Test Report: The Detection Capability of the Sniffex Handheld Explosives Detector

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NAVEODTECHDIV RDT&E Signature Sheet

Test Report: The Detection Capability of the SNIFFEX Handheld Explosives Detector

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Executive Summary

The Counter Terrorism Technology Task Force conducted testing of the SNIFFEX handheld explosives detector on 8-9 August 2005 at the Yuma Proving Ground's Joint Experimental Research Complex (JERC) in Yuma, Arizona. The test objectives were to evaluate the vendor's claims concerning the device's ability to detect explosives. Testing was performed in a manner consistent with the specifications of the SNIFFEX, and was designed only to evaluate the device's principles of operation, not to test its limits. Thus, explosive weights were considerably more than the minimum detectable amounts (20 or more pounds vs. 0.1 pounds), while distances were kept well within the maximum detectable ranges (10-25 feet vs. 300 feet) and the vendor was given the opportunity to take multiple passes prior to making a determination vice 2-3 as stated in their literature. As shown in Table 1, the SNIFFEX handheld explosives detector performed no better than random chance over the course of testing. None of the vendor's claims proved true during this test series.

Table 1. Summary of SNIFFEX test results.

SNIFFEX Location	Explosive Location	Explosive (Weight/Type)	Number of Tests/ Number correct	Percent True Positives	Percent False Positives*
Outdoor	Outdoor	20 lbs. TNT	5/0	0	-
Outdoor	None	None	1	-	100
Outdoor	Outdoor	20 lbs. C4	2/0	0	-
Indoor	Indoor	20 lbs. TNT	16/5	31	-
Indoor	None	None	3/0	-	100
Indoor	Outdoor	500 lbs. TNT	1/0	0	-
Overall correct determination rate		22.7% 5 out of 22, first 6 trials outside of specs			

* Device incorrectly identifies that explosives are present – vendor claim was 10% ,0% is the desired value

1 Purpose

A series of baseline and operational tests were developed to evaluate the SNIFFEX. Baseline tests were designed as double blind trials to determine the detection capabilities of the device beyond random chance, while operational tests were planned to assess its performance in realistic situations. Together, these tests were designed to provide a better understanding of SNIFFEX's capabilities and help determine if it should be considered for fielding.

1.1 Background

The SNIFFEX handheld explosive detector is manufactured in Bulgaria and distributed by SNIFFEX, Inc. of Irving, Texas. The device was tested in response to the

vendor's claim that it is able to detect small amounts of explosives (0.1 pounds) through almost any type of barrier in a relatively short amount of time at standoff distances of 10-300 feet (depending on quantity of explosives present). Furthermore, the vendor claims to be able to detect a wide variety of explosives with a greater than 90% true positive detection rate and a less than 10% false positive rate. The only major limitation identified by the vendor is that the wind speed must be less than one mile per hour to prevent the false indication of explosives when there are none present.

NAVEODTECHDIV purchased two SNIFFEX devices for investigative purposes in July 2005. SNIFFEX representatives delivered the devices and conducted a brief operators training session in Indian Head, Maryland. That knowledge was used to write a test plan for the conduct of formal testing at YPG. To meet the short delivery time requirements, SNIFFEX provided demo units with the promise of delivering new production units for the August tests at YPG.

1.2 System Description

The SNIFFEX, shown on the left in Figure 1, is a handheld device with two main components: the body and the antenna. The body of the SNIFFEX is 126mm long, 36mm wide, slightly longer than the width of the average person's palm. The antenna when extended is approximately 460mm long. The device weighs 550 grams. To operate the device, the SNIFFEX body is held in the hand opposite the side the explosives are to be detected on, while the free arm of the operator is held outward. The SNIFFEX antenna is extended fully outward and the operator walks carefully through the area in which it is suspected that explosives are present, as shown on the right in Figure 1. (Note, on one side the device is labeled SNIFFEX and on the other side it is labeled "arsenal", the name of the Bulgarian manufacturing company.) When the antenna, which is free to pivot on a set of bearings, rotates ninety degrees from the operator, explosives are present along the line of the antenna in the direction that it is pointing. By taking multiple readings with the device, the exact location of the explosive can be determined.

