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Further Laboratory Testing of In-Vehicle Alcohol Test Devices

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16. Abstract This technical report presents the results of laboratory testing of three models of commercially available in-vehicle alcohol test (IVAT) devices. These devices are designed to prevent persons with alcohol on their breath above a preset threshold from starting and driving a car. The models tested were: The Autosense, the Guardian Interlock and the Safety Interlock devices. Features of these devices designed to make them more difficult to circumvent were also evaluated.

Our laboratory findings indicate that, except for one of the Guardian units, the IVAT devices tested consistently identified low as well as high BAC users (0.04% or above) who followed instructions. Because one of the two Guardian units indicated a much higher alcohol threshold, five additional Guardian units were tested for accuracy. The threshold for these units was found to be more in line with the 0.04% BAC level.

Regarding the use of bogus breath samples as a circumvention strategy, none of the devices was totally successful in protecting against this circumvention strategy. However, the one unit with a temperature sensor, Safety Interlock, demonstrated that such a sensor, set at the appropriate temperature range, can make it more difficult to circumvent the device.

Regarding the use of filtered air samples as a circumvention strategy, none of the devices was totally successful in protecting against this circumvention strategy. However, the Autosense device, with its higher pressure requirement, protected against one type of filtered air sample.

The Guardian Interlock device, with its Controlled Breath Pulse Access (CBPA), is the only device which imposes a start-up requirement on its users. Our preliminary tests using a small sample of sober, volunteer subjects suggests that this strategy may be helpful in deterring or preventing a sober bystander from starting someone's car.

In summary, even with special features designed to prevent circumvention, it can be concluded that a motivated individual, with preplanning and some knowledge, can fool the devices tested. However, it is inappropriate to generalize these results to all current or future units. Additionally, these data do not address how well these devices will perform under real-world field conditions. Other future field evaluation research projects will need to address these issues.

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FURTHER LABORATORY TESTING OF
IN-VEHICLE ALCOHOL TEST DEVICES.*

Introduction

Since the publication of our 1985 report on laboratory tests of two prototype in-vehicle breath test devices (Frank, 1985), three alcohol-ignition interlock instruments have become commercially available in the United States. These devices are systems designed to prevent drivers whose breath alcohol concentration is above some preset minimum level from starting their cars. Also, as previously reported, some of these devices have additional features built into them designed to ensure that the sample being introduced is a true breath sample. For example, one possibility is to build a temperature sensor into the device to ensure that the temperature of the sample introduced falls within a range approximating human breath. Another possible feature is to build a pressure sensor into the device, so that the sample introduced would need to exceed some minimum level to activate the alcohol sensor, ensuring that the force of the sample introduced is as strong as a human breath.

The principal market for these devices continues to be traffic courts that may require drivers convicted of Driving While Intoxicated (DWI) to install one of these devices on their cars as a condition of probation. A voluntary market is also possible, including scenarios such as parents who want to exercise more control over their inexperienced teenaged driving children, and persons who may want to impose more external control over their own behavior. However, the manufacturers do not appear to be actively pursuing such markets at the present time.

The three new breath test devices are listed below:

- o "Autosense", manufactured by Autosense Corp., 3496 Breakwater Court, Hayward, CA 94545
- o "Guardian Interlock", manufactured by Guardian Interlock Systems, Inc., 1009 Grant Street, Denver, CO 80203
- o "Safety Interlock", manufactured by Safety Interlock, Inc., P. O. Box 221818, Carmel, CA 93922

Two units of each device were tested in our laboratory for accuracy and the degree to which they could be circumvented.

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* The data on which this report is based were collected for NHTSA by Dr. Arthur L. Flores and Mr. Arnold Spicer of the U. S. Department of Transportation's Transportation Systems Center, Cambridge, MA 02142

The specific objectives of this follow-up laboratory project were to:

1) determine how well each device distinguishes between simulated breath samples above and below the set breath alcohol threshold.

2) determine whether any additional features of the devices, such as temperature and/or pressure sensors, work as they were intended.

3) assess whether a motivated person could "fool" the system by introducing a bogus, non-alcoholic sample of air as if it were a breath sample.

