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9/13/06

Infrared Breath Testing Device

STUDENT MANUAL

Vermont Criminal Justice Training Council / Vermont Department of Health

PLEASE NOTE:

The information provided herein is not designed to make the operator an expert on the BAC DataMaster. Proper operation of the BAC DataMaster does not require an understanding of Infrared Technology, deep lung physiology, or microprocessing. The Infrared Breath Testing Certification is intended to insure that officers can determine when an instrument is operating properly, and administer a test in accordance with the instructions/ questions prompted by the instrument.

TABLE OF FIGURES

INFRARED BREATH TESTING

Training Goals and Objectives

Learning Goal

To certify Vermont Police Officers in the operation of the BAC DataMaster and enable them to obtain a breath sample from a DUI subject to determine the blood alcohol concentration.

Objectives

As a result of this training, students will be able to:

a) Ensure the DUI subject has been advised of his/her rights appropriate to this test and that the 15 minute observation period is adhered to.

b) Ensure the BAC DataMaster breath testing instrument is operable and working properly.

c) Operate the BAC DataMaster breath testing instrument in accordance with the instructions/ questions prompted by the instrument.

d) Verify that the BAC DataMaster performs the calibration checks according to the prescribed test sequence.

e) Inspect the test record (evidence ticket) to ensure all information was printed accurately.

f) Make a log entry of the subject test at the time the test is completed.

g) Complete the DUI Processing Form according to directions.

h) Ensure that the subject has a copy of the evidence ticket.

i) Be prepared to testify in court about the procedure followed to operate the BAC DataMaster.

INTRODUCTION

Why convert to infrared breath testing?

For many years the State of Vermont collected and analyzed samples using the Gas Chromatographic Intoximeter System (GCI). This system had been used in Vermont since 1971 and consisted of a Field Sample Collection Device known as the Crimper, which is designed to collect a breath sample in a cylindrical tube of soft indium metal. The encapsulated samples are then sent to the State of Vermont Health Laboratory for analysis. The Crimper had worked well in Vermont as it was portable, easy to operate, maintain a duplicate sample, and the test results were accurate.

Over the years, problems have occurred as the DUI conviction rate has increased from 845 in 1971 to over 5400 today. This increase has caused a serious backlog of samples to be analyzed at the State of Vermont Health Laboratory, resulting in a six to eight week delay in obtaining a BAC result. Another problem is that Vermont remains the only state in the United States totally dependent on the Crimper for breath sample collection. Due to the limited demand for the Crimper, it is no longer being manufactured and the breath kits are very costly. In a memorandum from the Commissioners of Public Safety and Health dated October 1996, the State discontinued the processing of indium tubes as of December 1996.

The decision to convert to infrared breath testing was made after two years of study and consultation with people involved in all aspects of the DUI program. A major advantage to converting to infrared technology is the availability of an instantaneous permanent record of a suspect's BAC at the time of arrest. The infrared units are easy to operate, self-diagnostic, quick and accurate. This type of breath testing is used throughout the United States and Canada and has been on the market for over twenty years. As infrared units are phased in throughout Vermont, the State will no longer be dependent on one type of breath collection device, there will be no waiting for BAC results, and the number of days from arrest to adjudication would decrease dramatically. The implementation of infrared breath testing will improve the effectiveness of our DUI program.

SECTION I

ALCOHOL AND THE HUMAN BODY

Pharmacology
Toxicology

PHARMACOLOGY

Alcohol

Alcohol is a name for a particular type of chemical compound. All alcohols are hydrocarbon derivatives. All alcohols contain a hydroxyl group composed of two atoms, one oxygen and one hydrogen. All alcohols are miscible (infinitely soluble) in water. Within the general category of alcohols there are many individual chemical compounds. All of these compounds are alcohols, but each possesses different chemical properties. The different chemical structures of these various alcohols result in each chemical being metabolized by the body into different metabolic products. This is why each alcohol has a different level of toxicity. All alcohols are toxic. If a sufficient quantity is consumed or introduced into a human then death will result! Ethanol is the specific alcohol, which is present in alcoholic beverages. Ethanol in its purest state is a colorless liquid, which possesses an ethereal odor and produces a burning taste sensation. Unless otherwise specified, the term alcohol will be considered to mean ethanol in this text.

Alcohol Production

Alcohol can be produced naturally through the process of fermentation or synthetically produced through industrial means. The usual method of synthetic production is from the breakdown products produced when petroleum is refined. Alcohol synthetically produced is not sold for human consumption and is therefore not taxed by the federal government. Commonly, this product is denatured (poisoned) to discourage the consumption of this non-taxed alcohol. Methanol, isopropanol, pyridine, and benzene are four denaturants frequently used to poison industrially produced ethanol. Consumption of denatured alcohol can be very unpleasant and possibly lethal.

All alcohol intended for human consumption must be naturally produced. Natural production of alcohol always begins with the process of fermentation. Fermentation is the only process by which beer and wine are produced, and is the first step in the production of distilled spirits. To produce beer, the fermentation process is usually carried out in a large vat in which at least one grain, some malted barley, and yeast are combined. This mixture is referred to as the "mash." The malted barley contains an enzyme, beta-amylase, which converts the starch of the grain into sugar. The yeast then consumes the sugar and excretes ethanol as a waste product. This process will continue until either all the sugar has been consumed or the ethanol concentration reaches a maximum of approximately 15% by volume, thereby inactivating the yeast. In the production of wine, fruit juice is substituted in place of the grain, and the malt is unnecessary because the fruit juice is already high in sugar content. When beer or wine are the desired end products, the fermentation process is usually carefully controlled so that a product with a specific alcohol concentration is collected.

Beer usually contains about 4% ethanol by volume. Wine contains between 12% and 15% ethanol by volume. Wines of greater alcohol content are produced by either adding additional alcohol or blending the wine with another alcoholic product, such as brandy. All values for alcoholic beverages listed in this text are approximate values, which vary not only from state to state, but also from one nation to another. Production of distilled spirits (whiskey, rum, vodka, etc.) is accomplished by heating the fermented mash to evaporate the alcohol. The type of grain or cereal used in the mash and the manner of processing determines the type of beverage produced. The vapors from the heated mash are collected and cooled to form a liquid. This distillate (liquid portion) formed from the cooled vapors contains the ethanol plus some water and flavorings from the fermented mash. Throughout the process it is essential that precautions be taken to ensure that ethanol is the only alcohol collected. After the distillate is collected, it is commonly placed in charred wooden barrels for aging. During the aging process certain chemicals are extracted from the wood and are dissolved in the distillate. It is these chemicals, called congeners, which give aged distilled spirits (whiskey, Scotch or rum) their distinctive color, aroma and taste. Colorless distilled spirits (vodka and gin) are not aged and consequently have

only a faint color in comparison to aged spirits. Distilled spirits usually contain from 40% to 50% ethanol by volume. Fermented fruit juice may also be distilled. This is the process used to produce brandy. After distillation, the brandy is usually aged in oak barrels for at least three years.

Proof System

In the United States, the ethanol concentration of distilled beverages is shown by the proof system. The proof of an alcoholic beverage is equal to twice the ethanol concentration. As an example, 100 proof whiskey contains 50% ethanol by volume. Pure ethanol would be 200 proof because it is 100% ethanol.

Dosage Forms of Alcohol

Alcohol is usually ingested through the consumption of an alcoholic beverage. For the purposes of discussion, one "drink" will be considered to be one 12 fluid ounce serving of beer or one fluid ounce serving of 100 proof distilled spirits. A "drink" contains approximately one-half fluid ounce of pure ethanol. Since beer contains about 4% ethanol by volume, a 12 fluid ounce container of beer contains approximately one-half fluid ounce of pure ethanol.

12 fl. oz. x 0.04 = 0.48 fl. oz. ethanol

One fluid ounce of 100 proof distilled spirits contains one-half ounce of pure ethanol. One and one-quarter ounce of 86 proof distilled spirits contains approximately one-half ounce of pure ethanol.

1 fl. oz. x 0.50 = 0.50 fl. oz. ethanol
1.25 fl. oz. x 0.43 = 0.54 fl. oz. Ethanol

Wine usually contains about 12% ethanol by volume; therefore, a 4 fluid ounce serving of wine contains approximately one-half fluid ounce of pure ethanol.

4 fl. oz. x 0. 12 = 0.48 fl. oz. ethanol

Absorption of Alcohol

Ethanol can enter the human body in several different ways: injection, inhalation, and ingestion. Ethanol has not been demonstrated 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." Another possible route for ethanol to enter the body is through inhalation of alcoholic vapors. When the alcoholic vapors come into contact with the lungs and mucous membranes lining the nasal passages and throat, then the ethanol can diffuse through these membranes into the blood. However, to reach significant levels of alcohol concentration requires exposure to a severely irritating environment for an extended period of time. It is therefore very unlikely that 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 absorbed into the blood stream by diffusion through mucous membranes. Ethanol is not digested, but absorbed unchanged! The mouth, throat, and the entire gastrointestinal tract are all common sites of alcohol absorption. The anal canal, vaginal tract, and ureter are also lined with mucous membranes and could serve as possible sites for alcohol absorption (see Figure 1).

Course of Alcohol

Mouth

Esophagus

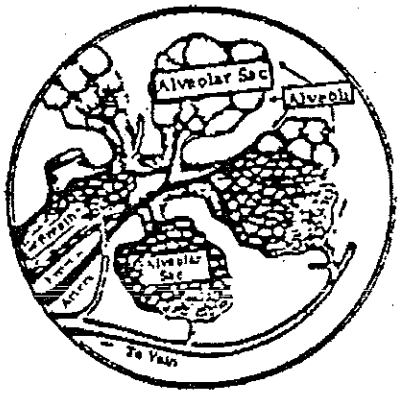
Stomach

Small Intestine

Portal Vein

Blood

To all parts of the body where it is stored in the water until returned by the blood to the liver to be oxidized.

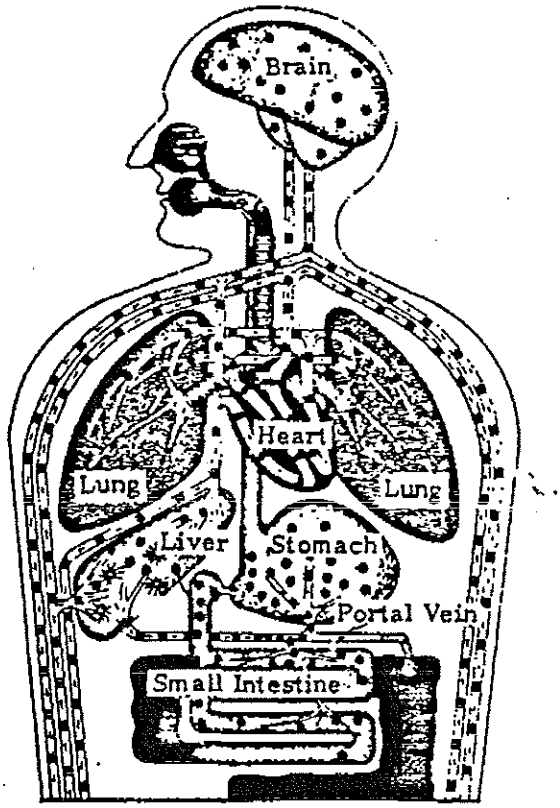


Primary Lobule of the Lung
(diameter of circle ≈ 1/50 inch)

Blood vessels in the lungs end in networks of capillaries in the walls of the alveoli.

Alcohol from the blood is imparted to the alveolar breath.

Alveolar breath contains 1/2100 as much alcohol as the blood.



> Direction of Flow

● Alcohol

✳ Alcohol being Oxdized

Figure 1: Anatomy and Alcohol Absorption

Once the alcoholic beverage enters the oral cavity, absorption begins immediately. Absorption continues as the beverage passes into the stomach and later into the small intestine. Since the alcohol absorbed through the mucous membranes lining the mouth is rapidly distributed to the surrounding tissue, the presence

of alcohol can still be detected even after the alcoholic beverage has been swallowed. Residual alcohol is the alcohol, which remains in the mouth and could affect a breath alcohol test. Alcohol can be reintroduced back into the oral cavity under certain conditions. If alcohol present in the stomach were regurgitated into the mouth, a portion of that alcohol would be absorbed by the mucous membranes lining the oral cavity. ***Regardless of how the alcohol is introduced into the mouth, the presence of residual alcohol diminishes below significant levels within 15 minutes. This is the reason for the 15 minute observation period in breath testing.***

When the alcoholic beverage reaches the stomach, some of the ethanol is absorbed through the stomach lining directly into the blood stream. This absorption from the stomach is unique because most other substances ingested cannot diffuse through the protective stomach lining.

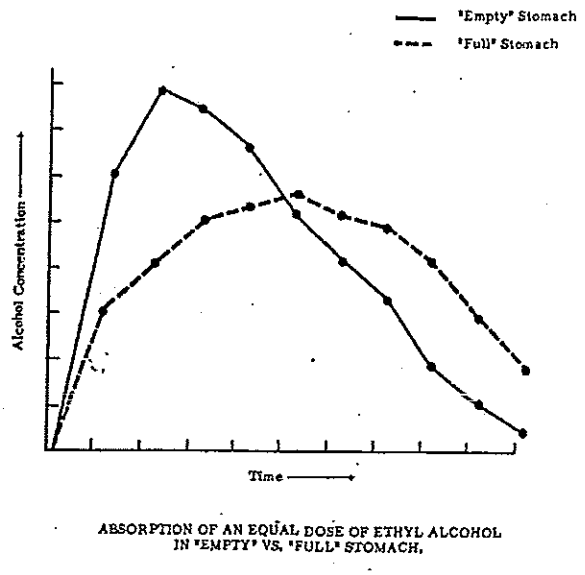


Figure 2: Absorption Rates with Full vs. Empty Stomaches

The rate of absorption of ethanol through the stomach lining and its passage into the remainder of the gastrointestinal tract can vary due to several factors. The type of alcoholic beverage consumed can affect the absorption rate. Carbonated beverages tend to promote absorption while fatty or oily beverages tend to slow down absorption. The concentration of ethanol in the alcoholic beverage consumed can also affect absorption. If the alcohol concentration in the stomach becomes too high, this can irritate the stomach lining and reduce the amount of alcohol absorbed from the stomach. Studies have also demonstrated that there is a concentration of' ethanol in a beverage which promotes the most rapid absorption. Concentrations higher or lower than this level are absorbed less rapidly. Higher altitudes tend to promote faster absorption of ethanol. The functioning of the pyloric sphincter, which controls the passage of the stomach contents from the stomach to the small intestine, can also have an effect on the rate of ethanol absorption. The longer the ethanol is held in the stomach, the slower the overall rate of absorption. The most significant effect on alcohol absorption is the quantity of food substances ingested with or immediately prior to consumption of an alcoholic beverage. A large amount of food present in the stomach will serve to delay the absorption of ethanol. If no food is present in the stomach, the rate of ethanol absorption is faster (see Fig. 2). The small intestine is the site of the most rapid absorption of ethanol and where 90-95% of the alcohol is absorbed into the bloodstream. All of these various factors are combine with others to determine the specific absorption rate of a particular individual. Because of these various factors, absorption of ethanol can best be explained through the use of general rules, which describe the overall concepts, but may not be specific for a particular situation. As a general rule only, complete absorption of a single alcoholic beverage on an empty stomach is usually accomplished in an hour to one and one-half hours after consumption.