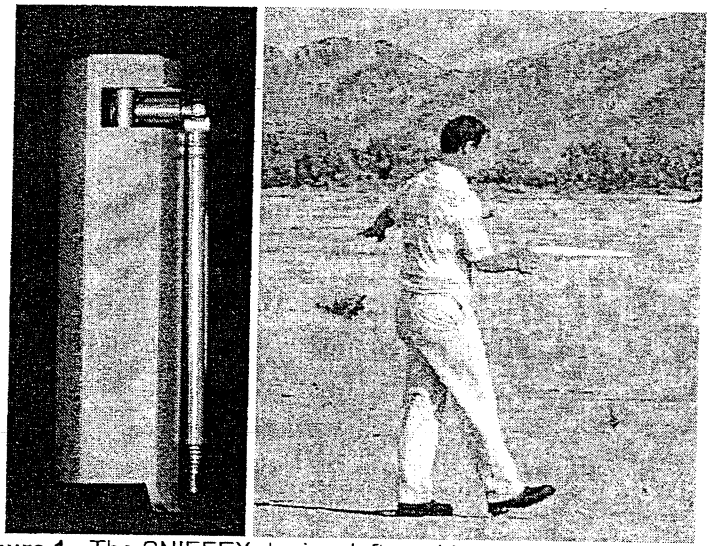

Figure 1. The SNIFFEX device, left, and its use during operation.

The SNIFFEX has very few internal parts, comprised only of magnets of two different sizes, a brass cylinder, and a spring with a brass contact piece on the end of it. The brass cylinder contains an unknown gas whose nature is considered a trade secret. The brass cylinder lies between two groups of magnets. In the center of the top group of magnets, a small spring with a brass cap resting on it is pressed against the base of the antenna. This entire assembly is contained in the body of the SNIFFEX, which is closed with an end cap.

2 Data Sources and Testing

2.1 Test Methodology

All baseline tests were conducted as double blind trials. In the first series of tests, four boxes were arranged on a flat, level area such that they formed the four corners of a square, fifty feet on each side, as shown in Figure 2. At most, only one box contained explosives for any given trial; for some tests, no explosives were present. While the explosives were being placed, the operators were removed from the test area to prevent them from knowing the explosive's location. After placement, any unnecessary explosives were moved out of the test area during each trial to a distance of approximately 0.35 miles away. The vendor agreed that this was sufficient standoff to prevent accidental identification of explosives. Those who knew the location of the explosives for each trial were isolated from the test area during testing. Any boxes that had previously contained explosives that were no longer in contact with explosives were removed from the area. The device was operated by a vendor representative while government observers recorded the vendor's findings and data such as the environmental conditions during the test (temp, wind speed, humidity,), how long it took to determine a result and other observations. The actual location of the explosives was not known by the government observer and vendor until after all the trials were completed.

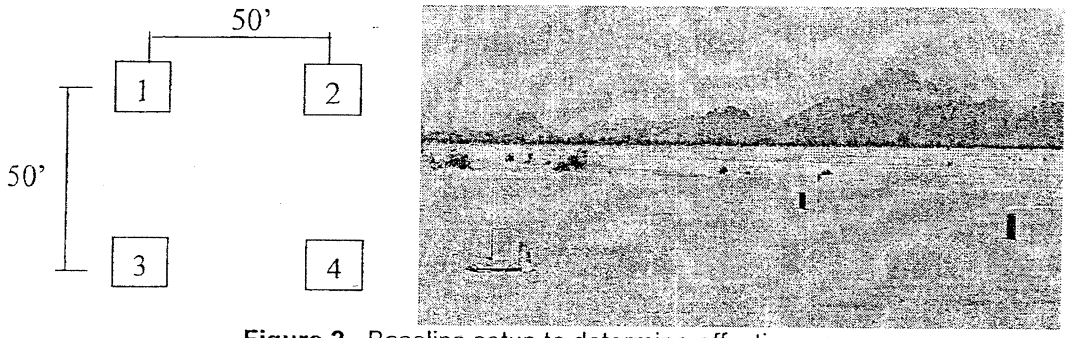

Figure 2. Baseline setup to determine effectiveness.

Originally, it was planned that the operator was to make two passes perpendicular to each other through the center of the square to determine which box contained explosives. Although this should have been sufficient, the operators requested the ability to make more passes through the test area. They were subsequently permitted to make as

many passes as necessary in any direction to make their determination. The first six trials of this configuration were performed outside, and unfortunately were subject to wind gusts of up to ten miles per hour.