4) assess whether a motivated person could "fool" the system by blowing through various filter systems and then into the device.

5) assess how easily a naive person can learn the special "entry requirements" of the Guardian Interlock device.

Method

Each manufacturer supplied NHTSA with two units of their device.

The alcohol sensor for each device is enclosed in a handheld unit approximately the size of a CB radio microphone, which is mounted on the dashboard of the car. A brief description of how each device operates follows.

The AUTOSENSE device provides its user with a digital BAC readout. In addition, the threshold level at which it will prevent a user from starting the car can be preset with the use of special equipment provided to the installer by the manufacturer. The handheld unit gives the user additional feedback in the form of (1) a digital "P" or "F" for pass and fail; and (2) a green or red light corresponding to the pass or fail designation. The user first activates the device by entering a four-digit number into a keypad, similar to a telephone keypad, which is part of the handheld unit. The digital code is not intended as a test to screen out particular users; it only activates the system before each use. Following entry of the code, the user blows into the mouthpiece for approximately 6 seconds to satisfy the requirements of the system. If the BAC exceeds the preset threshold, a user would not be able to start the car. The manufacturer told us the device has a pressure requirement, but does not have a temperature sensor.

The GUARDIAN INTERLOCK device can only be activated when a user blows a prescribed series of puffs and pauses, properly timed, into the mouthpiece. Guardian calls this entry "Coordinated Breath Pulse Access" or "CBPA" for short. The Guardian CBPA can be programmed at one of three different difficulty levels. If the CBPA has been satisfied, the device gives the user a breath alcohol reading from the sample puffs provided during activation. The reading is displayed by a series of lights, two green lights and five red ones on the units tested in our laboratory.

The easiest of the three difficulty levels of the CBPA requirement takes three blows into the mouthpiece, the first for 4 1/2 seconds, the second for 1 second and the third also for one second. The length of time of the required blows and the time interval between blows determines the difficulty level of the CBPA. The more difficult conditions create greater demands on the user to attend to the task. The CBPA is intended to be relatively easy for a sober user to learn, but difficult for a new user to pass on a single trial. An alcohol impaired user may also have difficulty with the CBPA. It is designed to prevent a user from getting an untrained, sober bystander to start his car. The Guardian device also has a pressure requirement for activation.

The SAFETY INTERLOCK device requires a user to blow into the device for 4 seconds to activate the system. When the device is ready to use after the four second period, a "Blow" light appears. The user then continues blowing until another light comes on which indicates whether the alcohol, pressure and temperature requirements of the system have been met (green light) or not (red light).

Calibration

The Autosense device was calibrated by the manufacturer before it was delivered for this testing. In addition to its digital readout, it provides the user with a "P" or "F" designation on the display; the manufacturer provided NHTSA with instructions on how to set the P/F designation at a particular BAC level. For purposes of this testing, the threshold BAC was set at 0.030%, so that all readings less than 0.030% were considered a "Pass".

The manufacturer of the Safety Interlock device also set the threshold of the test at 0.030% BAC.

The Guardian Interlock device was not factory calibrated. When it was hand delivered by the manufacturer, the representative of the company provided us with detailed instructions explaining how it was to be calibrated. Following those instructions precisely, the thresholds for the two Guardian units were set at 0.030% BAC.

The Alcohol Threshold

As indicated above, each device was set at a threshold of 0.03% BAC. Ten (10) trials of simulated breath samples were introduced into each device at selected BAC levels ranging from 0.00% to 0.070% BAC.

The simulated samples were generated by a Smith & Wesson Mark IIA Breath Alcohol Simulator set at 93°F. (34°C.). The commercially available simulator consists of a 500 ml glass jar into which both a thermostat-controlled heating element and an electric stirrer are immersed. The heating element and the stirrer ensure that the premeasured alcohol solution in the simulator is of uniform concentration and constant temperature. When air is blown through the alcohol solution, the vapor given off the top of the solution simulates breath at a known alcohol concentration.

