 | 2.33 |
| 66.0 | 3.35 | 3.34 | 3.33 | 3.31 | 3.29 | 3.27 | 3.25 | 3.23 | 3.20 | 3.18 | 3.15 | 3.12 | 3.08 | 3.05 | 3.01 | 2.97 | 2.93 | 2.89 | 2.85 | 2.80 | 2.75 | 2.70 | 2.65 | 2.60 | 2.54 | 2.49 | 2.43 |
| 67.0 | 3.45 | 3.44 | 3.42 | 3.41 | 3.39 | 3.37 | 3.35 | 3.33 | 3.30 | 3.28 | 3.25 | 3.22 | 3.18 | 3.15 | 3.11 | 3.07 | 3.03 | 2.99 | 2.95 | 2.90 | 2.85 | 2.80 | 2.75 | 2.70 | 2.64 | 2.58 | 2.53 |
| 68.0 | 3.55 | 3.54 | 3.53 | 3.51 | 3.49 | 3.47 | 3.45 | 3.43 | 3.40 | 3.38 | 3.35 | 3.32 | 3.28 | 3.25 | 3.21 | 3.17 | 3.13 | 3.09 | 3.05 | 3.00 | 2.95 | 2.90 | 2.85 | 2.80 | 2.74 | 2.69 | 2.63 |
| 69.0 | 3.65 | 3.64 | 3.63 | 3.61 | 3.59 | 3.58 | 3.55 | 3.53 | 3.51 | 3.48 | 3.45 | 3.42 | 3.39 | 3.35 | 3.31 | 3.28 | 3.24 | 3.19 | 3.15 | 3.10 | 3.06 | 3.01 | 2.95 | 2.90 | 2.85 | 2.79 | 2.73 |

# Appendix 5

## Commissioner's Order

**MINNESOTA DEPARTMENT OF PUBLIC SAFETY**


**Office of the Commissioner**

445 Minnesota Street • Suite 1000 • Saint Paul, Minnesota 55101
Phone: 651.201.7160 • Fax: 651.297.5728 • TTY: 651.282.6555
Website: dps.mn.gov




COMMISSIONER'S ORDER

NO. 2012-1

Pursuant to the provisions of Minnesota Statutes Section 169A.03 subdivision 11 and MN Rule 7502.0425 subparts 2 and 3, the Datamaster DMT-G which uses infrared technology and optionally, fuel cell technology, is approved for use in this state for the purpose of determining the alcohol concentration of a breath sample.

Dated May 23, 2012

Ramona L. Dohman

Ramona L. Dohman, Commissioner

Department of Public Safety

# Certificate of Procedure and Software Approval

## MINNESOTA DEPARTMENT OF PUBLIC SAFETY

Bureau of Criminal Apprehension Forensic Science Service

St. Paul Facility
1430 Maryland Avenue East, St. Paul, Minnesota 55106
Phone: (651) 793-2900 FAX: (651) 793-2901 TTY: (651) 282-6555

Bemidji Facility
3700 North Norris Court NW, Bemidji, Minnesota 56601
Phone: (218) 755-6600 FAX: (218) 755-6623

Website: http://bca.dps.mn.gov

Alcohol & Gambling Enforcement

Bureau of Criminal Apprehension

Driver and Vehicle Services

Emergency Communication Networks

Homeland Security and Emergency Management

Minnesota State Patrol

Office of Communications

Office of Justice Programs

Office of Traffic Safety

State Fire Marshal and Pipeline Safety

### CERTIFICATE OF PROCEDURE AND SOFTWARE APPROVAL

Pursuant to MS 169A.75 and MN Rule 7502.0410 subpart 1, the following procedure is approved and certified to be valid and reliable for the analysis of breath samples using Datamaster DMT-G with fuel cell option breath testing instruments:

1. Diagnostics
2. Air Blank
3. Subject Sample
4. Air Blank
5. Control
6. Air Blank
7. Subject Sample
8. Air Blank

Pursuant to MN Rule 7502.0410 subpart 2, the following software is approved and certified to be valid and reliable for the analysis of breath samples using Datamaster DMT-G with fuel cell option breath testing instruments:

208.206.205

Frank C. Dolejsi

Director

ANTHONY J. PETRACCA
Notary Public
Minnesota
My Commission Expires January 31, 2016

5/22/12

EQUAL OPPORTUNITY EMPLOYER

# Appendix 6

# DMT Troubleshooting

## Lock-up - Keyboard

Unplug the keyboard USB then plug it into a new USB port. Check the keyboard for functionality. If it still does not respond after trying all USB ports, turn off the DMT. Unplug the printer and keyboard USB from back of the DMT. After the DMT has been off for about 10 seconds, turn it back on. After the DMT has rebooted, plug in the keyboard (black) USB cable. Press the Num Lock key on the keyboard and verify the light above the key turns on. If not, start the process over from the beginning. If the light above the Num Lock key turns on, plug in the Printer (white) USB cable. If the keyboard locked at any time during the test and the DMT had to be restarted the, test was lost and must be rerun. Wait until the five-minute warm up period is complete and begin the test again.

## Lock-up – Printer

Turn off the DMT. Unplug the printer and keyboard USB from back of DMT. After the DMT has been off for about 10 seconds, turn it back on. After the DMT has rebooted, plug in the keyboard (black) USB cable. Press the Num Lock key on the keyboard and verify the light above the key turns on. If not, start the process over from the beginning. If the light above the Num Lock key turns on, plug in the Printer (white) USB cable. Press the “Copy” button on the DMT screen to verify the printer is responding properly. After the five-minute warm up period is complete the DMT will be ready to begin a test.

## Screen Freeze

Unplug keyboard USB then plug it in again. Check the keyboard for functionality. If it does not respond, turn off DMT. Unplug the printer and keyboard USB from back of the DMT. After the DMT has been off for about 10 seconds, turn it back on. After the DMT has rebooted, plug in the keyboard (black) USB cable. Press the Num Lock key on the keyboard and verify the light above the key turns on. If not, start the process over from the beginning. If the light above the Num Lock key turns on, plug in the Printer (white) USB cable. If the screen froze at any time during the test and the DMT had to be restarted, the test was lost and must be rerun. Wait until the five-minute warm up period is complete and begin the test again.

## Status Codes (Messages)

Refer to the Status Messages or Definitions Chapter of this manual or the flip chart attached to the front of the DMT. Follow directions under “Response”. If the message is not listed, begin another test. If you receive the same message on further tests, use a different instrument or offer the subject a blood or urine test and call 651-793-2777 during normal business hours.

For any problem that cannot be readily resolved, use a different instrument or offer the subject a blood or urine test and call 651-793-2777 during normal business hours.

# Appendix 7
# Importing DMT results into eCharging

The BCA's DWI eCharging program and the breath testing database are integrated, allowing officers to import the subject's breath test or lab results during the eCharging process.

When the peace officer imports the test results the applicable data fields are automatically populated and a PDF copy of the DMT Test Record (or the BCA Lab Report) is attached to the eCharging event, relieving records staff from having to manually attach those important supporting documents.

One to two minutes after a DMT test record begins to print, the breath test results become available to eCharging. On the eCharging Incident Details page, the officer simply clicks "Get Breath Test Results" (Figure 1). The DMT tests run under that agency's ORI since the date of arrest are displayed. SELECT and IMPORT the test result and record (Figure 2).

DMT operators must remember that the breath testing database and eCharging are linked by the ARRESTING AGENCY ORI. The DMT operator must accurately enter the arresting agency's ORI into the DMT during data entry. If the ORI is not accurately entered, the systems will not link and the test data will not be available to the eCharging user.

If the feature that imports the breath test results into the eCharging DWI event fails to work:

- The **DMT operator** should print an extra copy for the agency file.
- The **arresting officer** should manually enter the test result, date, time of the sample, and first and last name of the DMT Operator.

