



## National Fire Protection Association

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### MEMORANDUM

**TO:** Correlating Committee on Fire and Emergency Services protective Clothing and Equipment

**FROM:** Yvonne Smith, *Project Administrator*

**DATE:** October 21, 2016

**SUBJECT:** NFPA 1982 Proposed Tentative Interim Amendment (TIA) No. 1247

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The Technical Committee on Electronic Safety Equipment has been balloted on proposed TIA 1247, submitted by Craig Gestler of Mine Safety Appliances Company and endorsed by Robert Athanas of FDNY/SAFE-IR, Inc. A copy of the proposed TIA and the preliminary results of the TC balloting are attached.

This proposed TIA is being submitted to you for letter ballot to revise various sections of the 2013 Edition of NFPA 1982. In accordance with Section 5 of the *Regulations Governing the Development of NFPA Standards*, you are being balloted on any **correlating issues** of the proposed TIA and whether this matter is of an **emergency nature**. A “disagree” vote is limited to subjects within the purview of the Correlating Committee. Opposition on a strictly technical basis is not sufficient grounds for substantiating a “disagree” vote.

Please complete and return the attached letter ballot to Yvonne Smith either via email to [ysmith@nfpa.org](mailto:ysmith@nfpa.org) or via fax to 617-984-7110. **Ballots are due on Thursday, October 27, 2016.**

This proposed TIA 1247 has been published for public comment in the October 7, 2016 issue of *NFPA News* with a Public Comment Closing Date of November 9, 2016. Any public comments received will be circulated to the committee. The Standards Council will consider the issuance of this TIA at their November 30-December 1, 2016 meeting.

*Note: Please remember that the return of ballots and attendance at committee meetings are required in accordance with the Regulations Governing the Development of NFPA Standards.*

**NFPA 1982- 2013 Edition**

*Standard on Personal Alert Safety Systems (PASS)*

**TIA Log No.:** 1247

**Reference:** Various

**Comment Closing Date:** November 9, 2016

**Submitter:** Craig Gestler, Mine Safety Appliances Company

*1. Revise 1.1.3 to read as follows:*

**1.1.3\*** This standard shall ~~not specify the minimum requirements for any manufactured to previous editions of this standard~~ the design, performance, testing, and certification of PASS or RF PASS devices certified to an earlier edition of this standard that incorporate parts, components, and/or software to meet this edition of the standard.

*2. Revise 1.3.1 to read as follows:*

**1.3.1** This standard shall ~~not apply to any PASS manufactured to previous editions of this standard~~ the design, performance, testing, and certification of PASS or RF PASS devices certified to an earlier edition of this standard that incorporate replacement parts, components, and/or software to be certified to this edition of the standard.

*3. Revise 4.2.8.1 to read as follows:*

**4.2.8.1** The certification organization and the manufacturers shall evaluate replacement parts, components, and software to determine any changes affecting the form, fit, or function ~~for~~ of PASS or RF PASS devices certified to the 2007 edition of NFPA 1982 to permit revisions to the original certification 2013 or earlier editions of this standard, to permit incorporation of replacement parts, components, or software, leading to certification of devices to this edition of the standard.

*4. Add a new section 4.9 to read as follows:*

**4.9 Manufacturers Upgrade Notification.**

**4.9.1** Manufacturers shall be required to provide notice of all available upgrades to the AHJ.

*5. Add a new paragraph, 5.1.6.1, to read as follows:*

**5.1.6.1** PASS or RF PASS devices certified to previous editions of this standard that have been upgraded to meet this edition shall have the following statement legibly printed. All letters shall be at least 2 mm (1/16 in.) in height. The label is not restricted to one line. The original NFPA required labeling shall not be removed or covered by the upgrade label.

**“PASS ALARM SOUND UPGRADED”**

*6. Revise 6.4.3.9 to read as follows:*

**6.4.3.9** The PASS annunciator shall be driven by an alarm sequence consisting of the following ~~six~~ eight steps:

- (1) A Type 1 ~~Chirp sweep~~
- (2) A silent ~~interval period~~ of ~~400.0 ms +/- 2.0 ms~~ 300 ms ± 100 ms
- (3) A Type 2 ~~Chirp-sweep~~, repeated a total of four times with a ~~silent period gap~~ of 10 ms ± ~~0.05 ms~~ 5 ms between each ~~chirp-sweep~~
- (4) A silent ~~interval period~~ of ~~200-300 ms ± 40-100 ms~~
- (5) A Type 3 ~~chirp~~, repeated a total of 8 times with a gap of 10 ms +/- ~~0.050 ms~~ between each ~~chirp~~ A Type 1 warble
- (6) A silent interval of ~~1500.0 ms +/- 50 ms~~ A Type 2 warble
- (7) A Type 1 warble
- (8) A silent period of 600 ms ± 100 ms

**6.4.3.9.1** Following step ~~6~~ 8, the alarm sound shall repeat, beginning immediately with step 1.

**6.4.3.9.2 Type 1 Chirp Sweep.** The Type 1 chirp shall begin with a frequency of 4.000 kHz +/- 0.02 kHz and shall sweep to a frequency of 2.000 kHz +/- 0.01 kHz using the following method: The Type 1 chirp shall be a binary (on/off) pulse wave consisting of sequential cycles whose period changes on a cycle to cycle basis. The first cycle shall have a period of 250 us +/- 1.25 us. The second cycle shall have a period of 250.4 us +/- 1.252 us. The period for each succeeding cycle shall continue to be increased by 0.4 us +/- 0.002 us until the last cycle, which shall have a period of 500 us +/- 2.50 us. The Type 1 sweep shall be a 1 second ± 50 ms frequency sweep with a minimum of 100 frequency steps. The start frequency and end frequency shall be in the range of 2000 to 4000 Hz, and the end frequency shall be a minimum of 500 Hz greater than the start frequency.