Pressure to Activate Devices

The minimum pressure required to activate each device was measured by placing a Magnahelic Pressure Gauge (Dwyer Instrument Co., Michigan City, Indiana) in the line of a piece of rubber tubing connected to the mouthpiece of the device, so that precise measures of the pressure at the mouthpiece could be taken. The units of pressure measured were inches of water. Once the threshold was found, five trials per pressure level, 2 inches above and below that threshold were run to verify that the precise level had been identified.

Minimum Volume of Breath Required to Activate.

After the minimum pressure was identified for each device, that minimum pressure was applied from a pressurized tank of air for the time required by each device to provide a sample, which was 6 1/2 seconds for CBPA level #1 on the Guardian Interlock device, 3 seconds for the Autosense device, and 7 seconds for the Safety Interlock device. For these minimum volume measurements, each device was sealed inside a plastic "Zip-Lock" bag, so that all air passing into and through the device would be trapped inside the bag. When the device was activated, the process was halted, and the volume of air in the plastic bag was then exhausted through a vitalometer, measuring its volume. Five trials were run for each device.

The Temperature Window.

Two of the three devices tested had no operational temperature sensor (i.e., the Guardian Interlock and the Autosense devices). For the Safety Interlock, non-alcoholic simulated breath samples heated to various temperature levels were introduced into each unit by passing air through a coiled copper tube immersed in a constant temperature bath. Test temperature levels started at 20° C. (a level clearly below the lower limit) and continued in 2° increments until a level 4° above the upper temperature limit had been reached.

Coordinated Pulse Breath Access (CBPA) Testing

Some preliminary data were collected using ten (10) sober government employees as subjects who volunteered to assess whether they could satisfy the CBPA requirements when given minimal instructions and no prior practice.

Strategies for Fooling the Sensors.

Two different classes of strategies for fooling the sensors were examined, as in the earlier research (Frank, 1985). These were: (1) non-alcohol, bogus breath samples, and (2) processed/filtered alcoholic air samples.

Bogus breath samples.

Regarding bogus breath samples, the number of procedures tested was fewer than the 1985 study, because several of the procedures previously used were less likely to be used in the real world. The procedures selected were chosen because: (a) they might be easily thought of by motivated drivers; (b) they use materials that might be easily found around the home, or (c) they use materials that could be easily purchased. These procedures used the following:

1) a mylar plastic bag, typically available at stores that sell commercial toy balloons;

2) a rubber toy balloon;

3) a plastic bag used to pack produce in grocery stores.

For the device that has a temperature sensor, the Safety Interlock device, a number of simple procedures were designed to heat up the bogus air samples. These were:

1) using body heat by holding the bag/balloon under the arm

2) using wooden matches to warm up the bag/balloon

3) using a portable, 12 volt hair dryer, which could ordinarily be plugged into an automobile lighter socket and run off of the battery.

For each bogus breath sample procedure, five independent trials were run by: (1) heating the bag or balloon, if required, (2) attaching it to the mouthpiece of the breath test device, and (3) squeezing the bag or balloon to get the air sample into the device. When the samples were heated, the heating procedure was followed for about 15-20 seconds before introducing the bogus breath sample into the Safety Interlock units. In all cases, the pressure requirements of the system were met.

Processed/Filtered Alcohol Air Samples

As was the case with the bogus breath samples, fewer procedures were used in these tests than the 1985 (Frank) study, as only the most practical procedures, using the most easily obtained materials, were selected. Simulated breath samples were passed through two different types of filters and then into the IVAT devices. The filtering agents used were:

1) A homemade water filter, composed of a common styrofoam coffee cup. The cup was partially filled with warm water (approximating hot coffee in temperature).

2) A cylindrical, paper tube packed with 12 ounces of a commercially available absorbent material.

In each case, the simulated breath was set at one of four different BAC levels, namely 0.03%, 0.05%, 0.08%, and 0.10%. The temperature of the simulated breath (i. e., the output from the breath simulator) was held constant at 34° C. (93.2° F.). For each of the filters at each BAC level, five independent trials were run. All trials were run at pressures above the minimum pressure to activate the device, if possible.

Results

Precision Testing

In each case, the threshold for activating the IVAT devices was set at 0.03% BAC. The results of the precision testing are summarized in Table 1.