After it became obvious that the wind was seriously affecting the SNIFFEX's operation, the baseline tests were moved to an enclosed building approximately twenty-three feet on each side. Boxes were placed in a configuration similar to the previous tests but on a smaller scale, with one box being in the center of each wall, as shown in Figure 3. The test procedures and explosive weights were the same as for previous tests. The operator was allowed to move freely within the structure and make as many passes with the device as necessary.

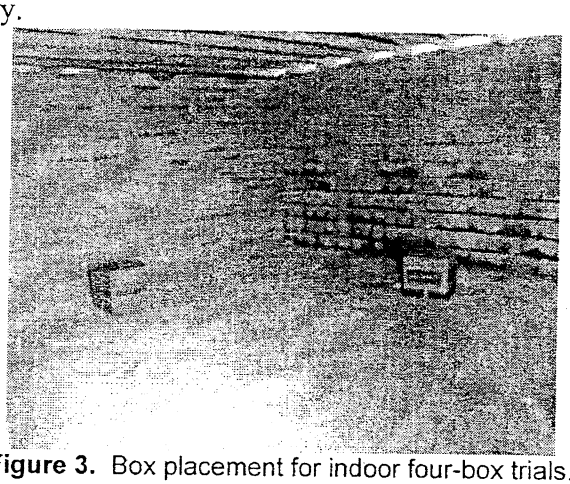

Figure 3. Box placement for indoor four-box trials.

Outside the enclosed test building, a test area exactly the same as the original four-box test was setup to use if the wind died down. This test area was used twice. The vendor agreed that both test areas provided an environment that would allow the SNIFFEX to easily detect explosives.

On the second day of testing, further baseline tests were performed. The operators were kept blind to the operations by keeping them inside an enclosed building during testing. Four boxes were placed outside the building, one at the center of each wall. For each trial, one box was chosen at random to place the explosives in. The operators were given as much time as necessary to determine the location of the explosives. The vendor agreed that this was an acceptable method of evaluating the SNIFFEX's abilities, and stated that the SNIFFEX would be able to detect explosives in this situation.

After the field tests were completed, the SNIFFEX devices were disassembled in an attempt to better understand their construction and to hopefully gain some insight into the devices operating principles.

2.2 Test Limitations

The tests were limited to proving if SNIFFEX could detect explosives per the vendor's claims. No attempt was made to determine detection range vs. explosive quantity or to explore the claimed limits of performance (i.e. what is the minimum amount of explosives it could detect or what the maximum effective range for any given explosive weight would be). Tests were limited to C-4 and TNT; the full range of explosives that SNIFFEX claims to be able to detect was not checked. However, discussions with the vendor revealed that they believed that their device was best at finding TNT. All tests were vs. bulk explosives – no loaded artillery rounds.

2.3 Test Results

The SNIFFEX did not detect explosives. A summary of the results is shown in Table 2. Every effort was made to meet the vendor's needs to allow the device to operate

Table 2 – Test Results Summary

Trial	Explosive Qty	Actual Location	SNIFFEX Says	Correct Y/N	# Passes	Time Min:sec
1	20 lb TNT	4	1	N	4	6:00
2	20 lb TNT	3	2	N	5	6:17
3	20 lb TNT	3	None	N	5	6:05
4	20 lb TNT	None	2	N	7	9:10
5	20 lb TNT	1	3	N	7	7:46
6	20 lb TNT	2	4	N	16	19:30
7	20 lb TNT	2	4	N	6	2:30
8	20 lb TNT	3	1	N	5	1:50
9	20 lb TNT	4	4	Y	4	1:30
10	20 lb TNT	None	1	N	8	3:30
11	20 lb TNT	2	1	N	8	3:08
12	20 lb TNT	4	3	N	4	2:45
13	20 lb TNT	4	3	N	8	3:15
14	20 lb TNT	1	1	Y	6	2:20
15	26 lb C-4	1	4	N	5	5:40
16	26 lb C-4	1	2	N	6	9:10
17	20 lb TNT	2	1	N	6	2:45
18	20 lb TNT	3	3	Y	8	3:14
19	20 lb TNT	3	3	Y	9	4:30
20	20 lb TNT	1	2	N	9	6:00
21	20 lb TNT	1	1	Y	10	4:25
22	20 lb TNT	None	1	N	11	5:15
23	20 lb TNT	None	4	N	15	9:10
24	20 lb TNT	3	2	N	10	5:40
25	20 lb TNT	2	None	N	10	9:00
26	20 lb TNT	2	3	N	10	4:30
27	20 lb TNT	4	2	N	10	4:30

28	500lb TNT	3	4	N	12	10:00

under ideal conditions, but there was absolutely no indication the device met any single vendor claim. A full tabulation of the testing and results can be found in Appendix A. Discounting trials 1-6 where wind speed exceeded the operating specification of the device, testing resulted in an accuracy rate of 22% , five correct determinations and seventeen incorrect determinations , 3 of which were false positives - i.e. no explosives were present.