Once the alcohol has been absorbed, it is transported throughout the entire body (see Figure 3). When the ethanol is absorbed into the blood stream from the small intestine, it is transported to, and passes through, the liver. From the liver, the alcohol travels with the blood to the right side of the heart. The alcohol and blood then travel to the lungs and return to the left side of the heart. When the alcohol and blood leave the heart, they are distributed throughout the entire body. The blood leaving the heart reaches the brain tissue directly through

the carotid arteries. Studies have shown that equilibrium between the arterial blood and the brain is reached extremely rapidly.

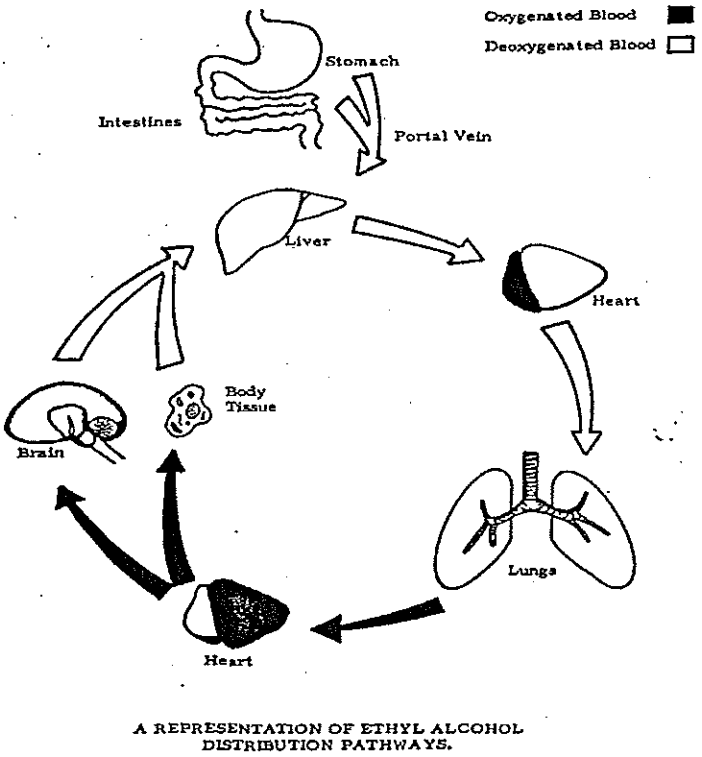


Figure 3: Ethyl Alcohol Distribution Pathways

The concentration of ethanol in the various tissues depends upon the tissue water content. The greater the water content of a tissue, the greater its alcohol concentration will be in relation to other tissues. Water content varies according to the different kinds of tissue. For example, the water content of muscle is greater than the water content of bone. The tissue water content can also vary from one individual to another. An obese person has less water per pound of body weight than an emaciated (thin) person does because adipose (fat) tissue has a very low water content. Body water content also varies according to sex. Females have less water per pound of body weight than males because, in general, they have a greater percentage of body fat. Since the concentration of alcohol is directly proportional to the body water content (within the limits already discussed) the concentration will vary according to the body weight. As a general rule, the heavier a person is the more alcohol that person must consume to reach a specific alcohol concentration in the body (see Figure 4). The rate of consumption can affect the distribution of alcohol throughout the body. A slow steady rate of consumption allows absorption and distribution to closely follow, thereby producing a slow steady rise in the alcohol concentration in the body. However, rapid consumption of a large quantity of an alcoholic beverage results in absorption exceeding the rate of distribution. This produces a rapid rise in the alcohol concentration in the body. When this happens, the alcohol concentration in the arterial blood will exceed the alcohol concentration in the venous blood. It is important to remember that it is the alcohol concentration in the arterial blood, which reaches the brain tissue and affects mental and physical faculties.

Elimination of Alcohol

Ethanol is removed or eliminated from the body by metabolism, excretion, and evaporation. Metabolic processes account for the elimination of most of the alcohol consumed. As the alcohol is transported through the body with the blood, it passes again and again through the liver. During each pass through the liver, a portion of the alcohol is metabolized by the enzyme alcohol dehydrogenase (ADH). The ethanol is oxidized to simpler compounds such as acetaldehyde and then acetic acid. The acetic acid is broken down by another process into carbon dioxide and water.

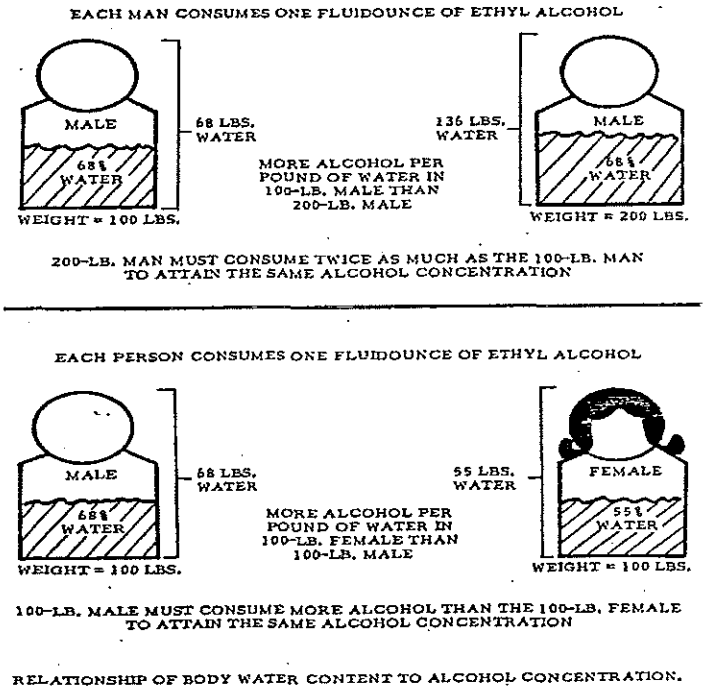
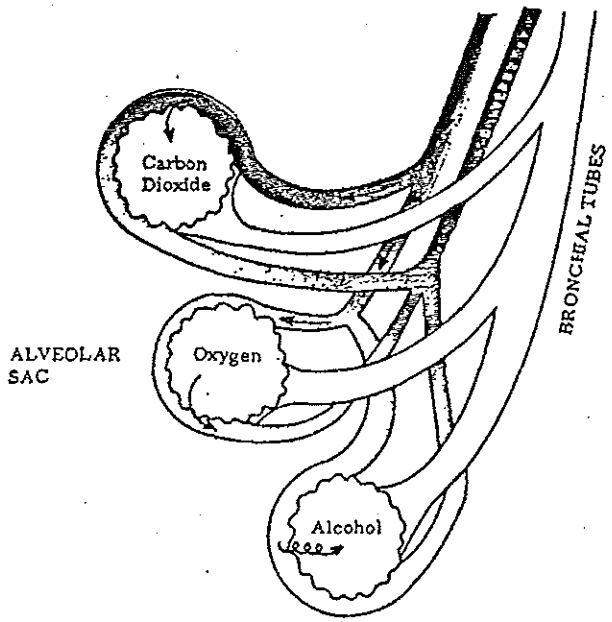


Figure 4: Body Water to Alcohol Concentration

A small percentage of ethanol consumed is excreted unchanged into the urine. The amount of ethanol in the urine is proportional, within certain limits, to the ethanol concentration in the blood. The urine is stored in the bladder prior to its elimination from the body. The bladder is very poorly supplied with blood and very little of the urine alcohol is reabsorbed back into the blood stream.

A portion of the ethanol consumed is eliminated from the body through the process of evaporation. Alcohol dissolved in the perspiration is transported through the skin and then evaporated into the surrounding air. A portion of the ingested alcohol diffuses into the breath and is then exhaled from the body. This exchange of alcohol from the blood to the breath occurs in the alveoli of the lungs (see Figure 5). The alveoli are minute tissue sacs in the lungs, which are richly supplied with blood from the heart. The separation between the alveoli and the blood capillaries is permeable to certain vapors. This is where the exchange between oxygen and carbon dioxide takes place. By diffusion, a portion of the alcohol in the blood evaporates into the breath. Henry's Law can explain this exchange of alcohol from the blood to the breath. According to Henry's Law, the concentration of a volatile substance in the air above a fluid is proportional to the concentration of the volatile substance in the fluid, within certain limits of concentration. The temperature of breath emanating from the mouth is normally 34 degrees Celsius. At this temperature the breath-blood ratio of 2100:1 has been accepted for use in computing alcohol concentrations. This means that a breath test instrument is calibrated so that 2100 milliliters of alveolar breath, at 34 degrees Celsius, will have the same alcohol concentration as one milliliter of blood. This does not mean that all individuals have a breath-blood ratio of exactly 2100:1. Recent studies have shown that the average breath-blood ratio is about 2300:1. If a person's ratio is higher than 2100:1, the breath analysis will slightly underestimate the blood alcohol concentration.

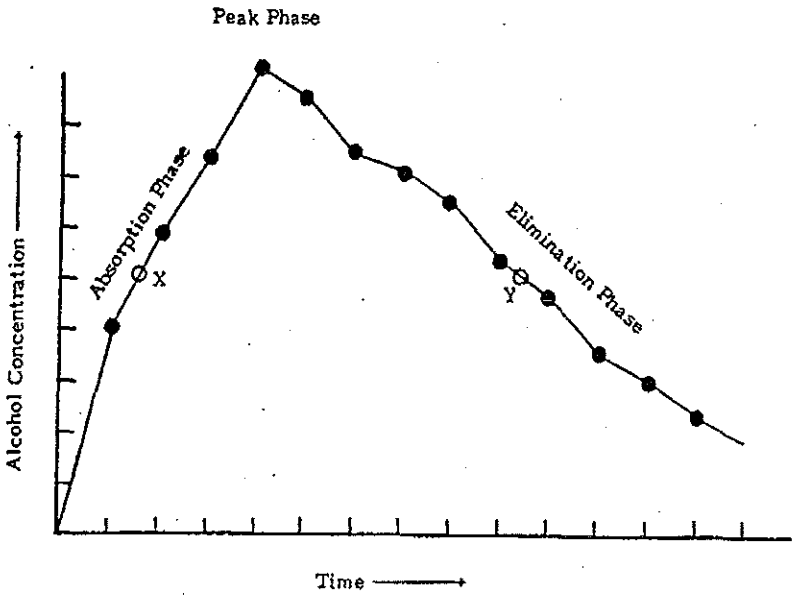


REPRESENTATION OF THE EXCHANGE OF ETHYL ALCOHOL BETWEEN THE BLOOD AND BREATH IN THE ALVEOLAR SACS OF THE LUNGS.

Figure 5: Alveolar in Lungs

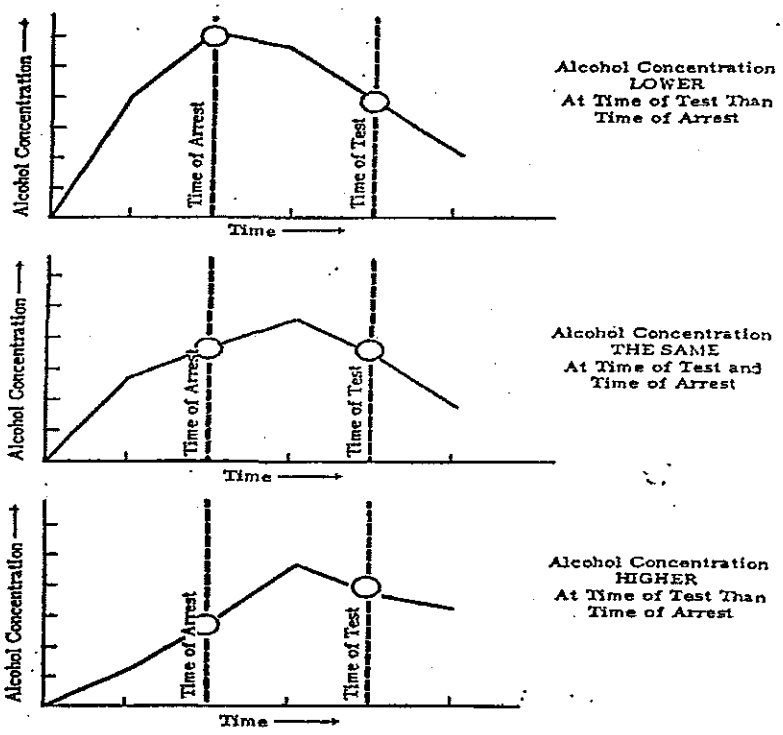
In breath alcohol testing, it is important to collect an alveolar sample. If an alveolar sample is not collected, then the sample will be diluted with breath of lower alcohol concentration from the upper respiratory tract. This will result in a lower than optimum test result. It is the responsibility of the breath test operator to collect the best sample possible. Regardless of the method, elimination is a physiological process and as such is not significantly affected by exercise or stimulants such as caffeine. Therefore, neither stimulants nor exercise will affect the results of a breath alcohol test. Fructose, a sugar, has been said to increase the rate of elimination of ethanol, but no consistent evidence of this occurrence has been demonstrated. Only increasing the rate of elimination would speed up the process of sobering up. Currently, the only proven method for sobering up is to allow sufficient time for the body to eliminate the alcohol.

The rate at which any one individual will eliminate ethanol is thought to be reasonably constant for that person. However, the rate of elimination may vary from one person to the next. It usually falls in the range between 0.01% and 0.02% per hour, the average being 0.015% per hour (these figures are understood to mean percent, or grams, of ethanol per one hundred milliliters of blood).