**6.4.3.9.3\* Type 2 Chirp Sweep.** Starting at a lower frequency of 2.0 kHz +/- 0.1 kHz, the frequency shall rise in a sweeping manner, by a minimum number of 100 equal or near equal frequency steps, to an upper frequency of 4.0 kHz +/- 0.1 kHz in 234 ms +/- 1.17 ms. The sweeping chirps are to be kept close to linear rising frequency steps from the lower to the upper frequency to maintain the consistent audible sound pattern. It shall be permitted to change from linear frequency steps to nonlinear steps to allow a particular frequency or frequencies to be held for up to 50 +/- 5ms before returning as quickly as practicable to a normal linear rate to finish at the upper frequency. At higher frequencies (e.g above 3.5 kHz) it might be necessary to increase the frequency step rate just before starting to hold a peak frequency. The Type 2 sweep shall be a 250 ms ± 12.5 ms frequency sweep with a minimum of 25 frequency steps. The start frequency and end frequency shall be in the range of 2000 to 4000 Hz, and the end frequency shall be a minimum of 500 Hz greater than the start frequency.

**6.4.3.9.4 Type 3 Chirp 1 Warble.** The Type 3 Chirp shall begin with a frequency of 2.000 kHz +/- 0.01 kHz and shall sweep to a frequency of 4.000 +/- 0.02 kHz using the following method. The Type 3 Chirp shall be a binary (on/off) pulse wave consisting of sequential cycles whose period changes on a cycle to cycle basis. The first cycle shall have a period of 500us +/- 2.50 us. The second cycle shall have a period of 499.2us +/- 2.496 us. The period for each succeeding cycle shall continue to be decreased by 0.8 us +/- 0.001 us until the last cycle, which shall have a period of 249.6 us +/- 1.248 us. The Type 1 warble shall be a 400 ms ± 20 ms sound that alternates between Tone A and Tone B every 10 ms ± 5 ms.

**6.4.3.9.5 Type 2 Warble.** The Type 2 warble shall be a 200 ms ± 10 ms sound that alternates between Tone B and Tone C every 10 ms ± 5 ms.

**6.4.3.9.6** Tones A, B, and C shall be between 2000 Hz and 4000 Hz.

**6.4.3.9.6.1 Tone A.** Tone A shall be a frequency between 2300 Hz and 4000 Hz.

**6.4.3.9.6.2 Tone B.** Tone B shall be a frequency 100 Hz to 200 Hz below Tone A.

**6.4.3.9.6.3 Tone C.** Tone C shall be a frequency 200 Hz to 300 Hz below Tone B.

7. *Revise 7.1.2 to read as follows:*

**7.1.2 PASS Alarm Signal.**

**7.1.2.1** PASS shall be tested for the sound pressure level of the alarm signal as specified in Section 8.2, Sound Pressure Level Tests, and shall not have the alarm signal, once activated, be deactivated by the motion detector; shall have the alarm signal sound pressure level not be less than 95-92 dBA; ~~for an uninterrupted duration of not less than 1 hour~~ and shall have PASS function properly as specified in 6.4.3.

**7.1.2.2** PASS shall be tested for frequency content as specified in ~~8.14~~ 8.15 and shall have the alarm signals as specified in 6.4.3.9.

8. *Revise Section 7.10 to read as follows:*

**7.10 Water Drainage.** PASS shall be tested for water drainage as specified in Section 8.11, Water Drainage Test, and the alarm signal sound pressure level shall be at least 95-92 dBA.

9. *Revise Section 7.11 to read as follows:*

**7.11 Heat Resistance.** ~~PASS shall be tested for resistance to heat as specified in Section 8.12, High Temperature Functionality~~

~~Test, and shall be evaluated for proper functioning of signals as specified in 6.4.2.3 and 6.4.3.2, shall have the sound pressure level not be less than 95 dBA, shall have the data logging functions specified in 6.1.3(1) through 6.1.3(5) operating properly, and shall not melt, drip, or ignite. PASS shall be tested for resistance to heat as specified in Section 8.12, High Temperature Functionality Test, and shall not melt, drip, or ignite.~~

**7.11.1** PASS shall be evaluated for proper functioning of signals as specified in 6.4.2.3 and 6.4.3.2.

**7.11.2** The sound pressure level shall not be less than 92 dBA.

**7.11.3** The data logging functions specified in 6.1.3(1) through 6.1.3(5) shall operate properly.

10. *Revise Section 7.14 to read as follows:*

**7.14 Alarm Signal Muffle Test.** PASS shall be tested for resistance to sound pressure level deadening or muffling as specified in Section 8.18, PASS Alarm Signal Muffle Test, and ~~shall~~ have the sound pressure level shall not be less than 95-92 dBA.

11. *Revise 8.2.4.3 to read as follows:*

**8.2.4.3** ~~The test chamber shall be as specified in ANSI S1.13, *Methods for Measurement of Sound Pressure Level*. The sound level meter shall meet the requirements of ANSI S1.4 Type 1.~~

12. *Revise 8.2.5.3 to read as follows:*

**8.2.5.3** ~~All sound pressure level measurements shall be made with the sound level meter ballistics set to the peak response setting.~~ All sound pressure level measurements for the PASS alarm signal as described in 6.4.3.9 shall be made with the sound level meter set to A-weighting with a fast response time (LAF). The maximum-hold function (if available) shall be permitted to be used to hold the maximum level observed by the meter for the specified period of time. All other sound pressure level measurements, including, but not limited to, the pre-alarm sequence and the low power source warning, shall be made with the sound level meter ballistics set to the peak response setting.