During most trials, the operators were very confident in their determination of the location of the explosives, regardless of whether the determination was actually correct. Also of note was that the deflection of the antenna during testing was considerably less than during demonstration and training and also varied between operators. In many cases, no deflection was visible to the government observers yet the operator indicated a positive finding. In other cases a deflection of 70-80 degrees was considered a positive indication of the explosive's location.

The vendor never suggested/considered that the SNIFFEXs were malfunctioning during any test despite the fact that the devices were not correctly identifying the location of explosives. On one occasion, the vendor wondered if the building was influencing the accuracy of the device, even though their device is purported to be able to detect explosives through most any barrier. In response to this, the operator proceeded to walk around the outside perimeter of the building while twenty pounds of TNT were inside. As he walked, the SNIFFEX indicated that explosives were present within the building as evidenced by a clear antenna deflection. However, as he was noting the positive indication of explosives in the structure, two explosives trucks containing a total of 1,000 pounds of explosives drove up behind him to a distance of approximately twenty feet away. The SNIFFEX failed to show any indication of this much larger quantity of explosives.

A total of four different SNIFFEXs were in the Navy's possession during the training, evaluation, and test period. Each was disassembled after being used. The devices used during the testing at YPG are shown in Figure 4.

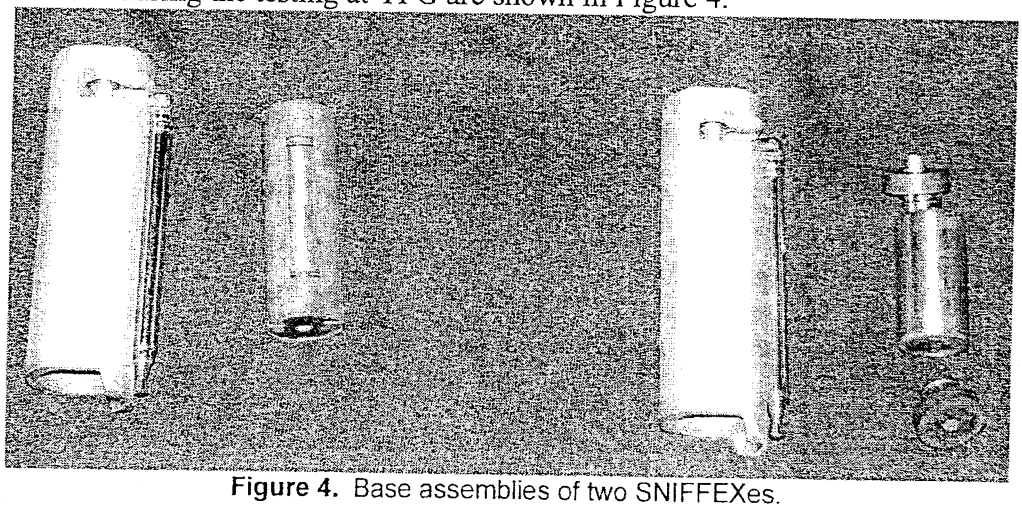

Figure 4. Base assemblies of two SNIFFEXes.

The two demo units contained two sets of two large $^{13}/_{16}$" magnets coupled with one smaller ½" magnet at either end of a brass cylinder. The production units had similar but not identical components. The production unit shown on the left in Figure 4, was of the same construction as the demo units but the internal parts were held together by a brass sleeve. The second production unit, shown on the right in Figure 4, had two sets of magnets comprised of three small ½" magnets coupled with one large $^{13}/_{16}$" magnet. While the significance of these differences is unknown, it seems that the SNIFFEX design is still a work in progress.