GENERALIZED ALCOHOL CONCENTRATION CURVE.

Figure 6: Generalized Alcohol Concentration Curve



THREE POSSIBLE RELATIONSHIPS BETWEEN ALCOHOL CONCENTRATION AT TIME OF TEST VS. TIME OF ARREST.

Figure 7: Test vs. Arrest

Alcohol Concentration Curve

As noted before, body weight affects the alcohol concentration reached when a given amount of alcoholic beverage is consumed. Assuming the normal healthy male with a body weight of 150 pounds, the consumption of one drink could produce an alcohol concentration of 0.027% in the blood. Recall that the body is capable of eliminating alcohol at the average rate of 0.015% per hour. Therefore, in order to accumulate alcohol in the body, the rate of absorption must exceed the rate of elimination. When consumption stops and absorption has been completed, the alcohol concentration will gradually fall as the alcohol is eliminated by the liver. Figure 6 shows a generalized representation of an alcohol concentration curve. This curve can be divided into three phases: the absorption phase, the peak phase, and the elimination phase. The slope of each phase will vary according to the various factors affecting absorption, distribution, and elimination of alcohol. It is important to understand that absorption, distribution, and elimination occurs in three phases. However, once the absorption rate has reached a peak, the rate of elimination is greater than the rate of absorption. This results in a net decrease in the alcohol concentration in the body.

The best method of determining the alcohol concentration in the body at any particular time is to conduct an analysis of a suitable specimen. When a breath alcohol test is administered, the results demonstrate the alcohol concentration at the time the sample was collected and analyzed. Based upon the results of a breath alcohol test, there are three possibilities as to what the alcohol concentration was at a time prior to the test. The alcohol concentration at a prior time could have been the same, higher, or lower depending on the circumstances (see Figure 7).

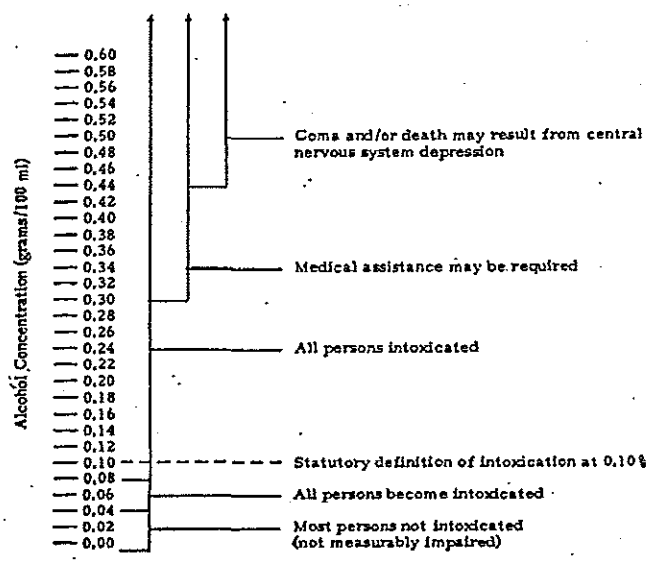
TOXICOLOGY

Intoxication

When the alcohol concentration reaches a certain level, the individual concerned is intoxicated. Intoxication refers to the reduction or loss of normal physical and mental faculties. Intoxication is based upon measurable changes in an individual's performance of a specific task, such as operating a motor vehicle. The term "intoxication" should be separated from the more common term "drunk." The term "drunk" is used as a descriptive word denoting a particular type of observed behavior.

A tremendous amount of research has been performed to identify the progressive levels of intoxication, induced by ethanol, with regard to impairment in the operation of a motor vehicle. This information does not apply either to public intoxication or the operation of boats, planes, or trains.

The single fundamental fact regarding alcohol consumption is that increasing alcohol concentration results in increasing impairment of normal physical and mental faculties. Research has demonstrated that even between 0.00% and 0.05% alcohol concentration, some individuals do exhibit measurable impairment. Changes in personality and mental states are sometimes observed, and some persons do show impairment even at this low level of alcohol concentration. When the alcohol concentration increases to between 0.06% and 0.09%, the majority of individuals demonstrate some degree of measurable impairment. Judgment is the first area noticeably affected. Behavioral changes are sometimes observed and there is a loss of social inhibitions. Fine muscular coordination is affected and complex reaction time is lengthened. Complex reaction time is the time required for a person to perform two tasks almost simultaneously. Above 0.08% alcohol concentration, current research has shown that all persons are impaired with regards to the operation of a motor vehicle (see Figure 8). Increasing the alcohol concentration above 0.08% results in further impairment of normal physical and mental faculties.



"A concentration of 80 milligrams of ethanol per 100 milliliters of whole blood (0.08% w/v) in any driver of a motor vehicle is indicative of impairment in his driving performance."
—National Safety Council Committee on Alcohol & Drugs, 1971

INTOXICATION GRAPH.

Figure 8: Intoxication Graph

As the alcohol concentration continues to rise, it presents a threat to life. Persons with an alcohol concentration of 0.30% or greater should be carefully observed and consideration given to seeking medical assistance. This level of blood alcohol may cause respiratory depression. An individual with an alcohol concentration of 0.40% or greater may lapse into a coma. This level of blood alcohol could result in death, although persons receiving medical attention have survived these levels and greater.

Tolerance and Ethanol

The least understood phenomenon of alcohol consumption is tolerance. Tolerance is usually defined as the effect, which results from the chronic use of a drug when larger doses become necessary to achieve the same desired effect. However, in discussing alcohol tolerance, it is more convenient to reverse this definition and consider tolerance as the effect where the expected changes in behavior or impairment in performance of a specific task are not observed. There are two general types of tolerance:

NATURAL TOLERANCE and LEARNED TOLERANCE.

NATURAL TOLERANCE consists of three areas: inborn tolerance, physical tolerance, and stress tolerance. Inborn Tolerance. Certain individuals demonstrate a natural inborn tolerance to low levels of alcohol concentration. These persons are able to perform a specific task as well and sometimes slightly better with a low level of alcohol compared to their performance when alcohol free. This effect may result because the alcohol has lowered the individual's anxiety in the testing situation. Physical Tolerance. The effect of a given alcohol concentration will always be greater in persons who are ill as compared to the same person when healthy. These individuals' normal physical and mental faculties are already affected due to their sickness and this adds to the effects of the alcohol.

Stress Tolerance. In high stress or anxiety situations, adrenaline is released in the human body to stimulate the body's response to the source of stress. In intoxicated individuals, this results in these persons appearing less intoxicated than they really are. Stress tolerance is only a temporary effect lasting for a few minutes. Due to the transient nature of this response, it has been difficult to determine whether this effect results in a lessening of the influence of the alcohol on these persons. Or if the adrenaline assists in making these individuals aware of their situation resulting in attempting to consciously disguise their intoxication. Regardless of how a person appears, it is imperative to remember that it is the impairment of the individual's normal mental and physical faculties, which are important. An individual may consciously or unconsciously attempt to disguise his intoxication, but this cannot alter the fact that his judgment, reactions, and coordination are impaired.

LEARNED TOLERANCE consists of three areas: behavioral tolerance, acquired tolerance, and acute tolerance. Behavioral tolerance is a result of the influence of the social setting and the social customs associated with alcohol consumption in a particular situation. An individual will behave differently in different social settings even though the alcohol concentration in that person was the same on both occasions. An individual's mood or sense of well-being will also influence his behavior at a particular alcohol concentration. A person who is depressed and unhappy is usually more depressed and unhappy following the consumption of alcohol. This effect is usually best observed at low levels of alcohol concentration because higher levels may alter the person's perception of reality. Acquired tolerance results from the chronic use of alcohol. A chronic user of alcohol is accustomed to the effects of alcohol and may attempt to compensate for these effects. These persons attempt to alter their behavior in order not to appear intoxicated. Tests demonstrate that these persons are indeed impaired in judgment, reaction, and coordination, but have learned through experience to disguise their outward appearance of intoxication. A novice drinker (one who has not experienced the effects of alcohol) will demonstrate greater outward effects than those expected at a given alcohol concentration. This is due to the absence of an acquired tolerance. Acute tolerance, sometimes referred to as the Mellanby Effect, is the result of an individual comparing his own assessment of his present condition with his past condition (see Figure 6). During the absorption phase of the alcohol concentration curve, the individual compares his perceived state with his condition when alcohol free. Thus a person at the position marked "x" compares his present state with his condition when alcohol free. His perception has been altered so that the effects of the alcohol are overestimated. Later, during the elimination phase, the same individual compares his present perceived state with the peak phase of the alcohol concentration curve. Thus, a person at the position marked "y" compares his present condition with the time when the alcohol in his body was at its highest concentration. His perception has been altered such that the effects of the alcohol are underestimated. In both instances, the alcohol concentration was equal and the person equally impaired. However, because the individual perceives himself as less intoxicated in the elimination phase, although equally impaired at a given alcohol concentration, this increases the hazard of operating a motor vehicle.

Because of the various aspects of alcohol tolerance, judging an individual's intoxication can be very difficult when based solely on visual observation. Their interpersonal relationships and social prestige often influence one person's judgment of another's intoxication. The best method for determining intoxication is to

analyze a suitable specimen to determine the alcohol concentration in that individual.

Effects of Alcohol

Ethanol acts as a depressant, not as a stimulant. It is this action of alcohol, which accounts for its effects on the human body. The effects of alcohol can be demonstrated in all sensory-motor functions, and there are definite effects on the biochemical pathways of the body. Ethanol has such a broad spectrum effect due to both the large quantity consumed and the site of action. It is not the alcohol in the peripheral areas of the body which impairs a person's coordination but the alcohol concentration in the brain tissue. It is in the brain that alcohol exerts its effects. In the brain, the alcohol acts to depress nerve transmission and to reduce coordination between various nerve centers. Depressing the nerve transmission results in the reduction of normal physical and mental faculties.

The first effect of alcohol is the impairment of judgment. Judgment is a general name given to various decision making aspects of human behavior. Such topics as social inhibitions, self-evaluation, risk assessment, and perception of reality are all included under judgment. Alcohol depresses learned social and cultural inhibitions. This can result in an individual demonstrating inappropriate behavior or the expression of suppressed hostility.

The depression of these inhibitions allows for the release of suppressed behavior that otherwise would have been concealed. Consumption of alcohol also results in an impairment of self-evaluation. Self-evaluation is the ability of an individual to judge his own behavior or performance in a particular situation. When individuals are required to perform a specific task both in an alcohol-free state and later when intoxicated, these individuals will usually rate their performance when intoxicated as better than when alcohol-free. However, independent observation of these individuals clearly demonstrates that when intoxicated they performed the task slower and with more errors. These individuals have lost the ability to judge their own performance. Alcohol also has the ability to create a feeling of euphoria. Euphoria is a sense of well-being. Because of this artificial sense of well-being, combined with an increase in the pain threshold, an intoxicated individual may ignore minor injuries. Serious injuries may be considered trivial with no attempt made to seek the necessary medical attention. Because of the induced state of euphoria, an intoxicated individual's perception of reality is altered. Another aspect of judgment affected by alcohol is risk assessment. Each person has the ability to determine what risks are acceptable to him and to understand the consequences of his actions. An intoxicated individual may accept risks, which would be unacceptable when alcohol-free.

Other aspects of an individual's mental faculties are also affected by alcohol. Intoxicated individuals may exhibit a loss of memory such as the inability to recite the alphabet. Intoxicated persons sometimes have difficulty in remembering the date and the time of day. Intoxicated individuals may demonstrate a shortened attention span and the inability to concentrate on a particular task.

Alcohol also has significant effects on the physical faculties. The sense of vision and visual perception, hearing, smell, and taste are all affected by alcohol. Alcohol can cause a blurring of vision because it depresses the coordination between the eyes causing them not to focus on the same spot. As the alcohol concentration is increased, this results in diplopia (double vision). Alcohol lengthens the glare recovery time. Glare recovery is the adjustment back to normal vision after a bright light has been shined in the eyes. Alcohol increases the time required for the eyes to make this necessary adjustment for night driving. When intoxicated, dim lights are more difficult to perceive and colors are harder to distinguish than when alcohol-free. An intoxicated individual may demonstrate the effect called light fixation. The intoxicated person's attention becomes fixed on a flashing light. It is not uncommon for police vehicles to be struck by another vehicle driven by an intoxicated person because of this effect. An intoxicated individual will also demonstrate the effect known as Positional Alcohol Nystagmus. When an intoxicated individual places his head in a lateral position, it can cause rapid involuntary eye

movements. This is why intoxicated persons sometimes complain of the room spinning around. Because of the rapid eye movements, the individual perceives that the room is moving. Alcohol affects visual perception resulting in the distorting of the estimation of distance. An intoxicated person will consistently overestimate distances and as one consequence will underestimate speed when operating a motor vehicle.

Alcohol also impairs hearing perception. Although no direct effect has been shown on the physical mechanism of hearing, alcohol raises the minimal level of noise to which the person will respond. Noises, which are usually heard, are ignored due to lack of attention. One consequence of this is that an intoxicated individual will raise his voice to compensate for this perceived hearing loss.

The nasal nerves are sensitive to small quantities of alcohol. Alcohol very quickly dulls the sense of smell. Because of this, the drinker quickly becomes unaware of his own odor. Alcohol also dulls the taste sensation resulting in most food tasting bland when an excess of alcohol has been consumed.

Alcohol exerts its effects on other physical faculties. Muscular coordination is affected by alcohol. Alcohol depresses the nerve transmission to the muscle, which affects the performance of the muscle. At low levels of alcohol concentration, fine muscular coordination is affected. As the alcohol concentration increases, larger groups of muscles are impaired, affecting gross muscular coordination. If the alcohol concentration continues to rise, the involuntary muscles are affected and respiration ceases, resulting in death. Because of the effects of alcohol on the nerves and muscles, reaction time is lengthened. At alcohol concentrations above 0.08%, the reaction time for performing a complex task is dramatically increased.

Alcohol can act as a vasodilator. This causes a relaxation of the blood vessel walls and results in more blood in the peripheral areas of the body (hands, feet, etc.). This effect is responsible for the flushed face observed in certain individuals who consume alcohol. This results in additional heat being lost from the human body because of the increase of blood near the body surface. Alcohol should not be given to a person suffering from exposure to cold because this may only further lower that person's body temperature.