13. *Revise 8.2.8.1 to read as follows:*

**8.2.8.1** The sound pressure level for the alarm signal shall be measured in a spherical radius at a distance of ~~3m +0.3m/-0 m (9.9 ft +0.9/-0 ft)~~ 1 m +2.5/-0 cm (3.3 ft +1/-0 in.) from the specimen's annunciator.

14. *Add a new paragraph, 8.2.8.2, and revise and renumber subsequent paragraphs to read as follows:*

**8.2.8.2** The specimen shall be mounted on the audio test mannequin in the preferred mounting position and orientation for optimal performance as specified by the manufacturer.

~~**8.2.8.23**~~ Before starting the test, the specimen's power source voltage shall be discharged to the level at which the PASS first emits the low power source warning signal specified in 6.4.4.

~~**8.2.8.34**~~ The power source voltage shall be discharged at a rate that is equal to the average current draw,  $\pm 10$  percent, of the same model PASS while in the operational condition that uses maximum current. The rate shall be determined by measurement by the certification organization.

~~**8.2.8.45**~~ The sound pressure level for the alarm signal shall be measured for 60 minutes +5/-0 minutes at 60 minutes +1/-0 minutes after the start of the test. Five measurements, each for a minimum duration of 6 seconds, shall be taken. The maximum sound pressure level shall be recorded for each measurement. The lowest of the five measurements shall be discarded and the remaining four shall be the sound pressure levels.

~~**8.2.8.56**~~ The alarm signal sound pressure level shall sound pressure levels for the PASS alarm signal shall be recorded, evaluated, and reported for the entire duration to determine pass or fail performance.

~~**8.2.8.67**~~ For testing purposes only, manufacturers shall be permitted to reconfigure a PASS device sample to allow external test equipment to access the digital signal being delivered to the sound mechanism/transducer element.

15. *Revise 8.12.5.11 to read as follows:*

**8.12.5.11** The specimen shall remain motionless and be allowed to cycle from sensing mode to alarm mode. When the PASS cycles into the alarm mode, within 30 seconds the sound pressure level for the alarm signal shall be measured in a spherical radius at a distance of ~~3 m +1/-0 m (9.9 ft +3.3/-0 ft)~~ 1 m +2.5/-0 cm (3.3 ft +1/-0 in.) from the specimen's annunciator.

16. *Revise 8.18.5.3 to read as follows:*

**8.18.5.3** All sound pressure level measurements shall be made with the sound level meter ballistics set to ~~the peak response setting and the A-weighting with a fast response time (LAF)~~. The maximum-hold function (if available) shall be permitted to be used to hold the maximum level observed by the meter for the specified period of time. The test subject shall do the following:

- (1) The protective ensemble specified in 8.18.4.3
- (2) The specimen PASS per the manufacturer's instructions

17. *Revise 8.18.5.5 to read as follows:*

**8.18.5.5** The sound pressure level for the alarm signal shall be measured in a spherical radius at a distance of ~~3 m +1/-0 m (9.9 ft +3.3/-0 ft)~~ 1 m +2.5/-0 cm (3.3 ft +1/-0 in.) from the ~~waist of the test subject~~ specimen's annunciator.

18. *Delete Annex A.6.4.3.9.3 and Figure A.6.4.3.9.3 in their entirety.*

**Substantiation.** Since the introduction of the new, common PASS alarm sound in the 2013 edition of NFPA 182, the Technical Committee on Electronic Safety Equipment has been hearing anecdotal concerns from firefighters regarding the effectiveness of the 2013 sound when compared to the pre-2013 sound. These concerns spanned all manufacturers and their 2013-compliant PASS alarms.

A TC task group was formed in July 2015 to investigate the reported PASS alarm issues and to propose a new PASS alarm sound for the 2018 edition of NFPA 182. A new PASS alarm sound was created and was compared to the 2013 sound through a series of formal and informal tests with firefighters who were concerned with the audibility of their 2013 PASS alarm sound. The feedback from these early tests was overwhelmingly in favor of the proposed 2018 PASS alarm sound.

Informal validation included a number of tests conducted in Indianapolis, Hartford and Orange County, NY. In one test, 2013 and proposed 2018 PASS alarms were set off in a burn building and firefighters in full gear and blindfolded were asked to find the PASS alarms using a right or left hand search. The time required to find the PASS was heavily in favor of the 2018 PASS alarm. In other tests, firefighters were asked to choose the louder PASS when the two were activated under the same conditions. Again, the overwhelming choice was the proposed 2018 alarm sound. A test comparing a pre-2013 PASS, A 2013 PASS and a proposed 2018 PASS showed that the Pre-2013 and the proposed 2018 were comparable in terms of distance from the

PASS for initial recognition while the 2013 PASS required that the firefighters be much closer to the PASS before they could identify it as such.

In order to formally validate the new PASS alarm sound, two evaluation sessions were conducted: one at Intertek laboratories in Cortland, NY (see NFPA 1982 TG on PASS Alarm “Testing at Intertek”) and the other at NIST in Gaithersburg, MD (see NFPA 1982 TG on PASS Alarm “Testing at NIST”). A panel of firefighters was invited to each session. Using carefully controlled tests under a variety of conditions, the 2013 PASS alarm sound was compared to the proposed 2018 PASS alarm sound. As with the informal, subjective tests, the results of the objective tests were overwhelmingly in favor of the proposed 2018 PASS alarm sound.

In addition to the above tests, a distance-to-detect test was also run at both formal validation test sessions. This test compared the distance from a PASS device at which the subject firefighter first identified the PASS alarm. As with the above tests, the results were overwhelmingly in favor of the proposed 2018 PASS alarm sound.