The second Guardian Interlock unit (Unit #2) was found to be off target. The five other units tested (i.e. the first Guardian Interlock unit, and both units for the Autosense and Safety Interlock devices) correctly triggered the interlock to stop a user from starting a car 100% of the time at the 0.04% BAC and above. Several units were apparently set a little low (one Autosense unit [#1], and both Safety Interlock units [#1 and #2]), so that their threshold BAC for activating the device was at 0.02% BAC.

Rather than retesting the one Guardian unit that gave unexpected scores, we obtained five additional Guardian units for the sole purpose of taking more alcohol threshold measurements. As with the two units in the original testing, these five Guardian units were also calibrated at our laboratory, following instructions provided by the manufacturer. The results of the alcohol threshold measurements on these five Guardian units are presented in Table 1a. Those data showed that all of the devices except one would not allow a car to start at BAC = 0.03% or above. The one exception allowed half of the trials to start at BAC = 0.04, but none above that level. Two of the devices prevented starts on some of the trials at BAC = 0.02%.

Breath temperature window

As indicated above, only the Safety Interlock had an operational temperature sensor built into the equipment. The actual range of breath temperatures within which a car could be started is presented in Table 2 for each of the Safety Interlock units (#5 and #6). In Unit #5, the acceptable simulated breath temperature range within which the device operated was 26°-50° C. (79°-122°F.), i.e. a range of 25°C. In Unit #6, this simulated breath temperature range was 32°-50°C. (90°-122°F.), i.e. a range of 19°C. For reference, normal breath temperature is slightly below normal body temperature (37° C.=98.6 °F.), and averages 34° C. (93.2° F.).

Minimum pressure to activate

The air pressure required to activate each unit was measured for each device and the results are presented on Table 3. The minimum pressures required for the Guardian Interlock, the Autosense, and the Safety Interlock were 5, 13, and 3 inches of water respectively. For reference, a human can produce up to about 30 inches of water pressure, so that pressures from 0-10 inches may be considered "mild blows", 10-20 inches may be considered "moderate blows", and 20-30 inches may be considered "hard blows." The pressure required to activate the Autosense device was a "moderate blow," higher than the "mild blow" required to activate the Guardian and Safety Interlock devices.

Table 1

IVAT Precision Testing

Number of Starts in Ten Trials
at Selected BAC Levels

BAC of simulator (34°C.)	IN-VEHICLE ALCOHOL TEST DEVICES: GUARDIAN #1	GUARDIAN #2	AUTOSENSE #1	AUTOSENSE #2	SAFETY-INTERLK #1	SAFETY-INTERLK #2
0.00%(Blank sample)	10/10	10/10	10/10	10/10	10/10	10/10
0.01%			10/10		10/10	10/10
0.02%	10/10	10/10	8/10	10/10	0/10	2/10
0.03%	10/10	10/10	0/10	10/10	0/10	0/10
0.04%	0/10	9/10	0/10	0/10	0/10	0/10
0.05%	0/10	10/10	0/10	0/10	0/10	0/10
0.06%		10/10				
0.07%		0/10				

Table 1a
Alcohol Threshold Measurement on Five Additional
Guardian Interlock Units (Number of Starts
in Ten Trials at Selected BAC Levels)

BAC of simulator (34°C.)	EXTRA GUARDIAN INTERLOCK DEVICES: #3	#4	#5	#6	#7
0.00%	10/10	10/10	10/10	10/10	10/10
0.02%	5/10	9/10	10/10	10/10	10/10
0.03%	0/10	0/10	0/10	0/10	0/10
0.04%	0/10	0/10	0/10	5/10	0/10
0.05%	0/10	0/10	0/10	0/10	0/10