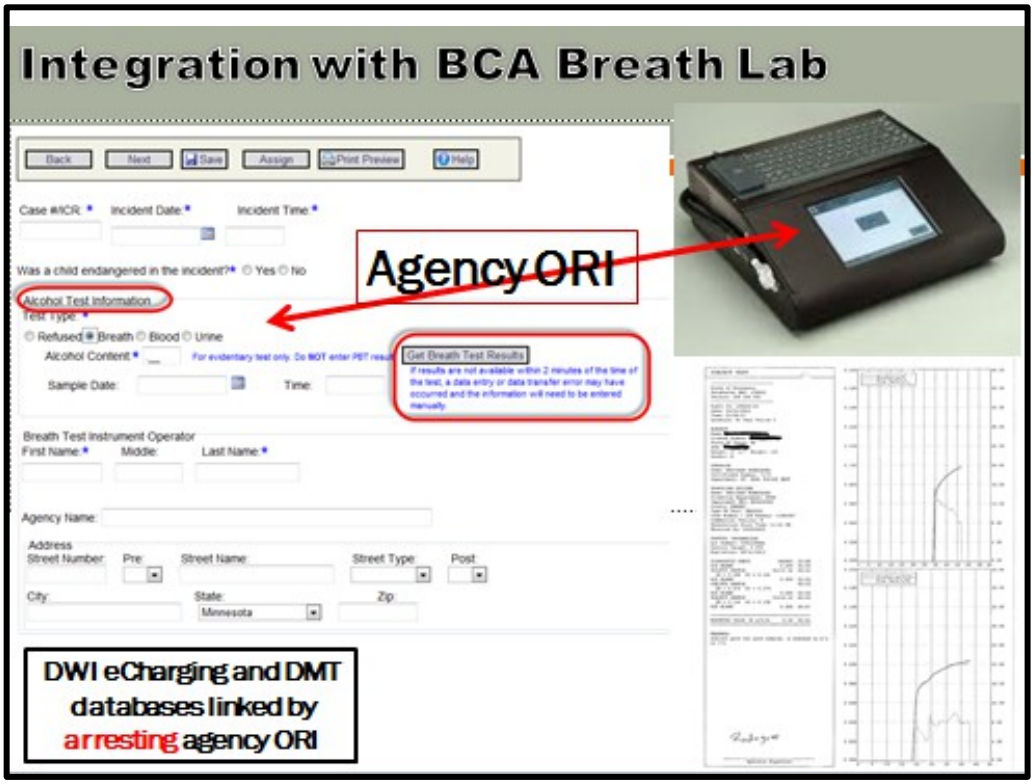


Figure 1

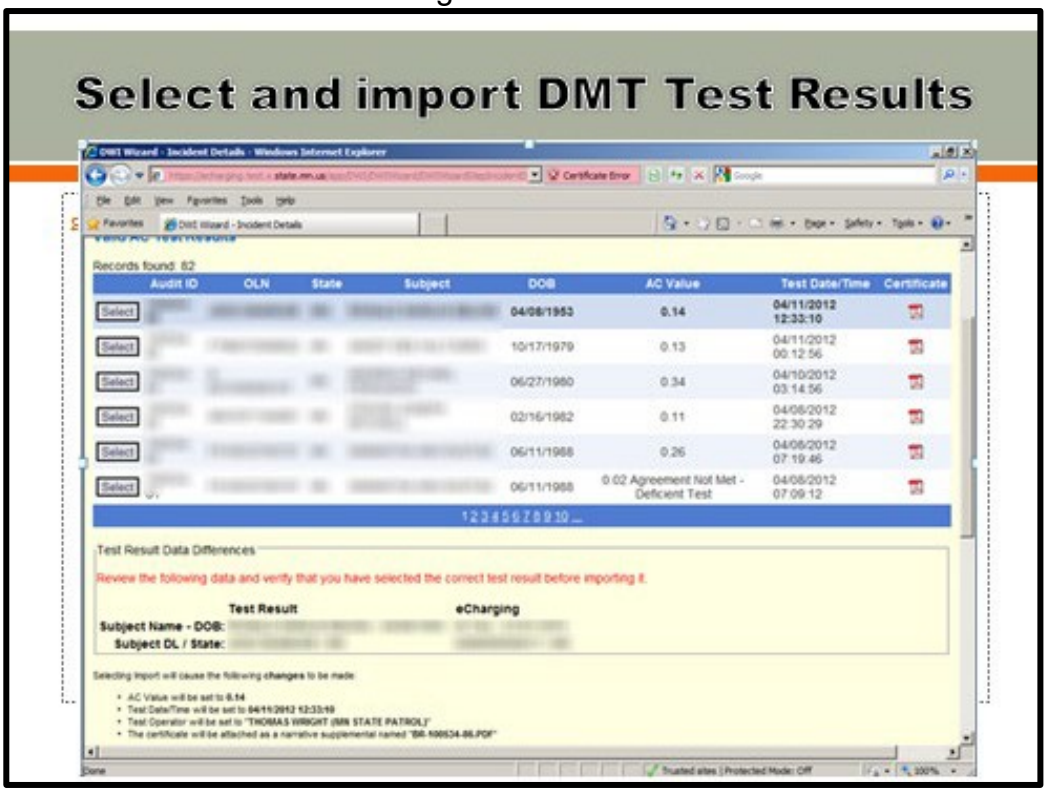


Figure 2

# Appendix 8
# References and Additional Reading

Baselt, RC. Disposition of Toxic Drugs and Chemicals in Man, seventh edition. Foster City, California: Biomedical Publications, 2004.

Couper, FJ and Logan, BK. Drugs and human performance fact sheets. DOT HS 809 725. U.S. Department of Commerce, National Technical Information Service, Springfield, Virginia, 22161, 2004.

Garriott, JC (editor). Medical-Legal Aspects of Alcohol, fifth edition. Tucson, Arizona: Lawyers and Judges Publishing, 2008.

Levine, B (editor). Principles of Forensic Toxicology, second edition. Washington, DC: AACC Press, 2003.

Moskowitz, H. and Fiorentino, D. A review of the literature on the effects of low doses of alcohol on driving-related skills. Herbert Moskowitz, PhD, Incorporated, DOT HS 809 028, U.S. Department of Commerce, National Technical Information Service, Springfield, Virginia, 22161, 2000.

National Patent Analytical Systems, Inc. Product Overview DMT, 2010

# Appendix 9

This information is provided as a convenience to agencies using breath testing equipment and is not a directive to do business with these particular companies. The prices listed may change; check before you order.