The First Draft of the 2018 edition of NFPA 1982 includes the new PASS alarm sound. This TIA is intended to update the PASS alarm sound in the 2013 edition of NFPA 1982 with the new sound that has been proposed for the 2018 draft of NFPA 1982 so that fire departments may purchase PASS devices with the new sound on SCBAs certified as compliant to NFPA 1981 (2013 edition), and to NFPA 1982 (2013 edition). This also allows fire departments to upgrade PASS devices with the 2013 sound previously certified to NFPA 1982 (2013 edition), to the proposed new PASS alarm sound.

**Emergency Nature.** The proposed TIA intends to accomplish a recognition of an advance in the art of safeguarding property or life where an alternative method is not in current use or is unavailable to the public.

The improvement in the proposed 2018 PASS alarm sound provides a higher level of safety for firefighters. The ability to detect and recognize a PASS alarm could mean the difference between life and death for a downed firefighter. This TIA modifies the existing 2013 edition PASS alarm sound in such a way as to make it both louder and more recognizable to a fire fighter, increasing the likelihood that an incapacitated fire fighter would be found in a timely manner. The 2013 PASS alarm sound focused on the ability of a “machine” to detect a PASS alarm that might not otherwise be heard by a fire fighter at a fire scene. Unfortunately, some of the human detection aspects were neglected, resulting in a PASS alarm sound that was not as readily detected as intended and that was perceived by fire fighters as being a step backward from the 2007 PASS alarm sounds. Significant effort over the last year has resulted in the development of a new PASS alarm sound that is more detectable by humans, as proven by a multitude of informal, subjective tests and, more importantly, the two large, formal, objective test sessions outlined in this TIA. The work done by the TC task group has resulted in a real and measurable improvement to firefighter safety that should be incorporated into the NFPA 1982 standard as soon as possible.

Background Noise Test

Test #	Location	Tests to be run
1 to 14	Location 1	Play all 14 Alarm Comparisons in pseudo-random order. Manufacturer A PASS
15 to 28	Location 2	Play all 14 Alarm Comparisons in pseudo-random order. Manufacturer B PASS
29 to 42	Location 3	Play all 14 Alarm Comparisons in pseudo-random order. Manufacturer C PASS
43 to 56	Location 4	Play all 14 Alarm Comparisons in pseudo-random order. Manufacturer D PASS
14(n-1)+1 to ..	Location n	Play all 14 Alarm Comparisons in pseudo-random order. Manufacturer E PASS
Change PASS manufacturers		
14(n)+1 to ..	Location 1	Play all 14 Alarm Comparisons in pseudo-random order. Manufacturer F PASS
	Location 2	Play all 14 Alarm Comparisons in pseudo-random order. Manufacturer A PASS
	Location 3	Play all 14 Alarm Comparisons in pseudo-random order. Manufacturer B PASS
	Location 4	Play all 14 Alarm Comparisons in pseudo-random order. Manufacturer C PASS
	Location n	Play all 14 Alarm Comparisons in pseudo-random order. Manufacturer D PASS
Continue until out of time		

Alarm Comparisons			
Alarm Comparison #	Background Noise	Background Noise dB	Play Order
A	Engine	HI	2013-2018
B	Engine	LO	2018-2013
C	Chain Saw	HI	2018-2013
D	Chain Saw	LO	2013-2018
E	Radio	HI	2013-2018
F	Radio	LO	2018-2013
G	Firelite Horn Strobe	HI	2018-2013
H	Firelite Horn Strobe	LO	2013-2018
I	First Alert Multistation	HI	2013-2018
J	First Alert Multistation	LO	2018-2013
K	Radionics Horn Strobe	HI	2018-2013
L	Radionics Horn Strobe	LO	2013-2018
M	Engine	HI	2018-2013
N	Engine	LO	2013-2018

Background Noises	
Sawsall	
Engine	
Chain Saw	
Radio	
Firelite Horn Strobe	
First Alert MultiStation	
Radionics Horn Strobe	
Gentex Horn Strob	

Background Noise Levels	
High	HI dBA @3m from speaker
Medium	MD dBA @3m from speaker
Low	LO dBA @3m from speaker

PASS Locations (tbd on arrival)	
Location 1	
Location 2	
Location 3	
Location n	

Other background noises available but not selected.

- Circular Saw (too similar to other saws)
- PPV Fan (similar to saw and has clipping - would need re-recorded)
- SCBA Breathing (too much dead time between breaths)
- Hose Stream (solid and similar to saws and engine)
- SAE Horn Strobe (similar to Gentex but with larger gaps)
- Simplex Horn Strobe (similar to Gentex but diff freq)
- Older Wheelock Horn (constant but lower freq than the Radionics)

Test subjects are seated in a room along with the background noise source. The PASS is in remote location 1, 2, 3 ... n  
 Use the score sheet created by Simon for each test.  
 Pre-randomize the tests to save time in Cortland  
 Assume one test every 2 minutes. 3 hours yields 90 tests.

Time to Locate Test

Test Number	Team Number	Time	Hiding Location	PASS Alarm
1	1		Location A	2013
2	2		Location A	2018
3	3		Location A	2013
4	4		Location A	2018
5	5		Location A	2013
6	1		Location B	2018
7	2		Location B	2013
8	3		Location B	2018
9	4		Location B	2013
10	5		Location B	2018
11	1		Location C	2013
12	2		Location C	2018
13	3		Location C	2013
14	4		Location C	2018
15	5		Location C	2013
16	1		Location D	2018
17	2		Location D	2013
18	3		Location D	2018
19	4		Location D	2013
20	5		Location D	2018

Teams made up of 2 fire fighters. Teams do not change  
 Record the time needed to find the PASS alarm.  
 Add more locations to collect more data if time permits.  
 More firefighters allows for more tests.  
 Must use the same manufacturer for all 2013 tests and the same manufacturer for all 2018 tests.  
 Two hours to complete this test set (??). More firefighter teams will extend the test.