Alcohol is a diuretic. Alcohol depresses the release of anti-diuretic hormones, which results in less water being retained in the body. The effect is best demonstrated when the alcohol concentration is rising.

Alcohol and Other Drugs

Alcohol is not the only agent, which could produce the effects already described. The situation will occasionally arise where an individual appears intoxicated but the breath alcohol test results are either 0.00 or much lower than expected from the observed behavior. This latter situation could occur if the subject was a novice drinker who lacked the experience of coping with alcohol-induced intoxication. However, the breath test operator should be aware that symptoms similar to alcohol intoxication could be produced by a combination or by certain diseases or illnesses.

When alcohol is consumed in combination with other chemical agents, illicit or prescribed, the symptoms of alcohol intoxication may be altered. This may explain the situation where an individual appears very intoxicated but the breath alcohol test results demonstrate a low level of alcohol. Combining drugs or other chemical agents with alcohol can produce two types of effects: additive or synergistic. When a given dose of a drug is combined with a given dose of alcohol and the effect is equal to the combination of the two doses of the drug and alcohol, this is referred to as the additive effect, i.e., 1+1 =2. The combination of alcohol and phenobarbital is an example of the additive effect. The synergistic effect exists when a given dose of a drug is combined with a given dose of alcohol and each reinforces the other, i.e., 1+1 no longer equals 2 but makes 4 or 5 units of effect. Valium is a drug, which produces the synergistic effect when combined with alcohol.

Drugs or other chemical agents, in the absence of alcohol, are capable of producing symptoms similar to alcohol intoxication. The breath alcohol test will not determine the presence of drugs other than alcohol. Other types of analyses must be performed to determine the presence of drugs or other chemical agents. Therefore, if an individual appears very intoxicated but the breath alcohol test results are negative, consideration should be given to the possibility that the individual is under the influence of drugs.

Certain illness or disease states are also able to produce symptoms similar to alcohol intoxication. Diabetes, epilepsy, and trauma are examples of conditions, which may fall within this category. When individuals have a low or zero breath alcohol test result, the breath test operator should consider the possibility of a medical condition being present. If a medical condition is suspected, consideration should be given to seeking medical assistance.

SECTION II

INFRARED THEORY

INFRARED THEORY

A gas law is a scientific statement of an order or relation that, as far as is known, is invariable under a given set of conditions. In other words, under the same set of conditions, the same things will happen each time. The following gas laws govern the operation of breath testing instruments.

Henry's Law

This law, discovered in 1803 by William Henry, a noted British chemist, applies to all breath testing regardless of the type of instrument used. If a water solution of a somewhat volatile chemical compound (ethyl alcohol) is brought to equilibrium with air at a constant pressure and temperature, a fixed ratio exists between the concentration of the compound in air and the concentration in water.

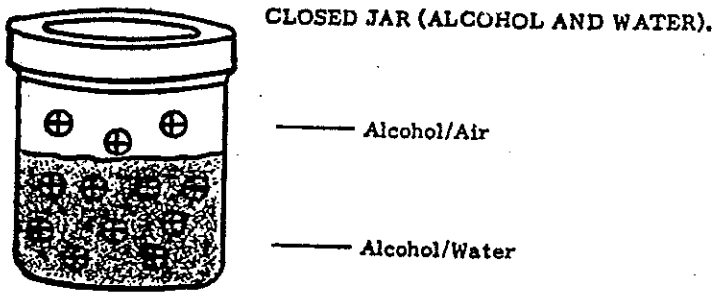


Figure 9: Alcohol and Water Jar

Volatile refers to any compound that evaporates rapidly. A state of equilibrium exists when there is no further change in the concentration of alcohol, in the air and the concentration in the liquid. Figure 9 represents a closed jar containing an ethyl alcohol-water solution with an air space above the solution. Being volatile, ethyl alcohol will evaporate into the air space above the solution. Equilibrium is reached when evaporation of the alcohol stops.

The same application of Henry's Law occurs in the innermost part of the lungs, the alveolar region. In this region, blood and air (breath) are in contact with one another. Just as in the closed jar example, alcohol in the blood will evaporate until a state of equilibrium is reached between the alcohol in the blood and the alcohol in the breath, and a fixed ratio of 2100 to 1 is established. This means that 2100 parts of the breath contain the same amount of alcohol as 1 part of blood.

This principle of Henry's Law accounts for the fact that by taking a breath sample, the concentration of alcohol in the blood can be determined.

Beer-Lambert Law

Documented by Lambert in 1760 and later detailed by Beer, the Beer-Lambert Law applies to those breath testing instruments which utilize the principle of infrared absorption by ethyl alcohol. As infrared energy and a breath sample are introduced into the breath test instrument, a measured amount of the infrared energy is absorbed. The energy absorbed is proportional to the amount of alcohol in the breath sample. The greater the amount of alcohol in the sample, the greater the absorption of infrared energy.

INSTRUMENTATION

The BAC DataMaster is one of the newest alcohol breath testing instruments to be introduced. Its forerunner, the BAC Verifier was introduced in the United States in 1981, and the current BAC DataMaster was developed in 1985. The operation of the instrument is controlled by a microcomputer. The instrument employs a method known as infrared absorption.

Please note that the information provided herein is not designed to make the operator an expert on the BAC Datamaster. It is to provide an understanding of what is happening inside the instrument so that the operator will be able to determine when the instrument is or is not operating property. Infrared absorption is a form of spectroscopy. It has been used for many years to determine the amount of interaction between light and molecules of matter. To understand what infrared absorption is, it is necessary to understand a little more about this interaction.

A prism can be used to separate light into its individual colors. This is a very simple example of spectroscopy. A rainbow after rain also displays the colors that are present in light. Light is one form of electromagnetic energy, which travels in rays or waves. The wavelength of a particular form of electromagnetic energy is the distance from the top of one wave to the top of the next. (See Figure 10).

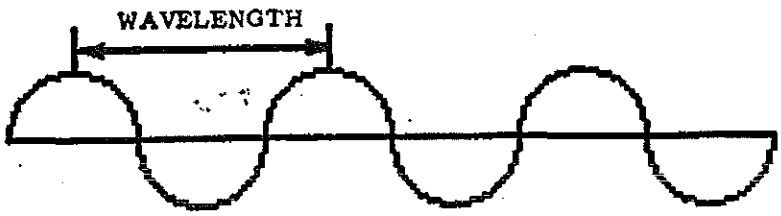


Figure 10: Wavelength

Wavelength can be measured in various units. One such unit is the micron.

1 micron = 1/1000 millimeter

The principle of infrared absorption is based on scientific observations that molecules of various chemical compounds will absorb infrared energy at certain wavelengths. Since these observations are repeatable, they form the basis for a scientific law. The Beer-Lambert Law defines the principle of infrared absorption.

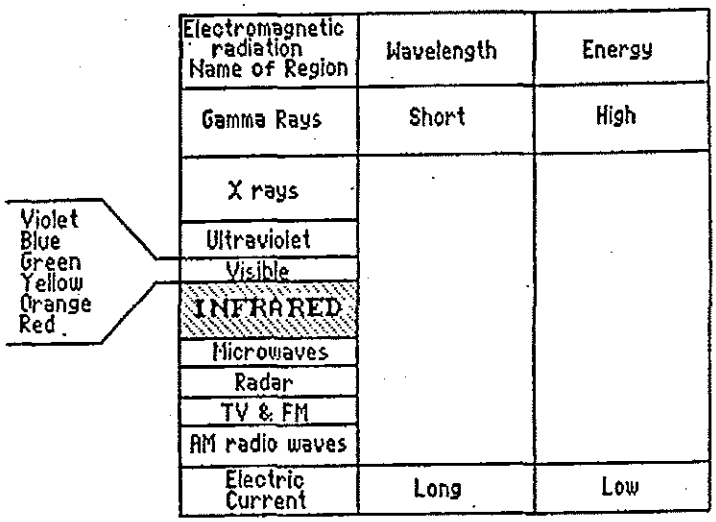


Figure 11: EM Spectrum Chart

Ethyl alcohol absorbs infrared energy with wavelengths in the 3 to 4 micron range. (The amount of alcohol present is determined by measuring the amount of infrared energy absorbed by the alcohol molecules in the sample.) By looking at the complete absorption spectrum of ethyl alcohol, we can determine at what wavelengths it is the most specific. This can be used to obtain optimal results. The instrument uses filters to isolate infrared energy at these specific wavelengths.

The following chart (see Figure 11) shows types of electromagnetic energy in order of, increasing wavelength.

SECTION III

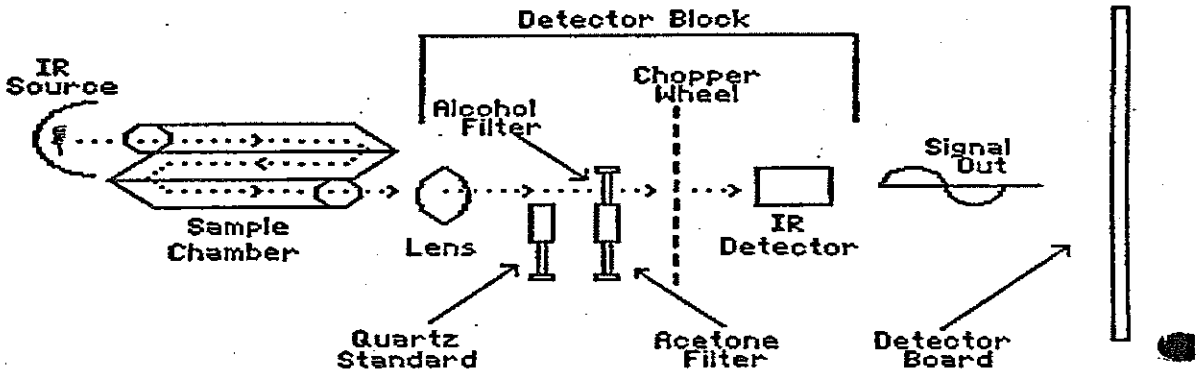
OPERATIONAL PRINCIPLES

Operational Principles of the BAC Datamaster

OPERATON

Basic Components of the BAC DataMaster

1. Source. A lamp which emits infrared energy (light).
2. Sample Chamber. The volume of the sample chamber is approximately 50 cc. The chamber is composed of three parallel sections with a total length of 1.1 meters through which the infrared energy passes. Mirrors are used to reflect the light through the entire length of the chamber.
3. Filters. The filters are used to isolate a specific wavelength by filtering out all other wavelengths. The BAC DataMaster has two filters, one, which filters infrared energy at 3.44 microns and a second, which filters infrared energy at 3.37 microns. The purpose of the second filter is to separate other compounds such as acetone that could be in the individual's breath and that also absorb infrared energy at or near the same wavelength as ethyl alcohol (see Figure 2, Page 19)
4. Quartz Standard. An internal quartz plate with a known infrared absorption.
5. Chopper. A device, which breaks up the light into shorter, beams or pulses before they reach the detector.
6. Detector. The detector is used to determine the amount of infrared energy. The amount of infrared energy absorbed is proportional to the amount of ethyl alcohol present in the sample.
7. Microcomputer. The microcomputer controls the test sequence and instructs the electronic components to automatically perform the various functions during the analysis. It also provides the instructions for storing the data collected on each test.
8. Simulator. The simulator is designed to contain a water-alcohol solution and is attached via two plastic hoses to the BAC DataMaster. The simulator is a constant temperature instrument that provides a high precision alcohol-air standard. The solution in the simulator is maintained at a constant temperature of 34 degrees (+ or - .5 degrees) Celsius by an internal heater.



BASIC COMPONENTS OF THE BAC DATAMASTER.

Figure 12: Datamaster Components

External Features of the BAC DataMaster

1. LCD. The liquid crystal display (LCD) identifies each part of the test procedure as it occurs and provides information to the operator to complete the test. The LCD displays 24 characters, which can be letters, numbers, or symbols.
2. Supervisor Control Panel. The supervisor control panel contains a set of buttons or pads, which control special functions.
3. Evidence Ticket Slots. There are two slotted openings on the lower left front of the instrument. An evidence ticket is inserted in the lower slot. When the test is completed, the ticket will be ejected through the upper slot.
4. RFI Antenna. The Radio Frequency Interference antenna monitors the instrument environment for the presence of RFI during the test. It inhibits operation when RFI is present.
5. Power Cord. The power cord is attached to the rear of the instrument. The instrument has an internal power monitor.
6. Power ON/OFF Switch. The power ON/OFF switch is located on the rear panel. Always make sure the power switch is in the OFF position before plugging the instrument in. *If a power failure occurs, switches should be reset and the instrument should be powered up using the initial START-UP procedure.*
7. Heated Breath Tube. An electrically heated tube, which provides a breath path from the mouthpiece to the sample, chamber.

START-UP Procedure

1. Place the instrument on a clean, flat, sturdy surface. Do not place on a padded or rug-like surface. Allow adequate space for ventilation on all sides of the unit. With the power switch in the "OFF" position, plug the instrument's power cord into an AC source.

NOTE: Smoking should not be allowed in the immediate area. The instrument and surrounding area should be kept as free from dust as possible. The keyboard should be the only object placed on top of the instrument. Beverages or other liquids should not be placed on the instrument or in the immediate area.

2. Push the power switch to the ON position. The instrument will display the date and time. "PLEASE WAIT" will appear on the display while the instrument is in the warm-up mode.
3. The warm-up period will last approximately 10 to 20 minutes. More time will be required if the instrument has been in a very cold environment.
4. The green READY light appears when the instrument is warmed up to operating temperature (approximately 50 degrees C). The instrument should be left with power ON continuously.

Steps of Operation of BAC DataMaster

Step 1: Visually observe subject for any evidence of food, gum, tobacco, or any foreign objects in the mouth. Ask subject if she/he has any food, gum, tobacco, or anything else in their mouth. Record the time of this examination using either the DataMaster LCD clock, the clock in the agency or processing room, or your own watch. Record which one you used and compare to the DataMaster time. Begin 15 minute observation period. **NOTE:** Time of the breath test will be recorded automatically by the BAC DataMaster.

Step 2: Confirm power (display) to BAC DataMaster is on. Always leave instrument turned on.

Step 3: Confirm breath tube is heated by touching it.

Step 4: The DataMaster will display the date, time, "READY" and a flashing "PUSH RUN". The operator will now push the RUN button to begin the breath analysis process.