Table 2

Determination of the Breath Temperature Window

Performance of Safety Interlock Devices
at Different Temperatures

NUMBER OF TRIALS OUT OF FIVE
CAR COULD BE STARTED

Temperature of non-alcoholic simulator solution	SAFETY INTERLOCK DEVICE Unit # 1	Unit # 2
22° C. (71.6°F.)	0/5	0/5
24° C. (75.2°F.)	0/5	0/5
26° C. (78.8°F.)	5/5	0/5
28° C. (82.4°F.)	5/5	0/5
30° C. (86.0°F.)	5/5	0/5
32° C. (89.6°F.)	5/5	5/5
34° C. (93.2°F.)	5/5	5/5
36° C. (96.8°F.)	5/5	5/5
38° C. (100.4°F.)	5/5	5/5
40°C. (104.0°F.)	5/5	5/5
42°C. (107.6°F.)	5/5	5/5
44°C. (111.2°F.)	5/5	5/5
46°C. (114.8°F.)	5/5	5/5
48°C. (118.4°F.)	5/5	2/5
50°C. (122.0°F.)	4/5	1/5
52°C. (125.6°F.)	0/5	0/5
54°C. (129.2°F.)	0/5	0/5

Table 3

Number of Trials out of Five Car Could Be Started To Determine Minimum Strength of Blow (Pressure) to Activate System (measured in inches of water)

Number of trials out of five car could start

STRENGTH OF BLOW (Inches of Water)		IN-VEHICLE ALCOHOL TEST DEVICES: GUARDIAN #1	GUARDIAN #2	AUTOSENSE #1	AUTOSENSE #2	SAFETY-INTERLK #1	SAFETY-INTERLK #2
1"						0	0
2"						0	0
3"		0	0			5	5
4"		0	0			5	5
5"	MILD	5	5			5	5
6"	BLOW	5	5				
7"		5	5				
8"							
9"							
10"							
11"				0	0		
12"				0	0		
13"				5	5		
14"				5	5		
15"	MODERATE			5	5		
16"	BLOW						
17"							
18"							
19"							
20"							
21"							
22"							
23"							
24"							
25"	HARD						
26"	BLOW						
27"							
28"							
29"							
30"							

Bogus Breath Samples.

Table 4a summarizes the results obtained when bogus breath samples were introduced at room temperature. Regarding the Guardian Interlock, the easiest CBPA breath code was satisfied and the sensor was fooled using three different techniques for introducing bogus samples to start the car. Regarding the Autosense device, only use of the Mylar balloon allowed our technician to "fool" the system, suggesting that the pressure threshold of the system prevented the other techniques from satisfying the pressure requirement of the system. The mylar bag was easier to handle than the balloon or the plastic produce bag. Therefore, more pressure could be forced out of it than the other two containers. Regarding the Safety Interlock devices, unit #2 could not be defeated by room temperature bogus air samples, though unit #1 was defeated in one of the three procedures used. These results are consistent with the previous information about the temperature requirements of these Safety Interlock units. Unit #2 has a minimum temperature requirement considerably above room temperature, thereby thwarting attempts to start the car using room temperature bogus samples. The Safety Interlock also has a pressure requirement (previously described), but it is so low that it was not a factor in these tests.

As the Safety Interlock was the only device with a temperature sensor, it was the only device tested when the samples were heated by various means. Table 4b shows the results of these trials. It shows that the minimum temperature that would still allow a user to start his car on unit #2 was high enough to still prevent use of the toy rubber balloon and the plastic grocery bag, using all three heating techniques. When the mylar bag was used, one of the three heating procedures (wooden matches) apparently warmed the sample enough to satisfy the temperature requirements of the system and "fool" the device. When unit #1 was tested, all of the warming techniques heated the bogus samples enough to "fool" the device. As we noted earlier, the lower limit of the "temperature window" on unit #1 is just slightly above room temperature, and the warming techniques used here were sufficient to meet the temperature requirements of that device.

Filtered Air Samples

As Table 5 shows, use of a water filter effectively removed alcohol from the simulated sample enough to satisfy the alcohol threshold of both the Guardian Interlock and the Safety Interlock Devices. The pressure requirement of each device was also met. However, the

Table 4a

Performance of three IVAT Devices when Bogus Breath Samples Introduced at Room Temperature