**NFPA 1982 Task Group on PASS Alarm "Testing at INTERTEK" Page 2 of 13**  
**Standard alarm sound test record**

Where you score 1 or 2, please add comments to explain.

<b>Participant name</b>	
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**INSTRUCTIONS:**  
 Score 1 if you believe the second sound is a lot worse than the first sound  
 Score 3 if you believe the sounds are equal or neither are better or worse  
 Score 5 if you believe the second sound is a lot better than the first sound

Test No.	Score					COMMENTS
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
	1	2	3	4	5	
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

For Recording Team Use!!!

<b>Location</b>	
<b>Seat Number</b>	

## Test Sequencing

Number	Seed	Key	Sound	VOL	PASS
1	10	K	Radionics Horn	HI	8
2	1	B	Engine	LO	8
3	12	M	Engine	HI	8
4	9	J	First Alert	LO	8
5	13	N	Engine	LO	3
6	4	E	Radio	HI	3
7	11	L	Radionics Horn	LO	3
8	0	A	Engine	HI	3
9	2	C	Chain Saw	HI	8
10	8	I	First Alert	HI	3
11	3	D	Chain Saw	LO	3
12	6	G	Firelite Horn	HI	8
13	5	F	Radio	LO	8
14	7	H	Firelite Horn	LO	3

Location 1, Round 1 - Scott

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
1	3	5	1		1	10
2	4	4	2			10
3	6	3		1		10
4		6	4			10
5			1		9	10
6				2	8	10
7				2	8	10
8				2	8	10
9	8	2				10
10		1		6	3	10
11				2	8	10
12	5	3	2			10

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
1	0	1	5	3	2018
0	0	2	4	4	2018
0	1	0	3	6	2018
0	0	4	6	0	2018
0	0	1	0	9	2013
0	0	0	2	8	2013
0	0	0	2	8	2013
0	0	0	2	8	2013
0	0	0	2	8	2018
0	1	0	6	3	2013
0	0	0	2	8	2013
0	0	2	3	5	2018

<b>13</b>	2	5	3				10
<b>14</b>	1				9		10

0	0	3	5	2
1	0	0	0	9

2018

2013

Location 2, Round 1 - Grace

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
<b>1</b>	4	2	4			10
<b>2</b>	6	3	1			10
<b>3</b>	10					10
<b>4</b>	1	4	5			10
<b>5</b>				5	5	10
<b>6</b>				4	6	10
<b>7</b>			1	6	3	10
<b>8</b>				2	8	10
<b>9</b>		3	6	1		10

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better
0	0	4	2	4
0	0	1	3	6
0	0	0	0	10
0	0	5	4	1
0	0	0	5	5
0	0	0	4	6
0	0	1	6	3
0	0	0	2	8
0	1	6	3	0

2018

2018

2018

2018

2013

2013

2013

2013

2018

<b>10</b>			1	6	3		10
<b>11</b>				4	6		10
<b>12</b>	4	4	2				10
<b>13</b>	6	2	2				10
<b>14</b>			1	4	5		10

0	0	1	6	3	2013
0	0	0	4	6	2013
0	0	2	4	4	2018
0	0	2	2	6	2018
0	0	1	4	5	2013

Location 3, Round 1 - Honeywell

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
<b>1</b>	2	4	4			10
<b>2</b>	3	5	2			10
<b>3</b>	4	5	1			10
<b>4</b>	1	4	5			10
<b>5</b>				3	7	10
<b>6</b>			1	2	7	10
<b>7</b>			2	1	7	10
<b>8</b>			1	1	8	10

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
0	0	4	4	2	2018
0	0	2	5	3	2018
0	0	1	5	4	2018
0	0	5	4	1	2018
0	0	0	3	7	2013
0	0	1	2	7	2013
0	0	2	1	7	2013
0	0	1	1	8	2013

<b>9</b>	6	4					10
<b>10</b>			2	2	6		10
<b>11</b>				1	9		10
<b>12</b>	3	6	1				10
<b>13</b>	3	3	4				10
<b>14</b>				2	8		10

0	0	0	4	6	2018
0	0	2	2	6	2013
0	0	0	1	9	2013
0	0	1	6	3	2018
0	0	4	3	3	2018
0	0	0	2	8	2013

Location 4, Round 1 - Interspiro

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
<b>1</b>	1		7	1	1	10
<b>2</b>	3	3	3	1		10
<b>3</b>	7	1	2			10
<b>4</b>	2	3	4	1		10
<b>5</b>				5	5	10
<b>6</b>				6	4	10
<b>7</b>			4	6		10
<b>8</b>			1	5	4	10
<b>9</b>	1	1	8			10

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
1	1	7	0	1	2018
0	1	3	3	3	2018
0	0	2	1	7	2018
0	1	4	3	2	2018
0	0	0	5	5	2013
0	0	0	6	4	2013
0	0	4	6	0	2013
0	0	1	5	4	2013
0	0	8	1	1	2018

<b>10</b>		1	3	4	2		10
<b>11</b>				3	7		10
<b>12</b>	4	2	4				10
<b>13</b>	4	2	4				10
<b>14</b>		1	2	6	1		10

0	1	3	4	2	2013
0	0	0	3	7	2013
0	0	4	2	4	2018
0	0	4	2	4	2018
0	1	2	6	1	2013

Location 1, Round 2 - Avon

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
<b>1</b>	4	2	1	3		10
<b>2</b>	1	4	5			10
<b>3</b>	9	1				10
<b>4</b>		2	4	4		10
<b>5</b>				6	4	10
<b>6</b>			1	4	5	10
<b>7</b>			2	6	2	10
<b>8</b>				5	5	10
<b>9</b>	2	2	6			10
<b>10</b>			3	7		10