Step 5. The instrument will then display: "INSERT TICKET"

Follow instructions on ticket, which indicates "This Side Down - This Edge In". Insert the evidence ticket in the lower slot marked "IN", face down. Follow instructions.

Step 6. The DataMaster will then sequentially display twelve (12) pre-programmed questions, which pertain to the subject and circumstances of the DUI incident. The questions are as follows:

"CASE NUMBER"
"TOWN CODE"
"SUBJECT'S NAME"
"SUBJECT'S DOB MM/DD/YY"
"SUBJECT'S SEX"
"LOCATION OF STOP"
"TIME OF STOP HH:MM"
"ACCIDENT? (Y/N)"
"TEST OPERATOR'S NAME"
"OFFICER ID NUMBER"
"DEPARTMENT"
"REVIEW DATA (Y/N)"

After all the above data has been entered correctly, two events will occur simultaneously:

1. Data will be entered into the memory of the instrument.
2. The BAC DataMaster begins the breath test sequence.

Step 7: The instrument will sequentially display the following:

"PURGING" - Room air is being pumped into sample chamber through the breath tube.

"AMBIENT ZEROING" - Setting of atmospheric ethyl alcohol, if any, to zero.

"BLANK TEST" - Check of sample chamber for contaminants.

"INTERNAL STANDARD CHECK" - An automatic check by the instrument to ensure the detector is functioning properly.

"EXTERNAL STANDARD"

"TEST RESULTS ALCOHOL" - The DataMaster automatically runs a sample from the external standard (simulator) attached to the instrument.

The external standard should be between .090 and .110 inclusively. (If the external standard is less than .090 or greater than .110, then):

1. Instrument will print "Simulator Out Of Range" on LCD and ticket. Instrument will not allow further operation and will be out of service until reset by supervisor.
2. Take subject to another instrument or take to hospital to have blood drawn.
3. Report external standard out of tolerance to your DataMaster Supervisor.

After the external standard is run, the instrument then displays:

"PURGING"
"AMBIENT ZEROING"
"BLANK TEST"

Step 8. "SUBJECT TAKE TEST (Y/N)"

A. If the subject consents to the breath test, type "Y".

B. If the subject refuses to provide a breath sample, type "N" for a refusal. The evidence ticket, when printed, will document the refusal and the breath sampling sequence automatically ends. All refusals must be documented with an evidence ticket.

Step 9: If the subject has consented to the breath test, the display now flashes: "PLEASE BLOW".

Insert a new mouthpiece into the breath tube.

NOTE: Each mouthpiece is in its own plastic bag. Open one end of the plastic bag. Use the plastic bag to avoid *touching the mouthpiece* as you firmly insert the mouthpiece into the breath tube.

At this time, the operator will instruct the subject to provide a slow, consistent, continuous breath sample through the mouthpiece attached to the breath tube of the instrument. This may take 5-10 seconds or longer depending on the individual. The internal electronics of the instrument determine when an adequate sample has been obtained. DO NOT instruct the subject to take a deep breath prior to giving sample.

As the subject complies, the words "PLEASE BLOW" no longer flash, but remain on the display and a steady tone will be heard. Subject must continue to blow until told to stop by the officer. A BAC result will then appear in the lower right hand corner of the display. Inform the subject of this test result.

"TEST RESULTS"
"ALCOHOL (three digits)"

Operator must now remove the mouthpiece and discard it.

Step 10: The following displays will then appear on the LCD:

"PURGING"
"2ND TEST REQUESTED (Y/N)"

Step 11: The operator must inform the subject of the result of the evidentiary test and ask if the subject wishes to provide a second test. If the subject declines the second test, the operator should enter "N" and an evidence ticket will be printed. The evidence ticket will indicate the result of the evidentiary test and will also show "SECOND TEST NOT TAKEN" and will display the "SIMULATOR TEMPERATURE". (If the subject requests a second test, the operator should press "Y".)

The instrument will then display:

"PURGING"
"AMBIENT ZEROING"
"BLANK TEST"
"INTERNAL STANDARD CHECK"
"EXTERNAL STANDARD"
"TEST RESULTS ALCOHOL"
"PURGING"
"AMBIENT ZEROING"
"BLANK TEST"
Following completion of the blank test, the instrument will display:

"PLEASE BLOW"

The operator should insert a ***new*** mouthpiece in the breath tube and instruct the subject to provide a breath just as was done during the first test.

Once a sufficient sample has been collected, the instrument will display:

"TEST RESULTS"
"ALCOHOL" (three digits)
The operator must remove the mouthpiece immediately and discard it.

"PURGING"

An evidence ticket will then be printed.

After the evidence ticket has been printed, the ticket will advance through the upper slot of the instrument.

Remove the ticket ***after*** the printer has stopped.

NOTE: The evidence ticket is printed in triplicate. It is intended that:

1. The top sheet (white) will go with the rest of the paperwork of the case to the State's Attorney.
2. The arresting officer will retain the second sheet (yellow).
3. The third sheet (pink) will be given to the subject.

DATA REVIEW PROCEDURES

The BAC DataMaster will ask you 12 questions regarding your DUI arrest. Use the keyboard to type in answers (data) to these questions. Use the backspace to correct typing errors as you enter the data. After each answer, press the return key to advance the display to the next question. When you answer the last question (and press the return key), the display will ask "Review Data". If you want to review the data, type "Y" for yes. The first question will reappear. Pressing the return key advances the display to the next question. If you find data has been entered incorrectly, these are two methods available to correct it.

1. Press control and "I" keys simultaneously. This will move the cursor to the right.
2. The backspace key can also be used. This will move the cursor to the left.
3. The delete key will remove the character that the cursor is on.

Note: As you type in each character (letter and number), you will hear a beep. If a disallowed character is typed, you will hear a louder beep and the character will not be displayed. The table below summarizes how to correct answers (data) to the operator questions.

Modes

Press Key(s)	Enter Mode	Review Mode
BACKSPACE cursor left one at a time.	Erases one character at a time; moves cursor left.	Does not erase; moves
CONTROL AND X	Erases entire line; puts cursor at the start.	Does not function.
CONTROL AND I one space at a time.	Does not function.	Does not erase; moves cursor right
DELETE leaves no space.	Does not function	Deletes the character the cursor is on;

NOTE: After editing data the instrument will ask if you again wish to "Review Data". The officer should press "N" for no.

NOTE: If any of the following messages are displayed, the instrument will not function:

"FATAL SYSTEM ERROR"

"CALIBRATION ERROR"
"TEMPERATURE HIGH"
"TEMPERATURE LOW"
"PUMP ERROR"
"SIMULATOR TEMPERATURE ERROR"

A. Attempt to restart the test by pushing the RUN key.

B. If the message persists:

(1) Take instrument out of service.

(2) Take subject to another instrument, or have blood drawn.

(3) Report instrument out of service to your DataMaster Supervisor.

(4) Retain error ticket and attach to your case.

Time Restrictions on Data Entry

The operator will have approximately five (5) minutes when prompted to enter data. If data is not entered, the instrument will return to the beginning of the data entry procedure. When prompted by the instrument for a decision ("Subject Take Test [Y/N]", "Review Data", or "Use Previous Data") the operator will have one (1) minute to enter the reply.

Once the data has been entered, and the "Please Blow" prompt is displayed, the subject will have approximately two (2) minutes to give a sample. If a sample is not given, the instrument will return to the "Subject Take Test" prompt.

ERROR MESSAGE CORRECTIONS

If any of the error messages given below appear on the DataMaster instrument display, follow the appropriate instructions listed below:

1. **BLACK BAR** appears on upper half of display.
   A. Turn instrument OFF with switch at rear of instrument.
   B. Wait one (1) second and turn instrument ON.
   C. If dark bar remains:
      1. Turn instrument OFF with switch at rear of instrument.
      2. Contact your DataMaster Supervisor for corrective action.

2. **INCORRECT TIME** appears in upper right comer of display.
   - Contact DataMaster Supervisor for corrective action.

3. **INCORRECT DATE** appears in upper left comer of display.
   - Contact DataMaster Supervisor for corrective action.

4. **KEYBOARD** does not function.
   A. Disconnect keyboard from rear of instrument.
   B. Reconnect keyboard into terminal marked KEYBOARD at rear of instrument.
   C. If keyboard still does not function
   D. Take instrument out of service. Contact DataMaster Supervisor for corrective action.

5. **"NOT SET UP"** - default options not located in instrument.
   - Take instrument out of service. Contact DataMaster Supervisor for corrective action.

6. **"SYSTEM WON'T ZERO"** - message appears when instrument is unable to zero.
   A. Remove mouthpiece from breath tube.
   B. Open windows or use fan to draw fresh air into room.
   C. Start testing procedure again.
   D. If "SYSTEM WON'T ZERO" message remains
      1) Place fresh mouthpiece on breath tube.
      2) Alternately blow into and suck back strongly and rapidly on breath tube 5-6 times.
      3) Start testing procedure again.

E. If "SYSTEM WON'T ZERO" message remains take instrument out of service. Contact DataMaster Supervisor for corrective action.

7. **"PLEASE BLOW"** flashes - but instrument does not take sample
   A. Remove mouthpiece from breath tube and replace with a new mouthpiece.
   B. Have subject provide breath sample again.
   C. If "PLEASE BLOW" error message remains
      1) Turn instrument OFF for one minute
      2) Turn instrument ON and wait for "READY - PUSH RUN" to appear on display panel.
      3) Start testing procedure again
   D. If "PLEASE BLOW" error message remains
      1) Take instrument out of service. Contact your DataMaster Supervisor for corrective action.

8. **"PRINTER ERROR"** - evidence ticket has jammed or printer has malfunctioned.
   A. Gently remove evidence ticket as noted.
   B. Press CPY button
   C. Insert evidence ticket in lower slot.
   D. If "PRINTER ERROR" remains take instrument out of service. Contact your DataMaster Supervisor for corrective action.

9. **"PUMP ERROR"** - pump fails because of sticking valve.
   A. Place fresh mouthpiece on breath tube.
   B. Alternately blow into and suck back strongly and rapidly on breath tube 5-6 times.
   C. If "PUMP ERROR" remains, take instrument out of service. Contact your DataMaster Supervisor for corrective action.

10. **"SIMULATOR OUT OF RANGE"** - simulator solution is exhausted.
    A. Take instrument out of service. Contact your DataMaster Supervisor for corrective action.

11. **"SIMULATOR TEMPERATURE ERROR"** - simulator temperature is out of range.
    A. Wait for a few minutes.
    B. Press "RUN" button.
    C. Insert ticket when prompted.
    D. When "USE PREVIOUS DATA (Y/N)" prompt is displayed, enter "Y".
    E. Review data and make necessary corrections.

F. Process subject.

G. If "SIMULATOR TEMPERATURE ERROR" remains take instrument out of service. Contact your DataMaster Supervisor for corrective action.

12. **"RADIO INTERFERENCE"** - triggered by keying microphone of portable radio "ON" near the instrument or possibly by physically causing antenna to vibrate excessively.

A. Turn radio "OFF" and/or be certain antenna is not touched during processing.

B. Press "RUN" button.

C. Insert ticket when prompted.

D. When "USE PREVIOUS DATA (Y/N)" prompt is displayed, enter "Y".

E. Review data and make necessary corrections.

F. Process subject.

G. If "RADIO INTERFERENCE" message remains take instrument out of service. Contact your DataMaster Supervisor for corrective action.

13. **"NOT CALIBRATED"** - instrument has lost calibration.

A. Take instrument out of service.

B. Contact your DataMaster Supervisor for corrective action.

14. **"INVALID SAMPLE"** - caused by insufficient breath from subject.

A. Press "RUN" button.

B. Insert ticket when prompted.

C. When "USE PREVIOUS DATA (Y/N)" prompt is displayed, enter "Y".

D. Review data and make necessary corrections.

E. Process subject, carefully explaining how to blow into instrument to provide valid sample.

F. If "INVALID SAMPLE" message appears again, may treat as a refusal.

15. **"INVALID SAMPLE"** - caused by subject bringing alcohol into mouth by burping, belching, vomiting, etc.

A. Start 15 minute observation period again.

B. Press "RUN" button.

C. Insert new evidence ticket when prompted.

D. When "USE PREVIOUS DATA (Y/N)" prompt is displayed, enter "Y".

E. Review data and make necessary corrections.

F. Process subject.

G. If "INVALID SAMPLE" message appears again, may treat as a refusal.

16. **"INTERFERENCE DETECTED"** - a material other than ethyl alcohol is detected.
    A. Start 15 minute observation period again.
    B. Press "RUN" button
    C. Insert new evidence ticket when prompted.
    D. When "USE PREVIOUS DATA (Y/N)" prompt is displayed, enter "Y".
    E. Review data and make necessary corrections.
    F. Process subject.
    G. If "INTERFERENCE DETECTED" message appears again, have subject's blood drawn.

17. **"INCOMPLETE OR ILLEGIBLE EVIDENCE TICKET"** - caused by ticket jam or improper insertion
    A. Press "CPY" (copy) key on keyboard or supervisor panel.
    B. Insert evidence ticket when prompted by instrument display screen.

Sample Question Displays

Question 1 - CASE NUMBER

Agency Case Number. A maximum of 20 characters is allotted for the case number. They may be:

1. A number
2. A hyphen
3. A letter of the alphabet

Example: "95-021-B—00001"

Press RETURN key to continue.

Question 2 - TOWN CODE

County/Town Code. This is the assigned code for the county/town. See Appendix for your code. This is the county/town in which the offense took place, NOT where the processing is done. A maximum/minimum of four (4) characters are required. They must be numbers.

Example: "1128" (Code for Rutland County/Town of West Rutland)

Press RETURN key to continue.

Question 3 - SUBJECT'S NAME

Subject's Name (L/F/M): Forty characters are allotted for subject's name. They may be:

1. A letter
2. A slash
3. A hyphen

Type "last name/first name/middle initial"; use slash to separate as shown below. Use hyphen *only* when part of subject's name. If no middle initial, leave blank.

Examples: ALLEN/DOUGLAS

PLAGE-WOLK/CAROLYN/J

Type in subject's name. If subject's name is unknown, type in UNKNOWN.

Press RETURN key to continue.

Question 4 – SUBJECT'S DOB

Subject's date of birth.

mm/dd/yy

No future dates allowable. The month/day combination must be valid. All six characters must be entered. All characters must be numeric.