Number of trials out of five car could start

STRATEGY FOR USE OF BOGUS AIR SAMPLE	IN-VEHICLE ALCOHOL TEST DEVICES: GUARDIAN #1	GUARDIAN #2	AUTOSENSE #1	AUTOSENSE #2	SAFETY-INTERLK #1	SAFETY-INTERLK #2
Toy Rubber Balloon (Room Temp.=23°C.)	5/5	5/5	0/5	0/5	0/5	0/5
Mylar balloon (Room Temp.=23°C.)	5/5	5/5	5/5	5/5	5/5	0/5
Plastic produce bag from local grocery (Room Temp. Air at 23°C.)	5/5	5/5	1/5 (connection to mouthpce difficult)	0/5	1/5	0/5

Table 4b

Performance of the Safety Interlock Device
when Bogus Breath Samples were Introduced
using various warming techniques

HEATING CONDITIONS FOR DEVICE WITH TEMP. SENSOR:	NUMBER OF TRIALS OUT OF FIVE CAR COULD BE STARTED SAFETY #1	INTERLOCK #2
Toy Rubber Balloon Heated by Body Heat By Being Held Under Arm	3/5	0/5
Toy Rubber Balloon Heated by Matches Held Under Balloon	3/5	0/5
Toy Rubber Balloon Heated with 12 v. portable hair drier	1/5	0/5
Mylar Bag Heated by Body Heat By Being Held Under Arm	5/5	0/5
Mylar Bag Heated by Matches Held Under Bag	5/5	4/5
Mylar Bag Heated with 12 v. portable hair drier	4/5	0/5
Plastic Produce Bag from Grocery Heated by Body Heat by Being Held Under Arm	4/5	0/5
Plastic Produce Bag from Grocery Heated with Matches Held Under Bag	2/5	0/5
Plastic Produce Bag from Grocery Heated with 12 v. portable hair drier	4/5	0/5

amount of pressure a human can produce through the water filter was less than the pressure required to activate the Autosense device, as previously measured. It is, therefore, reasonable to conclude that the pressure requirement of the Autosense units prevented us from introducing filtered samples into them. Note should be made that tests of the Guardian device were run after the easiest CBPA difficulty condition was satisfied in each trial.

Use of paper tubing packed with an everyday absorbent material proved effective in removing enough alcohol from the samples to satisfy the minimum alcohol threshold requirements of all three systems. In the case of the Safety Interlock, the first breath passed through the absorbent material was apparently at a low enough temperature that the temperature requirement of the system was not met, even if the alcohol was filtered out of the sample. However, repeated blowing through the absorbent material produces a heating effect. When the temperature was raised by passing breath through the system several times, alcohol was successfully filtered out of the sample, allowing the car to be started at all BAC levels except 0.10%. In other words, once the temperature was raised,this filter worked the same for all three units, except at 0.10% BAC.

Learning the Guardian CBPA code.

After repeated practice, the CBPA breath requirements were satisfied at all three difficulty levels by squeezing a plastic bag forcing air through the device with the required pattern of puffs and pauses. At the more difficult levels, however, the likelihood of a failing trial increases.

The more interesting issue is whether a naive, untrained person, given simple instructions, can also satisfy the CBPA requirements. Our preliminary data presented in Table 6, based on data from a total of ten sober government volunteer subjects, suggests that at the easiest CBPA level, a sober naive user may be able to satisfy the CBPA requirements about 1/3 of the time. At the more difficult levels, it appears highly unlikely a naive, untrained user would be able to pass the requirement. Though based on a very limited sample, these preliminary data suggest that the Guardian CBPA requirement, even if only set at the least difficult level, serves as an additional screen to prevent use by a naive, cooperating bystander.

Table 5

Performance of IVAT Devices Using Processed/Filtered Air Samples

FILTERED AIR SAMPLES AT SELECTED BACs	Number of trials out of five car could start ------IN-VEHICLE ALCOHOL TEST DEVICES ------- GUARDIAN #1	GUARDIAN #2	AUTOSENSE #1	AUTOSENSE #2	SAFETY-INTERLK #1	SAFETY-INTERLK #2
Water Filter						
at simulated BACs=0.03%	5/5	5/5	See Note 1 regarding these measures.		5/5	5/5
0.05%	5/5	5/5			5/5	5/5
0.08%	5/5	5/5			3/5	5/5
0.10%	5/5	5/5			1/5	5/5
Paper Tubing Packed w/ 12 OZ. Absorbent Material					(See Note 2) new tube ea.blw	
at simulated BACs=0.03%	5/5	5/5	5/5	5/5	0/5	0/5
0.05%	5/5	5/5	5/5	5/5	0/5	0/5
0.08%	5/5	5/5	5/5	5/5	0/5	0/5
0.10%	5/5	5/5	5/5	5/5	0/5	0/5
	SPECIAL CONDITIONS FOR SAFETY INTERLOCK ONLY				new tube betw. trials/test 2nd and third blow	
Paper Tubing =0.03%					5/5	5/5
packed with =0.05%					5/5	5/5
absorbent materl.=0.08%					5/5	5/5
(See Note 2) =0.10%					0/5	0/5