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
0	3	1	2	4	2018
0	0	5	4	1	2018
0	0	0	1	9	2018
0	4	4	2	0	2018
0	0	0	6	4	2013
0	0	1	4	5	2013
0	0	2	6	2	2013
0	0	0	5	5	2013
0	0	6	2	2	2018
0	0	3	7	0	2013

<b>11</b>			1	4	5		10
<b>12</b>	2	1	7				10
<b>13</b>	1	3	5	1			10
<b>14</b>				5	5		10

0	0	1	4	5	2013
0	0	7	1	2	2018
0	1	5	3	1	2018
0	0	0	5	5	2013

Location 2 - Round 2 - MSA

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
<b>1</b>	6	2	2			10
<b>2</b>	6	3	1			10
<b>3</b>	9	1				10
<b>4</b>	1	7	2			10
<b>5</b>				2	8	10
<b>6</b>			1	2	7	10
<b>7</b>				5	5	10
<b>8</b>				2	8	10
<b>9</b>	7	1	2			10
<b>10</b>				6	4	10
<b>11</b>					10	10

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
0	0	2	2	6	2018
0	0	1	3	6	2018
0	0	0	1	9	2018
0	0	2	7	1	2018
0	0	0	2	8	2013
0	0	1	2	7	2013
0	0	0	5	5	2013
0	0	0	2	8	2013
0	0	2	1	7	2018
0	0	0	6	4	2013
0	0	0	0	10	2013

<b>12</b>	3	5	2				10
<b>13</b>	3	1	6				10
<b>14</b>				1	9		10

0	0	2	5	3	2018
0	0	6	1	3	2018
0	0	0	1	9	2013

Location 3 - Round 2 - Grace

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
<b>1</b>		2	7	1		10
<b>2</b>		9	1			10
<b>3</b>	8	1	1			10
<b>4</b>		4	6			10
<b>5</b>				2	8	10
<b>6</b>				5	5	10
<b>7</b>				5	5	10
<b>8</b>				2	8	10
<b>9</b>	4	3	3			10
<b>10</b>			1	4	5	10
<b>11</b>				1	9	10
<b>12</b>		3	6	1		10
<b>13</b>	1	8		1		10

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
0	1	7	2	0	2018
0	0	1	9	0	2018
0	0	1	1	8	2018
0	0	6	4	0	2018
0	0	0	2	8	2013
0	0	0	5	5	2013
0	0	0	5	5	2013
0	0	0	2	8	2013
0	0	3	3	4	2018
0	0	1	4	5	2013
0	0	0	1	9	2013
0	1	6	3	0	2018
0	1	0	8	1	2018

<b>14</b>				2	8		10
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0	0	0	2	8
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2013

Location 4 - Round 2 - Scott

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
<b>1</b>	2	3	4		1	10
<b>2</b>	2	4	3	1		10
<b>3</b>	9	1				10
<b>4</b>	2	5	3			10
<b>5</b>				1	9	10
<b>6</b>			1		9	10
<b>7</b>				5	5	10
<b>8</b>				1	9	10
<b>9</b>	8	1	1			10
<b>10</b>			2	6	2	10
<b>11</b>	2	5	3			10
<b>12</b>	1	6	2		1	10
<b>13</b>	1	4	5			10
<b>14</b>				3	7	10

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better
1	0	4	3	2
0	1	3	4	2
0	0	0	1	9
0	0	3	5	2
0	0	0	1	9
0	0	1	0	9
0	0	0	5	5
0	0	0	1	9
0	0	1	1	8
0	0	2	6	2
2	5	3	0	0
1	0	2	6	1
0	0	5	4	1
0	0	0	3	7

2018

2018

2018

2018

2013

2013

2013

2013

2018

2013

2013

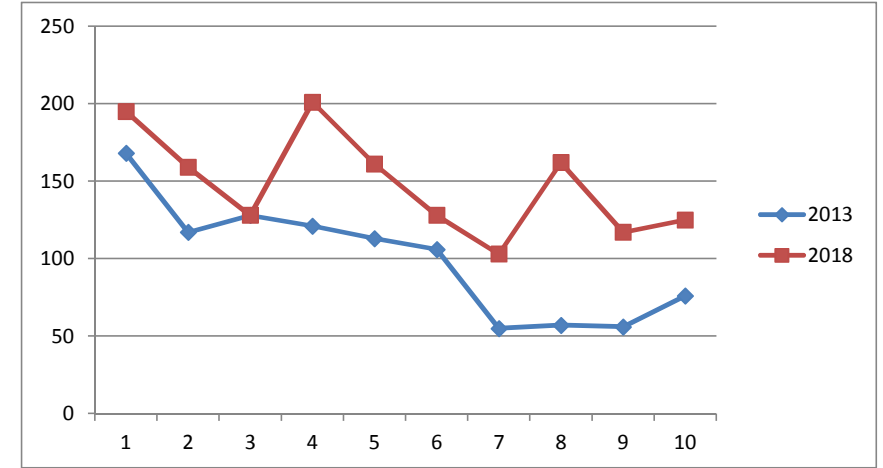
2018

2018

2013

Participant initials	Years in service	Manufacturer	Distance reading 2013	Distance reading 2018	2013 Actual Distance (ft)	2018 Actual Distance (ft)	Differential (ft)	Total
JT	5	A	74	47	168	195	27	242
JG	2	A	125	83	117	159	42	
WL	2	A	114	114	128	128	0	
JB	20	A	121	41	121	201	80	
GL	23	A	129	81	113	161	48	
RA	22	A	136	114	106	128	22	
NP	18	A	187	139	55	103	48	
GJ	13	A	185	80	57	162	105	
AV	22	A	186	125	56	117	61	
CG	28	A	166	117	76	125	49	