Examples:

Correct Forms	Incorrect Forms
01/07/56	1/7/56
07/07/76	7/7/76
10/01/10	10/1/10
10/10/01	10/10/1
01/10/10	1/10/10

Type in month, type in day (slash (/) is typed automatically), type in year. If birth date is unknown, type in the date sample is collected.

Press the RETURN key to continue.

Question 5 - SUBJECT'S SEX

One character is required. Must be either "M" or "F".

Press RETURN key to continue.

Question 6 - LOCATION OF STOP

Location where vehicle was stopped or accident occurred. A maximum of 40 characters is allotted. They may be:

A. A letter

B. A number

C. A hyphen

D. A slash

Be as specific as possible. It is NOT necessary to include name of town/city as this information is recorded in Question # 2.

Examples:

Route 7/Blakely	(On Rte 7 at Blakely)
Church and Main	(At intersection of Church & Main)
189/MM90	(Interstate 89 at Mile marker 90)
SR116/2 mi. South of Bristol	(State Rte 116 as indicated)

Press RETURN to continue.

Question 7 - TIME OF STOP

Time of stop (hh/mm)

When this display occurs, type in the time you stopped vehicle and made contact with the subject. Record time in 2400 hour time.

Examples:

0300, 1408, 2318

Press RETURN key to continue.

Question 8 - ACCIDENT?

Did this incident involve a motor vehicle accident? One character is required and must be either a "Y" for yes or "N" for no.

Press RETURN key to continue.

Question 9 - TEST OPERATORS NAME

Operators name (L/F/M).

Note: Operator is operator of BAC DataMaster.

Forty characters are allotted. They may be:

A. A letter

B. A slash

C. A hyphen

Type "your last name/first name/middle initial". If no middle initial, leave blank.

Use hyphen *only* when part of your name. Use slash to separate as shown above.

Examples:

FURILLO/FRANK/J

DAVENPORT-FURILLO/JOYCE/A

Press RETURN key to continue.

Question 10 - OFFICER ID NUMBER

Processing Officer's individual ***Vermont Traffic Complaint (VTC) number*** used in traffic violation cases. A maximum of 7 characters is allotted for the officer's ID number. They may be:

1. A letter
2. A number

Question 11 - DEPARTMENT

Operator's agency. A maximum of 30 characters is allotted for the officer's agency. They may be:

1. A letter
2. A number

3. A space
4. A hyphen
5. A slash

Examples:

PD/Colchester

VSP/Bethel

SD/Orleans

FW/Chittenden

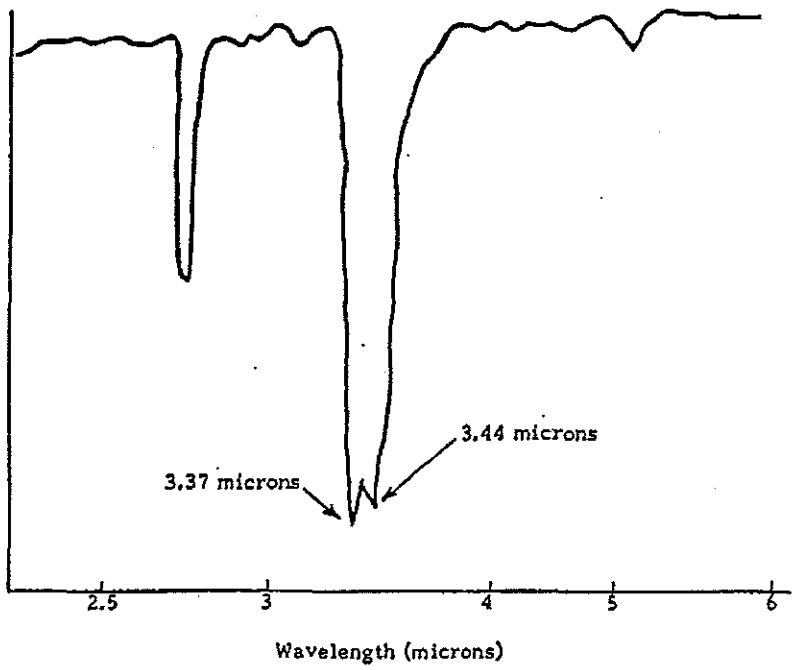
DMV/CVE (Commercial Vehicle Enforcement)

Constable/Essex

Press RETURN key to continue.

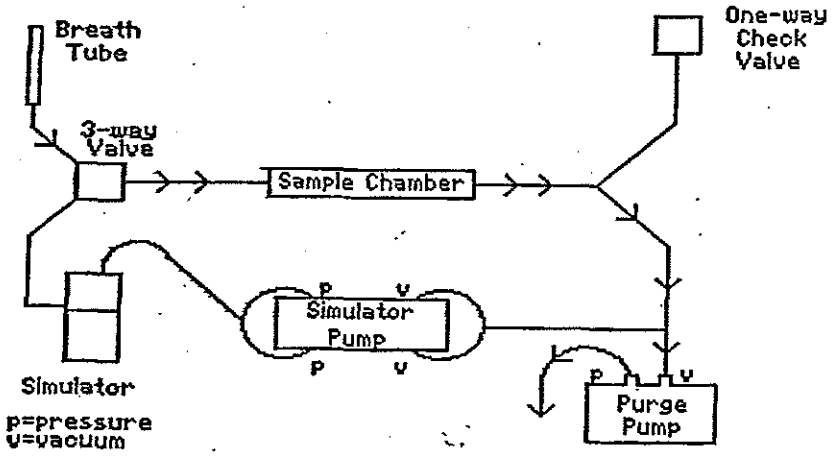
Question 12 - REVIEW DATA (Y/N)

Type "Y" to review the data you have entered. **ALL DATA MUST BE REVIEWED AT LEAST ONCE!** When reviewing data, operator must press RETURN to advance to next field. When review is complete, press RETURN key to continue. Type "N" if you have reviewed data and do not wish to do so again.



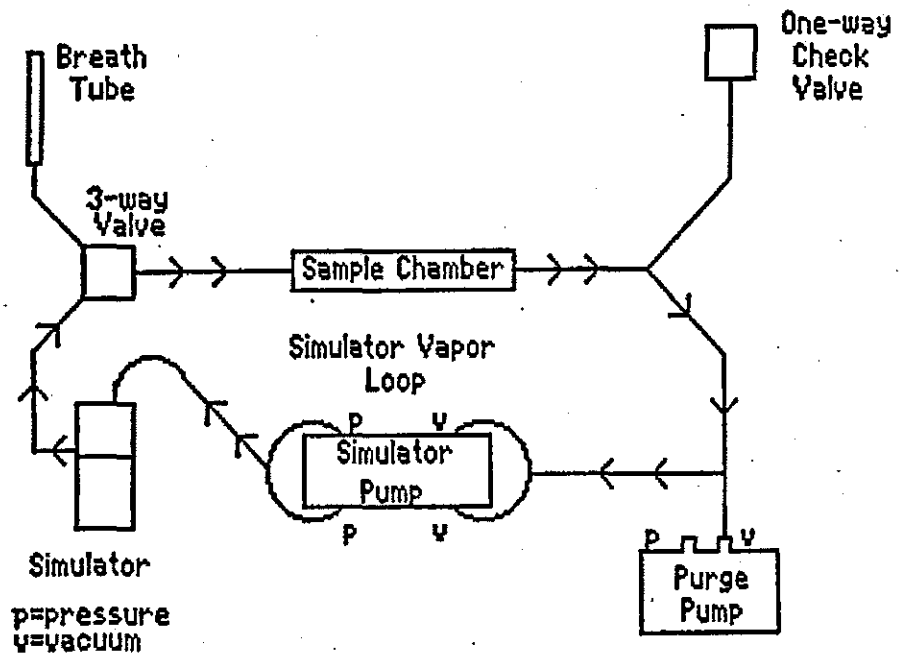
INFRARED SPECTRUM OF ETHYL ALCOHOL.

Figure 13: Partial IR Spectrum of ETOH



PURGE PATH.

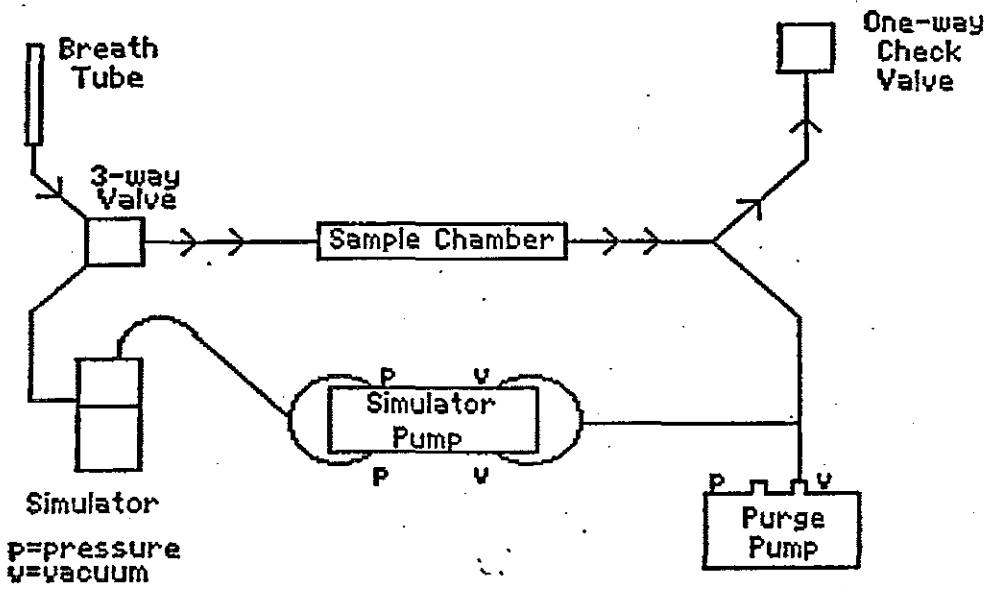
Figure 14: Purge Path



EXTERNAL STANDARD PATH.

Figure 3-5

Figure 15: External Standard Path



BREATH PATH.

Figure 16: Breath Path

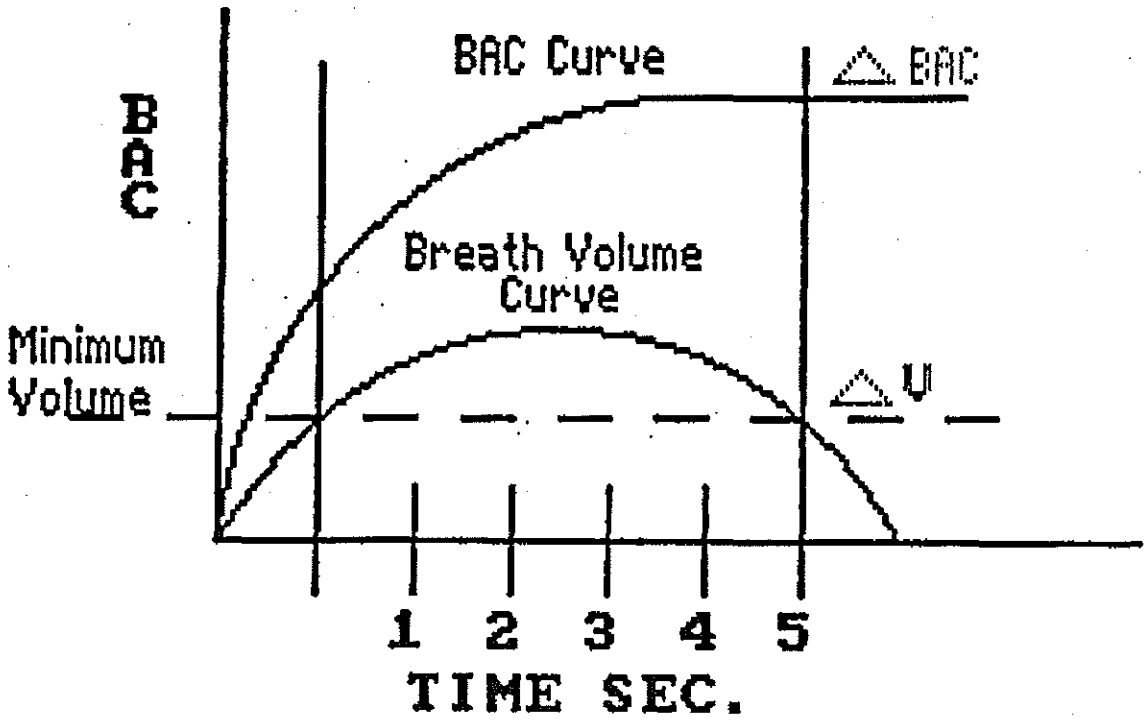


Figure 17: BAC/Breath Volume vs. Time (sec.)

SECTION IV

DUI FIELD PROCESSING FORMS

SECTION V

LEGAL ISSUES

DIRECT EXAMINATION QUESTIONS FOR A POLICE OFFICER TESTIFYING TO AN INFRARED TEST RESULT.

Preliminary questions regarding the officer's training, experience, basis for the stop, investigation, field sobriety testing and other observations will remain unchanged.

Direct Examination IR Test Questions:

1. Where did you take the defendant to administer the breath test?
2. Were you the person who administered the breath test to the defendant?
3. Did you use a DataMaster infrared instrument for the breath test?
4. Have you received training in the operation of the DataMaster?
5. Where did you receive this training?

Questions 6-10 are leading, but should be permitted as foundational only.

6. Did your training include the procedures for operating the DataMaster?
7. Did you receive any practical experience in operating the DataMaster during your training?
8. Did you pass a written examination as part of your training for operating the DataMaster?
9. Did you pass a proficiency test for operating the DataMaster during your training?
10. How many times have you administered a breath test utilizing the DataMaster?

Observations Of Defendant Prior To Testing

1. Prior to administering the test, did you observe the defendant?
2. For how long did you observe the defendant?
3. Why did you observe the defendant?
4. During this observation, what were you looking for?
5. As you watched the defendant during the waiting period, did you observe any of the signs that you were trained to look for?
6. If you had observed any of these signs, what would you have done?

Taking The Test

1. After observing the defendant, were you prepared to run a test?
2. Was the DataMaster properly warmed up?
3. How did you know the DataMaster was warmed up?
4. After ensuring that the DataMaster was warmed up, did you press the RUN button?
5. What did the DataMaster tell you to do next?
6. Did you insert the appropriate form into the slot on the front of the instrument?