According to the vendor's website, the SNIFFEX is comprised of a signal generator module and a detection module. The signal generator module, which "is activated to emit an energy signal of a target material's characteristic frequency," has no clear analogue to a physical part of the SNIFFEX . The patent for the product (Patent 6,344,818) states that the device operates on frequencies between 10 MHz and 1.3 GHz. As evidenced by the disassembled device in Figure 4, there is no power source present that is capable of producing an electromagnetic signal. This was further evaluated using a spectrum analyzer. SNIFFEX emits no detectable signal in the 100 Hz to 26.5 GHz range when operating.

3 Observations

3.1 Capabilities

Based upon the observed test results, the SNIFFEX handheld explosives detector is not capable of detecting explosives regardless of the distance between the device and any explosives.

3.2 Limitations

Per the vendor's specifications, the device is limited to operation when wind speeds are 1 mph or less. The device is also limited to conditions when there is sufficient light to see the antenna and walk.

3.3 Safety Issues

Aside from misleading an operator to believe that explosives are or are not present and the hazards that go along with that misinformation, there are no safety issues with the SNIFFEX device.

3.4 Supportability

The SNIFFEX device is ruggedly constructed and contains only one moving part, the antenna. There are no consumable parts. The availability of replacement parts is unknown. Maintenance requirements for the device were not discussed with the vendor.

Their website makes no mention of repair parts or customer support. SNIFFEX states that an operator's manual is available but did not deliver one along with the devices.

3.5 Survivability

The testing conducted did not investigate any survivability issues.

3.6 Training

The vendor gave us a brief (2 hour) training session and felt that was all that was required. The actual execution of the operating procedures is much more difficult, though. The bearings on the antenna are extremely smooth, and no resistance is offered to any external influence on the antenna. The antenna is prone to deflection from slight breezes, magnetic influences, and improper handling. Furthermore, the device is extremely susceptible to a well-documented phenomenon known as the *ideomotor effect*. This effect holds that involuntary muscular movements can be caused by suggestion and observation, both conscious and unconscious. If the location of the material being detected is known, the chances of the device correctly identifying it are increased greatly, even if the operator is trying to be objective and does not intentionally affect the antenna's movement [Carroll].

4 Conclusions and Recommendations

The SNIFFEX handheld explosives detector does not work. The vendor failed to make good on any guarantee of the device's performance and provided no possible reason as to why the SNIFFEX was unable to perform as marketed.

No further resources should be allocated to matters concerning the SNIFFEX handheld explosives detector until the vendor presents clearer principles of operation and a better demonstration of the capabilities of the device.

5 Appendices

Appendix A – Test Results

Table A1. Test results for first day of testing. Tests were performed in three different areas. The first set of tests was the original four-box test, and were subject to wind gusts exceeding the specification limits. The second set of tests were performed in an enclosed building. The third set of tests were a four-box test performed outside in which the wind was calm.

SNIFFEX Test Data Sheet
Data Recorder: Adam Shaker/ Valter Ezerins
Date: 8/8/2005
Test Type: 4 Box
Temperature Range: 85°F morning
98°F afternoon

Location:
1= Drop Zone Across from UAV Site
2= Inside of 4 Wall Building
3= Outside of 4 Wall Building