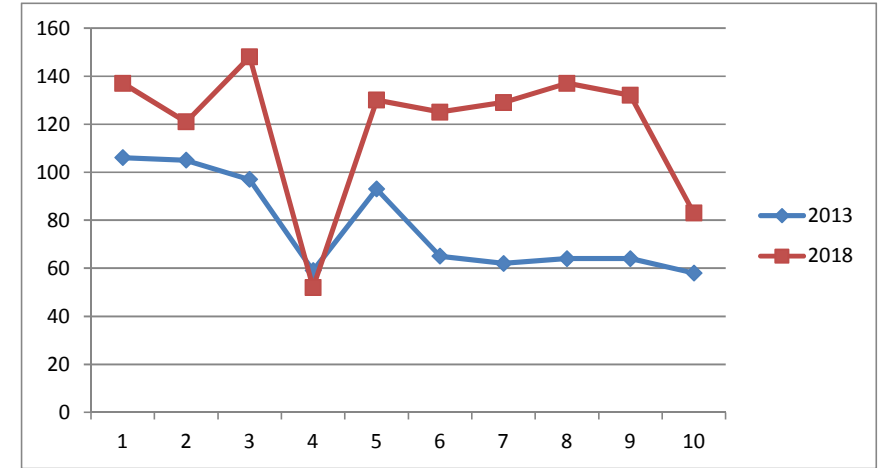
99.7 147.9 48.2 Averages



Test 2

JT	5	B	136	105	106	137	31	Averages	
JG	2	B	137	121	105	121	16		*door was opened
WL	2	B	145	94	97	148	51		*poor hearing
JB	20	B	183	190	59	52	-7		
GL	23	B	149	112	93	130	37		Averages
RA	22	B	177	117	65	125	60		
NP	18	B	180	113	62	129	67		
GJ	13	B	178	105	64	137	73		
AV	22	B	178	110	64	132	68		
CG	28	B	184	159	58	83	25		
					77.3	119.4	42.1		

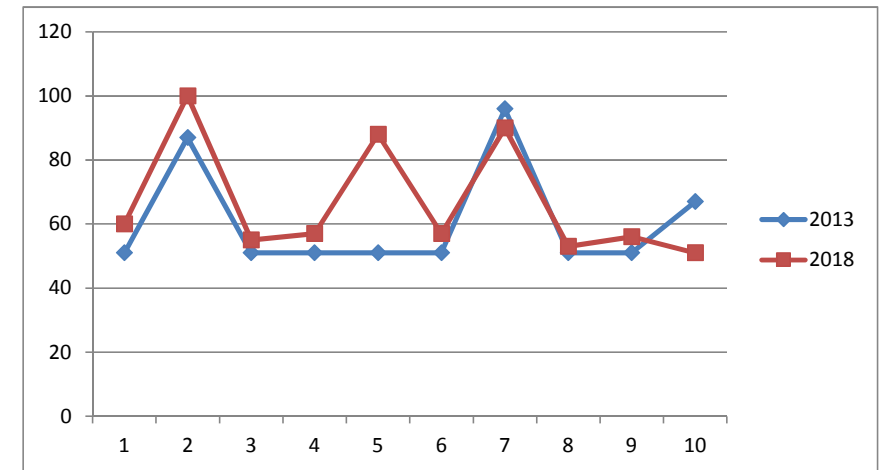
77.3 119.4 42.1 Averages



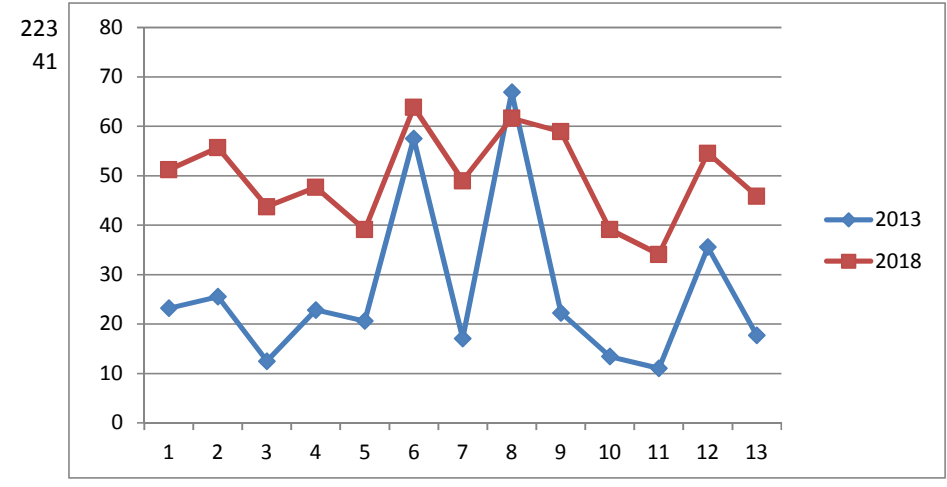
Test 3

JT	5	C	191	182	51	60	9	Averages
JG	2	C	155	142	87	100	13	
WL	2	C	191	187	51	55	4	
JB	20	C	191	185	51	57	6	
GL	23	C	191	154	51	88	37	
RA	22	C	191	185	51	57	6	
NP	18	C	146	152	96	90	-6	
GJ	13	C	191	189	51	53	2	
AV	22	C	191	186	51	56	5	
CG	28	C	175	191	67	51	-16	