7. What did the DataMaster ask you to do next?
8. Did you enter the defendant's name and date of birth into the DataMaster as requested?
9. What did the DataMaster ask you to do next?
10. Did you provide all of the information as requested by the DataMaster?
11. What did the DataMaster do next?
12. Did you attach a new mouthpiece to the breath tube?
13. When the DataMaster display read "PLEASE BLOW", did you have the defendant give a breath sample?
14. What was the time of the stop and what time was the breath sample collected?
15. How much time elapsed between the time of the stop and the time that the sample was collected?
16. Was this elapsed time less than two (2) hours? (This is required to be established so that the test does not need to be related back to the time of operation.)
17. After the defendant gave a breath sample, did a BAC value appear on the display?
18. Did a BAC value appear on the printed evidence ticket, which came out of the DataMaster?
19. Did the BAC value displayed on the DataMaster agree with the BAC value printed on the printed evidence ticket for the defendant?
20. Was the printed evidence ticket, which displays the defendant's test results attached to the case?
21. Do you recognize that printed evidence ticket?
22. How do you recognize that printed evidence ticket?
23. Does that printed evidence ticket have the defendant's BAC value of the breath sample taken on (date of test)?
24. What was the defendant's blood alcohol content as determined by the DataMaster?

Cross Examination Of The Officer

1. The officer should be prepared to testify to when the DataMaster was last calibrated. This may best be done by actually having him bring a copy of the last page of the maintenance log for that particular instrument to court.
2. The officer should also be prepared to testify to how he knew the instrument was operating properly when the test was given. The best testimony here would be to state that the DataMaster went through its normal procedures of checking itself and of running the external standard and that, based on the officer's observations and experience, he/she determined the instrument was operating properly. The officer might also wish to testify that if the instrument was unable to zero itself and did not obtain the appropriate result from the analysis of the external standard, it would have shut itself down and not permitted any testing to be done. The reason for the instrument's shutdown would be printed on the evidence ticket.
3. The officer should be able to testify to what would happen if the defendant did not give a proper breath sample or if the instrument detected radio frequency interference (RFI). The officer should testify that if the defendant blows incorrectly the DataMaster would not run a test. If RFI is detected the instrument will display "RADIO INTERFERENCE" on the LCD and will not produce a BAC reading. The DataMaster will stop processing the breath sample and will print "RADIO INTERFERENCE" on the evidence ticket.
4. An officer may be asked to explain how the DataMaster functions (i.e. how the instrument is able to analyze a sample of breath and determine the BAC). The officer should state, "I am not qualified to explain that but I do know, based on my training and experience, that the DataMaster was operating properly."

SECTION VI
GLOSSARY

GLOSSARY

Acetone - A colorless liquid with a fruity odor that mixes easily with water. Acetone may be produced in the body of a diabetic and sometimes in fasting persons. Acetone is also produced by industry. It has many common uses including being a major ingredient in nail polish remover.

Alcohol - A chemical compound. A hydrocarbon derivative. All alcohols contain a hydroxyl group composed of two atoms, one oxygen, and one hydrogen. All alcohols are soluble in water. There are various types of alcohol; each has a different level of toxicity.

Alveolar Air - Air from deep in the lung where blood vessels end in networks of capillaries in the walls of the alveoli. Alcohol from the blood is imparted to the alveolar air. Alveolar breath contains 1/2100 as much alcohol as the subject's blood.

BAC DataMaster - A forensic breath testing device which measures ethanol, incorporating the principles of deep lung physiology, infrared absorption and microcomputer technology. This automated instrument determines the amount of alcohol in deep lung air which is directly proportional to blood alcohol concentration.

Beer-Lambert Law - This law applies to breath testing instruments which utilize the principle of infrared absorption by ethyl alcohol. As infrared energy and a breath sample are introduced into the breath test instrument, a measured amount of infrared energy is absorbed. The energy absorbed is proportional to the amount of alcohol in the sample. The greater the amount of alcohol in the sample, the greater the absorption of infrared energy.

Centigrade or Celsius Scale - A scale of temperature measurement in which water freezes at 0 degrees and boils at 100 degrees Centigrade. Each degree Centigrade is 1.8 times as large as each degree Fahrenheit. Scientific measurement of temperature is generally made by using the Centigrade scale.

Normal Body Temperature: 37 degrees C or 98.6 degrees F

Breath Temperature: 34 degrees C or 93.2 degrees F

Chopper - An internal component of the BAC DataMaster that spins in front of a beam of light, breaking the light up into short pulses before they reach the detector.

Detector - An internal component of the BAC DataMaster that determines the amount of infrared energy. The amount of energy absorbed is proportional to the amount of ethyl alcohol present in the sample.

Distilled Spirits - Alcoholic beverages produced by the heating of a fermented grain or cereal mash to evaporate the alcohol. (Whiskey, Rum, Vodka, etc.)

Ethanol - The type of alcohol found in alcoholic beverages. Ethanol in a pure state is a colorless liquid, which produces a burning taste sensation and has an ethereal odor.

Evidence Ticket Slots - These external features of the BAC DataMaster are located on the front left of the instrument. An evidence ticket is inserted into the lower slot. When the test is completed, the ticket is ejected from the upper slot.

Filters - Internal components of the BAC DataMaster used to isolate specific wavelengths of infrared energy by filtering out all other wavelengths The instrument has two filters: one filters infrared energy at 3.44 microns; the other filters infrared energy at 3.37 microns. The purpose of the second filter is to separate other compounds such as acetone that could be in an individual's breath and that absorbs infrared energy at or near the same wavelength as ethyl alcohol.

Henry's Law - If a water solution of a volatile chemical (ethanol evaporates easily) is brought to an equilibrium with air at constant pressure and temperature, a fixed ratio will exist between the concentration of the compound in air and it's concentration in water. This law is demonstrated in the alveolar region of the lung where alcohol in the blood evaporates into the air of the lung. A fixed ratio of 2100 to 1 is established (2100 parts of breath contains the same amount of alcohol as 1 part of blood).

LCD - This internal feature of the BAC DataMaster is a liquid crystal display that identifies each stage of the breath test procedure as it occurs and provides information to the operator to complete the test. The LCD displays 24 characters, which can be numbers, letters, or symbols.

Microcomputer - Internally controls the test sequence and instructs the electronic components of the BAC DataMaster to automatically perform the various functions during the analysis. It also provides the instructions for storing the data collected on each test.

Micron - A unit of measurement in the metric system. A micron is equal to 1/1000 of a millimeter.

Proof - The proof of an alcoholic beverage is equal to twice the ethanol concentration. (100 proof whiskey contains 50% ethanol by volume. Pure ethanol would be 200 proof.)

Quartz Standard - An internal component of the BAC DataMaster composed of a quartz plate with a known infrared absorption.

RFI Antenna - This external component of the BAC DataMaster is located on the back of the instrument. This antenna is connected to an internal sensor circuit, which detects radio frequency interference. If RFI is detected in the immediate environment of the instrument, the instrument will not allow a test to be run.

Sample Chamber - An internal component of the BAC DataMaster in which a breath sample is introduced to infrared energy. The chamber is composed of three parallel sections with a total length of 1.1 meters and a volume of 50 cc. Mirrors are used to reflect the light the entire length of the chamber.

Simulator - The simulator is designed to contain a water-alcohol solution and is attached via two plastic hoses to the BAC DataMaster. The simulator is a constant temperature instrument that provides a high precision alcohol-air standard. The solution in the simulator is maintained at a constant temperature of 34 degrees (+ or - .5 degrees) Celsius by an internal heater.

Infrared Source - An internal component of the BAC DataMaster, which emits infrared energy.

Supervisor Control Panel - This external feature of the BAC DataMaster is located on the front right of the instrument. It is a locked panel that contains a set of keys, which adjust and control special functions.

Wavelength - Electromagnetic energy (such as infrared rays) travel in related patterns of waves. The distance from crest to crest determines wavelength.

SECTION VII

APPENDIX

LENGTH, VOLUME, WEIGHT

The metric system, a standard method of measuring length, volume, weight, and other values originated in France in the late eighteenth century. Before the French Revolution, Europe had a confusing assortment of units, standards of weight, and measures. During the chaotic revolution in France, the French National Assembly decided to establish a more uniform system of measures (the metric system). Oddly enough, several years earlier, Thomas Jefferson had tried to introduce a similar system in the United States.

The metric system, adopted by France in 1791, was made mandatory there on July 4, 1837. Sixteen years before the French decree, John Quincy Adams advocated the use of the metric system in the United States. Congress, however, did not pass a law legalizing the system for the public until 1866.

The metric system today is the legal system of measures in nearly every civilized country. Only in the United States (and in Brunei, Burma, Liberia, and Yemen), is it not yet the system generally in use. Repeatedly, our nation has approached metrification, but it has always backed away from full embrace. On December 23, 1975, President Gerald R. Ford signed the Metric Conversion Act of 1975, calling for voluntary conversion to the metric system and establishing a U.S. Metric Board to coordinate that conversion.

Even without metric legislation, we have already traveled a considerable distance down that road. Scientists use metric measurements exclusively. So do many of our engineers. The Department of Agriculture reports crop yields in metric tons. The Patent and Trademark Office now requires that patent applications include metric dimensions of items. Most of us are familiar with 350 milligram pills, 35 millimeter cameras and film; hypodermics measured in cubic centimeters (cc's) and cars with engine displacement stated in liters. We have watched races in the Olympic Games—all in metric. Bottling companies of soft drinks now market their products in 1, 2, and 3 liter containers. Wines and spirits are now bottled in metric sizes (the familiar fifth has become 750 milliliters).

DEFINITIONS

Measure of Length

The metric system was originally based on the distance between the North Pole and the Equator, about 6,200 miles. A line running from the North Pole to the Equator can be divided into 10 million equal parts. Each part is a meter, or approximately 39.4 inches (the meter has since been redefined for even greater accuracy as 1,650,763.73 wavelengths of orange-red light emitted by the krypton-86 atom). It is from this length measurement, the meter, that the units of volume and weight are derived. The unit of volume is the liter; the unit of weight is the gram.

Measure of Volume

The space an object takes up is called the volume or its cubic contents. Using a rectangular box, we can find its volume from the inside dimensions. The result is called its capacitor cubic contents. The liter is used to measure volume. A liter is equivalent to 1,000 cubic centimeters.

Measure of Weight

The gram is the weight of one cubic centimeter of distilled water at a temperature of 4 degrees Celsius at sea level. By adding Latin prefixes to the basic units (meter, liter, and gram), the names of the units of division (tenths, hundredths, thousandths, etc.) are formed. For example, *deci* means one-tenth (0.1), *centi* means one-hundredth (0.01), and *milli* means one-thousandth (0.001). By adding Greek prefixes to the basic units, the names of the units of multiplication are formed. For example, Deka means 10, Hecto means 100, and Kilo means 1,000.

RELATIONSHIP AMONG MEASURES IN THE METRIC SYSTEM

All units in the metric system are derived from the meter. If a cube that is ten (10) centimeters on each side, is filled with water at 4 degrees Centigrade, the volume of water held by the cube is equal to one liter and weighs one kilogram. Since the cube has sides of 10 cm each, one liter is equal to 1,000 cubic centimeters (10 cm x 10 cm x 10 cm). If one liter is also equal to 1,000 milliliters, then one milliliter must equal one cubic centimeter. Since the weight of the cube filled with water is equal to one kilogram (1,000 grams) then one cc or ml must weigh one gram.

The decimal nature of the metric system is its most distinguishing characteristic. The metric system is referred to as the decimal system because it is based on the powers of ten. This means that as units increase in size, each unit is ten times larger than the preceding unit and conversely, as units decrease in size, each unit is ten times smaller than the previous unit.

Larger units are changed to smaller units by moving the decimal point the necessary number of places to the right; smaller to larger units by moving the decimal point the necessary number of places to the left.

TEMPERATURE

Fahrenheit

Fahrenheit is probably the most familiar temperature scale. On this scale, there are 180 degrees between the freezing and boiling points of water. Water freezes at 32 degrees Fahrenheit and it boils at 212 degrees Fahrenheit.

Centigrade

Scientific measurements of temperature are generally made by using the Centigrade scale. This may also be referred to as the Celsius scale. Water freezes at 0 degrees Centigrade and it boils at 100 degrees Centigrade. Since there are 100 degrees between the freezing and boiling points of water on this scale, one can see that each degree Centigrade is 1.8 times as large as each degree Fahrenheit.

Temperatures to Remember:

Body Temperature	37 degrees C	98.6 degrees F
Breath Temperature	34 degrees C	93.2 degrees F

Instrument Operating Temperature

BAC DataMaster Approximately 50 degrees C

Temperature Conversion Formulas

1. Degrees F = (9/5 x degrees C) + 32 OR

= degrees C x 9/5 + 32

2. Degrees C = 5/9 (degrees F - 32) OR

@ (degrees F - 32) x 5/9

Examples:

100 degrees C x 9 = 900/5 = 180 + 32 = 212 degrees F

212 degrees F - 32 = 180 x 5 = 900/9 - 100 degrees C

QUESTIONS AND ANSWERS

1. Q. How does the instrument work?

   A. The subject blows into a heated breath tube leading to a chamber, which is in the path of an infrared light beam. The subject must blow at least 5-10 seconds before the instrument will accept the breath sample. This ensures the sample is deep lung air. The instrument measures how much infrared light was absorbed by ethanol at two different wavelengths, the ratio of which is specific for ethanol. The BAC is displayed on the front of the instrument, printed on an evidence ticket, and stored in memory.

2. Q. Is this an accepted method for analyzing ethanol in human breath?

   A. Yes. The BAC DataMaster uses well-established techniques, and principles of chemistry (infrared spectroscopy and the Beer-Lambert Law).

3. Q. Will anything besides ethanol show absorption of infrared light?

   A. Many substances will absorb infrared light. However, the BAC DataMaster measures the absorption at two different wavelengths, the ratio of which is specific for ethanol. If any substance besides ethanol is present, the instrument will recognize it as interference.

4. Q. Can acetone in the breath of a diabetic or fasting person affect the breath alcohol reading?

   A. Yes. Acetone at high enough levels can impact the results of the BAC DataMaster.

5. Q. Does a change in line voltage have an affect on a BAC reading?

   A. No. The instrument filters out fluctuations in the line voltage.

6. Q. Can the reading be affected by changing external conditions?

   A. No. Internal and external standards protect against false readings due to ambient conditions.

7. Q. Is it possible for the operator to change a subject's breath test result?

   A. No. The operator simply follows instructions displayed by the instrument. Operator involvement is minimized. He/she is not involved with the determination of the result.