## Mouthpieces for the DMT

CMI, Inc.
316 E. Ninth St.
Owensboro, KY 42301
☎(800)835-0690 Fax (502)685-6268
https://www.alcoholtest.com

Intoximeters
2081 Craig Road
St. Louis, MO 63146
☎(314) 429-4000 Fax (314)429-4170
https://www.intox.com

## Mouthpieces for PBTs

CMI, Inc. (SD-2 & Alco-Sensor III)
316 E. Ninth St.
Owensboro, KY 42301
☎(800)835-0690 Fax (502)685-6268
https://www.alcoholtest.com

Intoximeters (SD-2, Alco-Sensor III, IV & FST)
2081 Craig Road
St. Louis, MO 63146
☎(314) 429-4000 Fax (314)429-4170
https://www.intox.com

LifeLoc. (FC-10 & FC-20)
12441 West 49th Avenue Unit #4
Wheatridge, CO 80033
☎(800)722-4872 Fax (303)431-1423
https://lifeloc.com

## Toner Cartridges for the Printer

HP printers use an HP CE278A toner cartridge. These cartridges are available from most office supply retailers.

## Dry Gas Cylinders and Regulators for PBT Calibration – Call manufacturer for current prices

CMI, Inc 1-800-835-0690
- Dry-Gas – 105 Liter
- Dry-Gas tank regulator

Intoximeters (314) 429-4000
- PBT Dry-Gas – 108 Liter (C)
- Dry-Gas tank regulator
- Dry Gas Cylinder Draining Tool
  (works best with Intoximeters tanks)

LifeLoc Technologies, Inc. 1-800-722-4872
- Dry-Gas – 105 Liter
- Dry-Gas tank regulator