Test Site	Trial	Expl.	Operator	Device #	Sniffex Determination	Time - Start, Stop	Wind Const	Wind Gust	Actual Location	Correct Y/N	Comments
1	1	20lb. TNT	Stephen	A260	Box 1	08:38:47, 08:45:13	4-5 S	7-8 S	Box 4	N	1 Device, 4 passes
1	2	20lb. TNT	Stephen	A260	Box 2	08:59:00, 09:05:17	2-4 S	5-8 S	Box 3	N	1 Device, 5 passes
1	3	20lb. TNT	Stephen	A260	Empty	09:13:15, 09:19:20	1-2 S	4-6 S	Box 3	N	1 Device, 5 passes
1	4	20lb. TNT	Stephen	A260	Box 2	09:28:30, 09:37:40	6 S	8-11 S	Emtpy	N	1 Device, 7 passes
1	5	20lb. TNT	Paul	A144	Box 3	09:47:00, 09:54:46	4 S	6-10 S	Box 1	N	1 Device, 7 passes
1	6	20lb. TNT	Paul	A144	Box 4	10:03:30, 10:23:00	5 S	8-10 S	Box 2	N	1 Device, 16 passes
2	7	20lb. TNT	Stephen	A260	Box 4	11:42:15, 11:44:45	—	—	Box 2	N	1 Device, 6 passes
2	8	20lb. TNT	Stephen	A260	Box 1	11:51:10, 11:53:00	—	—	Box 3	N	1 Device, 5 passes
2	9	20lb. TNT	Stephen	A260	Box 4	12:00:00, 12:01:30	—	—	Box 4	Y	1 Device, 4 passes
2	10	20lb. TNT	Stephen	A144	Box 1	12:10:00, 12:13:30	—	—	Emtpy	N	1 Device, 8 passes
2	11	20lb. TNT	Stephen	A144	Box 1	12:20:30, 12:23:38	—	—	Box 2	N	1 Device, 8 passes
2	12	20lb. TNT	Stephen	A144	Box 3	12:30:15, 12:33:00	—	—	Box 4	N	1 Device, 4 passes
2	13	20lb. TNT	Stephen	A260	Box 3	12:35:45, 12:39:00	—	—	Box 4	N	1 Device, 8 passes
2	14	20lb. TNT	Stephen	A260	Box 1	12:53:00, 12:55:20	—	—	Box 1	Y	1 Device, 6 passes
3	15	26lb. C-4	Stephen	A260	Box 4	13:02:00, 13:07:40	1 S	3.5 S	Box 1	N	1 Device, 5 passes
3	16	26lb. C-4	Paul	A260	Box 2	13:08:30, 13:17:40	1 S	3.5 S	Box 1	N	1 Device, 6 passes
2	17	20lb. TNT	Stephen	P22	Box 1	13:29:30, 13:32:15	—	—	Box 2	N	1 Device, 6 passes

Table A2. Test results for the second day of testing. All tests were performed with the operator inside an enclosed building. The explosives were placed in the center of one wall on the outside of the building.

SNIFFEX Test Data Sheet
Data Recorder: Adam Shaker/ Valter Ezerins
Date: 8/9/2005
Test Type: 4 Box
Temperature Range: 90°F
Humidity 60%

Location: 2= Inside of 4 Wall Building, explosives on outside

Test Site	Trial	Expl.	Operator	Device #	Sniffex Determination	Time - Start, Stop	Wind Const	Wind Gust	Actual Location	Correct Y/N	Comments
2	18	20lb. TNT	Stephen	A260	Wall 3	09:38:30, 09:41:44	—	—	Wall 3	Y	1 Device, 8 passes
2	19	20lb. TNT	Stephen	P22	Wall 3	09:43:30, 09:48:00	—	—	Wall 3	Y	1 Device, 9 passes
2	20	20lb. TNT	Stephen	P22	Wall 2	09:52:00, 09:58:00	—	—	Wall 1	N	1 Device, 9 passes
2	21	20lb. TNT	Stephen	A260	Wall 1	10:01:20, 10:05:45	—	—	Wall 1	Y	1 Device, 10 passes
2	22	20lb. TNT	Paul	A260	Wall 1	10:09:45, 10:15:00	—	—	Empty	N	1 Device, 11 passes
2	23	20lb. TNT	Paul	A260	Wall 4	10:22:30, 10:31:40	—	—	Empty	N	1 Device, 15 passes
2	24	20lb. TNT	Stephen	A260	Wall 2	10:37:00, 10:42:40	—	—	Wall 3	N	1 Device, 10 passes
2	25	20lb. TNT	Adam	A144	Empty	10:47:00, 10:56:00	—	—	Wall 2	N	1 Device, 10 passes
2	26	20lb. TNT	Paul	A144	Wall 3	10:56:30, 11:01:00	—	—	Wall 2	N	1 Device, 10 passes
2	27	20lb. TNT	Stephen	A144	Wall 2	11:05:30, 11:10:00	—	—	Wall 4	N	1 Device, 10 passes
2	28	500lb expl	Paul	A144	Wall 4	11:16:00, 11:26:00	—	—	Wall 3	N	1 Device, 12 passes

6 References

Carroll, Robert Todd. "Ideomotor Effect." The Skeptic's Dictionary. 24 July 2005. Accessed 11 August 2005. <http://skepdic.com/ideomotor.html>.

SNIFFEX | | The Explosive Detection Experts. SNIFFEX, Incorporated. Accessed 26 August 2005. <http://www.SNIFFEX.com/overview/default.asp>