COUNTY/TOWN CODES

ADDISON				BENNINGTON		CALEDONIA		CHITTENDEN	
0101	Addison	0120	Vergennes	0201	Arlington	0301	Barnet	0401	Bolton
0102	Bridport	0121	Waltham	0202	Bennington	0302	Burke	0402	Buel's Gore
0103	Bristol	0122	Weybridge	0203	Dorset	0303	Danville	0403	Burlington
0104	Cornwall	0123	Whiting	0204	Glastenbury	0304	Groton	0404	Charlotte
0105	Ferrisburg			0205	Landgrove	0305	Hardwick	0405	Colchester
0106	Goshen			0206	Manchester	0306	Kirby	0406	Essex
0107	Granville			0207	Peru	0307	Lyndon	0407	Hinesburg
0108	Hancock			0208	Pownal	0308	Newark	0408	Huntington
0109	Leicester			0209	Readsboro	0309	Peacham	0409	Jericho
0110	Lincoln			0210	Rupert	0310	Ryegate	0410	Milton
0111	Middlebury			0211	Sandgate	0311	St. Johnsbury	0411	Richmond
0112	Monkton			0212	Searsburg	0312	Sheffield	0412	St. George
0113	New Haven			0213	Shaftsbury	0313	Stannard	0413	Shelburne
0114	Orwell			0214	Stamford	0314	Sutton	0414	So. Burlington
0115	Panton			0215	Sunderland	0315	Walden	0415	Underhill
0116	Ripton			0216	Winhall	0316	Waterford	0416	Westford
0117	Salisbury			0217	Woodford	0317	Wheelock	0417	Williston
0118	Shoreham			0218	Old Bennington			0418	Winooski
0119	Starksboro								

ESSEX		FRANKLIN		GRAND ISLE		LAMOILLE		ORANGE	
0501	Averill	0601	Bakersfield	0701	Alburg	0801	Belvidere	0901	Bradford
0502	Avery's Gore	0602	Berkshire	0702	Grand Isle	0802	Cambridge	0902	Braintree
0503	Bloomfield	0603	Enosburg	0703	Isle LaMotte	0803	Eden	0903	Brookfield
0504	Brighton (Island Pond)	0604	Fairfax	0704	North Hero	0804	Elmore	0904	Chelsea
0505	Brunswick	0605	Fairfield	0705	South Hero	0805	Hyde Park	0905	Corinth
0506	Canaan	0606	Fletcher			0806	Johnson	0906	Fairlee
0507	Concord	0607	Franklin			0807	Morristown	0907	Newbury
0508	East Haven	0608	Georgia			0808	Stowe	0908	Orange
0509	Ferdinand	0609	Highgate			0809	Waterville	0909	Randolph
0510	Granby	0610	Montgomery			0810	Wolcott	0910	Strafford
0511	Guildhall	0611	Richford					0911	Thetford
0512	Lemington	0612	St. Albans City					0912	Topsham
0513	Lewis	0613	St. Albans Town					0913	Tunbridge
0514	Lunenburg	0614	Sheldon					0914	Vershire
0515	Maidstone	0615	Swanton					0915	Washington
0516	Norton							0916	West Fairlee
0517	Victory							0917	Williamstown
0518	Warner's Grant								
0519	Warren's Gore								

ORLEANS		RUTLAND		WASHINGTON		WINDHAM		WINDSOR	
1001	Albany	1101	Bensen	1201	Barre City	1301	Athens	1401	Andover
1002	Barton	1102	Brandon	1202	Barre Town	1302	Brattleboro	1402	Baltimore
1003	Brownington	1103	Castleton	1203	Berlin	1303	Brookline	1403	Barnard
1004	Charleston	1104	Chittenden	1204	Cabot	1304	Dover	1404	Bethel
1005	Coventry	1105	Clarendon	1205	Calais	1305	Dummerston	1405	Bridgewater
1006	Craftsbury	1106	Danby	1206	Duxbury	1306	Grafton	1406	Cavendish
1007	Derby	1107	Fair Haven	1207	E. Montpelier	1307	Guildford	1407	Chester
1008	Glover	1108	Hubbardton	1208	Fayston	1308	Halifax	1408	Hartford
1009	Greensboro	1109	Ira	1209	Marshfield	1309	Jamaica	1409	Hartland
1010	Holland	1110	Mendon	1210	Middlesex	1310	Londonderry	1410	Ludlow
1011	Irasburg	1111	Middletown Springs	1211	Moretown	1311	Marlboro	1411	Norwich
1012	Jay	1112	Mt. Holly	1213	Northfield	1312	Newfane	1412	Plymouth
1013	Lowell	1113	Mt. Tabor	1214	Plainfield	1313	Putney	1413	Pomfret
1014	Morgan	1114	Pawlet	1215	Roxbury	1314	Rockingham	1414	Reading
1015	Newport City	1115	Pittsfield	1216	Waitsfield	1315	Somerset	1415	Rochester
1016	Newport Town	1116	Pittsford	1217	Warren	1316	Stratton	1416	Royalton
1017	Troy	1117	Poultney	1218	Waterbury	1317	Townsend	1417	Sharon
1018	Westfield	1118	Proctor	1219	Woodbury	1318	Vernon	1418	Springfield
1019	Westmore	1119	Rutland City	1220	Worcester	1319	Wardsboro	1419	Stockbridge
		1120	Rutland Town			1320	Westminster	1420	Weathersfield
		1121	Sherburne			1321	Whitingham	1421	Weston
		1122	Shrewsbury			1322	Wilmington	1422	West Windsor
		1123	Sudbury			1323	Windham	1423	Windsor

1124	Tinmouth	1424	Woodstock
1125	Wallingford		
1126	Wells		
1127	West Haven		
1128	West Rutland		

OFFICER'S INFRARED BREATH TESTING LOG

Officer's Name: _____ **Department** _____

DATE	INCIDENT #	SUBJECT	IR SERIAL #	IR LOCATION	BAC RESULTS

* SAMPLE *

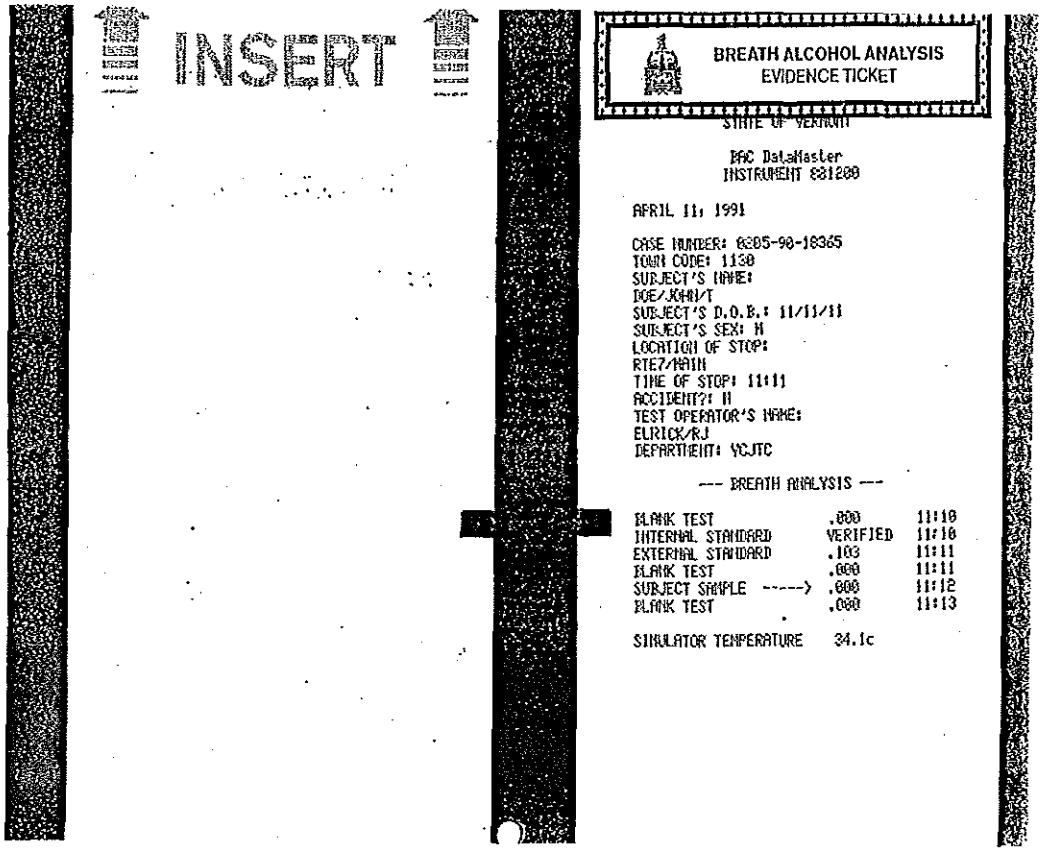
VSP/Colchester
DEPARTMENT

INSTRUMENT LOG
OPERATOR'S PAGE

881332
SERIAL #

DATE (1991)	OPERATOR	SUBJECT'S NAME	BAC	SIM. TARG.	SIM. RESULT	I. TEST
9/20	O'Leary, W.	Smart, John	.133	.100	.098	No
9/22	Sheets, W.	Test	.000		.099	No
9/22	Roy, J.	Test	.000		.098	Yes
9/25	O'Leary, W	Test	.000		.099	No
9/28	Roy, J.	Walker, Jerry	.179		.098	Yes
10/01	Roy, J.	Baker, Henry	.155		.098	No
10/02	Sheets, W.	Plumber, George	.089		.098	Yes
10/05	Sheets, W.	Runner, Larry	Refusal		.097	No
10/09	O'Leary, W.	Stupid, Felix	.099		.097	Yes
10/11	Roy, J.	Teen, Sharon	.031		.097	No
10/13	Elrick, R.J.	Test	.000		.097	Yes
10/14	Sheets, W.	Spacey, Gordon	.000		.096	No
10/16	Rooky, R.	Test	.000		.096	Yes
10/18	Rooky, R.	Offender, Orly	Invalid		.096	No
10/18	Rooky, R.	Offender, Orly	RFI		.096	No
10/18	Rooky, R.	Offender, Orly	.171	↓	.095	Yes
10/21	Sheets, W.	Carpenter, Bob	Sim.	Temp.	Error	
10/21	Sheets, W.	Carpenter, Bob	.117	.100	.095	No
10/24	Roy, J.	Sharp, Richard	Invalid	↓	.095	No
10/24	Roy, J.	Sharp, Richard	System Won't Zero			
10/24	Roy, J.	Sharp, Richard	.123	.100	.095	Yes

page _____



BREATH ALCOHOL ANALYSIS
EVIDENCE TICKET

STATE OF VERMONT

BAC DataMaster
INSTRUMENT 881348

NOVEMBER 25, 1991

CASE NUMBER: 1128-91-00001
TOWN CODE: 1119
SUBJECT'S NAME:
DANGER/LITTLE
SUBJECT'S D.O.B.: 02/09/24
SUBJECT'S SEX: F
LOCATION OF STOP:
IS4/MM112
TIME OF STOP: 03:00
ACCIDENT?: N
TEST OPERATOR'S NAME:
JONES/DAVID/L
DEPARTMENT: VSP/BRADFORD

--- BREATH ANALYSIS ---

BLANK TEST	.000	13:26
INTERNAL STANDARD	VERIFIED	13:26
EXTERNAL STANDARD	.101	13:27
BLANK TEST	.000	13:27
SUBJECT SAMPLE ----->	REFUSED	13:28
SIMULATOR TEMPERATURE	31.6c	

BREATH ALCOHOL ANALYSIS
EVIDENCE TICKET

STATE OF VERMONT

BAC DataMaster
INSTRUMENT 881348

NOVEMBER 25, 1991

CASE NUMBER: 050-91-01234
TOWN CODE: 1232
SUBJECT'S NAME:
BARN/RED/B
SUBJECT'S D.O.B.: 03/30/30
SUBJECT'S SEX: M
LOCATION OF STOP:
GRAND UNION LOT
TIME OF STOP: 18:35
ACCIDENT?: Y
TEST OPERATOR'S NAME:
JUSTICE/BUFORD/T
DEPARTMENT: SD/BENNINGTON

--- BREATH ANALYSIS ---

1 RADIO INTERFERENCE

TECHNICAL ASSISTANCE

VERMONT DEPARTMENT OF HEALTH

Robert Drawbaugh	Toxicology Program Chief	863-7335
Theodore Manazir	Senior Chemist	863-7335

LEGAL ISSUES

Michael Harty, Esq.	Vermont Department of State's Attorneys and Sheriff's	828-2891

TRAINING AND CERTIFICATION

Carolyn Wolk	Training Specialist Vermont Criminal Justice Training Council	483-6228

VCJTC DUI INSTRUCTORS

Sheriff R.J. Elrick	Rutland County Sheriff's Department	775-8002
Tpr. Richmond Hopkins	Vermont State Police – Brattleboro	257-7101
Tpr. Mark Lauer	Vermont State Police – Headquarters	244-8718
Chief Gary Margolis	UVM Police Services	656-2027
Corporal James Roy	Colchester Police Department	655-3053
Officer Raymond St. Pierre	Colchester Police Department	655-3053

Date:_____ Officer's Name:_____

Department:_____

Training Location:_____

PROFICIENCY CHECKLIST

INFRARED BREATH ALCOHOL TESTING DEVICE

_____ 1. Subject will have had nothing in his/her mouth for at least fifteen (15) minutes prior to this breath test. Record the time from the Datamaster's LCD on the field processing form.

_____ 2. When instrument is ready press RUN.

_____ 3. Insert evidence ticket into the instrument.

_____ 4. Type in the data as requested by the instrument.

_____ 5. Review all data entered before continuing.

_____ 6. Administer the evidentiary test to the subject.

_____ 7. Remove the mouthpiece.

_____ 8. Ascertain whether subject wants a second test.

_____ 9. Administer second test, if requested, using a new mouthpiece.

_____ 10. Remove completed ticket and give the pink copy to the subject.

_____ 11. Enter final data into the officer's log and the instrument log.

Certified by:_____

P = Pass
F = Fail
R = Required Remedial Training

revised 11/96

11/96

INFRARED BREATH TESTING DEVICE
TABLE OF CONTENTS

SECTION

Date:_____ Officer's Name:_____

Department:_____

Training Location:_____

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revised 11/96