Note 1: Back pressure from the water filter prevented the technician from producing a sample at a pressure great enough to satisfy the pressure requirements of the Autosense. Even when one blows directly into the water filter, eliminating the simulator, it was not possible to produce a pressure greater than 5 inches of water between the water filter and the Autosense. As previously reported, the Autosense requires at least 13 inches of water pressure to be activated.

Note 2: When testing the Safety Interlock units, blowing a second or third time through the same absorbent material-packed tube produces a different result, because the tube heats up, raising the temperature of the sample to a level within the acceptable range set for the Safety Interlock temperature sensor. Results at the bottom of the table illustrate this point. Under these conditions, the absorbent material filtered the alcohol out of the system at each BAC level except 0.10%.

Table 6

Average Percentage of Naive, Sober Volunteers
Passing Guardian's CBPA Requirements

DIFFICULTY LEVEL

EASIEST --------MOST DIFFICULT

	1	2	3
Average Percentage Passing	33 %	11 %	0%
number of Subjects	4	3	3

Conclusions

Our laboratory findings indicate that, except for one of the Guardian units, the IVAT devices tested consistently identified low as well as high BAC users (0.04% or above) who followed instructions. Because one Guardian unit indicated a much higher alcohol threshold, five additional Guardian units were tested for accuracy. The threshold for these units was found to be more in line with the 0.04% BAC level.

Regarding possible strategies to fool the devices, each of the devices we evaluated incorporated at least one feature designed to prevent this (e.g., a temperature sensor, a pressure requirement, a special start-up requirement, etc.). None of the devices incorporated all of these special features.

Regarding the use of bogus breath samples, none of the devices was totally successful in protecting against this circumvention strategy. However, the one unit with a temperature sensor, Safety Interlock, demonstrated that such a sensor, set at the appropriate temperature range, can make it more difficult to circumvent the device. However, we do not have information about how difficult it is to establish a stable temperature sensor, how often its calibration would need to be checked, and how it might be influenced by extreme environmental conditions.

Regarding the use of filtered air samples, none of the devices was totally successful in protecting against this circumvention strategy. However, the Autosense device, with its higher pressure requirement, protected against one type of filtered air sample. The higher pressure requirement made it very important that the seal between the filter and the IVAT be tight. In those cases where it was more difficult to ensure a tight seal when using the Autosense device, the pressure requirement prevented the user from circumventing the device.

The Guardian Interlock device, with its Controlled Breath Pulse Access (CBPA), is the only device which imposes a start-up requirement on its users. Our preliminary tests using a small sample of sober, volunteer subjects suggests that this strategy may be helpful in deterring or preventing a sober bystander from starting someone's car. As we collected no data using dosed (impaired) subjects, we cannot address the issue of its effectiveness with impaired users.

In summary, even with special features designed to prevent circumvention, it can be concluded that a motivated individual, with preplanning and some knowledge, can fool the devices tested. However, it should also be noted that only two units of each device were tested in this limited laboratory project (except for the extra accuracy data collected on five additional Guardian Interlock devices). It is, therefore, inappropriate to generalize these results to all current or future units. Furthermore, these data do not address how well these devices will perform under real-world field conditions. Other future field evaluation research projects will need to address these issues.

Reference

Frank, James F. "Laboratory Testing of Two Prototype In-Vehicle Breath Test Devices." Washington, DC: National Highway Traffic Safety Administration, August, 1985. (NHTSA Technical Report No. DOT HS 806 821).