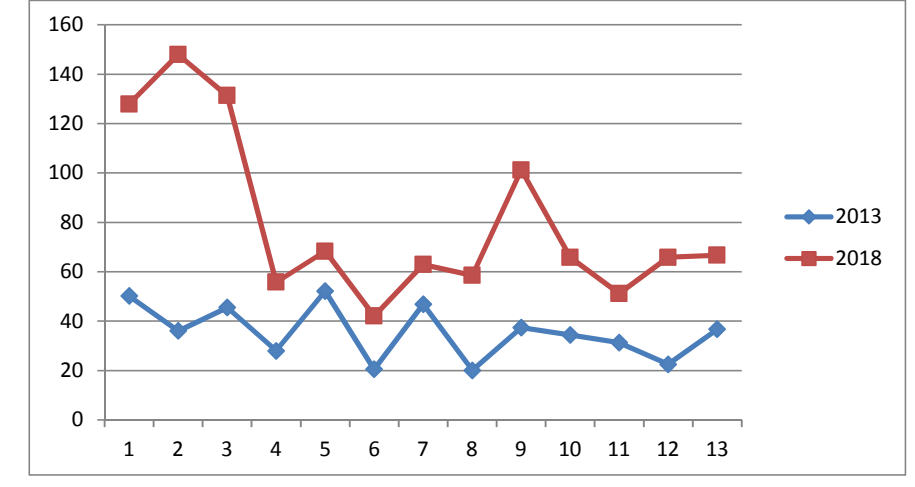
\*Unit not performing well 60.7 66.7 6 Averages



Participant initials	Years in service	Manufacturer	Distance reading		2013 Actual Distance (ft)	2018 Actual Distance (ft)	Differential (ft)	Total Measure Pt	
			2013	2018					
Strickland		Avon	-17.82	10.24	23.18	51.24	28.06	223	
Brantley			-15.47	14.7	25.53	55.7	30.17	41	
Reed			-28.53	2.74	12.47	43.74	31.27		
Martin			-18.15	6.66	22.85	47.66	24.81		
Varner			-20.39	-1.88	20.61	39.12	18.51		
Grossnickle			16.53	22.89	57.53	63.89	6.36		
Black			-23.91	7.99	17.09	48.99	31.9		
Sipes			25.9	20.65	66.9	61.65	-5.25		
Schreiber			-18.74	17.95	22.26	58.95	36.69		
Ramey			-27.59	-1.87	13.41	39.13	25.72		
Bianchi			-29.95	-6.89	11.05	34.11	23.06		
Bonkoski			-5.45	13.57	35.55	54.57	19.02	*	
Sampl			-23.31	4.87	17.69	45.87	28.18	*	
					26.62461538	49.58615385	22.9615385	Averages	



Participant initials	Years in service	Manufacturer	Distance reading		2013 Actual Distance (ft)	2018 Actual Distance (ft)	Differential (ft)	Total Measure Pt	
			2013	2018					
Sampl		Scott	9.17	86.86	50.17	127.86	77.69	*	
Strickland			-4.93	106.94	36.07	147.94	111.87	*	
Brantley			4.53	90.28	45.53	131.28	85.75	*	
Reed			-13.02	14.79	27.98	55.79	27.81		
Martin			11.2	27.26	52.2	68.26	16.06		
Varner			-20.45	1	20.55	42	21.45		
Grossnickle			5.82	21.85	46.82	62.85	16.03		
Black			-20.92	17.47	20.08	58.47	38.39		
Sipes			-3.65	60.17	37.35	101.17	63.82		
Schreiber			-6.62	22.85	34.38	65.8	31.42		
Ramey			-9.69	10.18	31.31	51.18	19.87		
Bianchi			-18.46	24.8	22.54	65.8	43.26		
Bonkoski			-4.31	25.68	36.69	66.68	29.99		
					35.51307692	80.39076923	44.8776923	Averages	



Participant initials	Years in service	Manufacturer	Distance reading		2013 Actual Distance (ft)	2018 Actual Distance (ft)	Differential (ft)	Total Measure Pt	
			2013	2018					
Reed		Honeywell	34.75	9.8	75.75	50.8	-24.95	*	
Martin			29.42	19.69	70.42	60.69	-9.73	*	
Varner			0	10.82	41	51.82	10.82	*	
Grossnickle				18.42				*	
Black				-1				*	
Bianchi			-18.46	0	22.54	41	18.46	*	
Sipes			24.87	12.66	65.87	53.66	-12.21	*	
Schreiber			24.14	9.25	65.14	50.25	-14.89	*	
Ramey			10.51	71.66	51.51	112.66	61.15	*	
Bonkoski			31.73	87.68	72.73	128.68	55.95	*	
					58.12	68.695	10.575	Averages	

Notes:

All Tests: A leaky nitrogen tank was located 68 ft from the PASS Alarm. The volume of this leak changed over the course of the tests (see individual notes).  
 Test 1: 2018 was played first. A sampling pump on a side hallway (41 ft) was present for all measurements except Bronkoski and Sampl's 2013 reading.  
 Test 2: Sampl, Strickland, and Brantley ran 2018 then 2013 before any other people. All others ran 2013 first.  
 Test 3: 2018 run first. The nitrogen started leaking loudly during the 2018 run. 4 of the 2018 were rerun after the tank was drained and moved (Sipes, Schreiber, Ramey, Bonkoski). All 2013 runs experienced no leak noise. Blank and Grossnickle were called away

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Location 1, Round 1 - Honeywell

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
1	1	2	3	4	5	13
2		6	4	1	2	13
3		9	1	2	1	13
4		3	4	5	1	13
5		1		7	5	13
6		1	1	9	2	13
7			1	9	3	13
8			1	7	5	13
9	6	6	1			13
10			5	7	1	13
11			1	8	4	13
12	4	8	1			13
13	1	5	5	1	1	13
14				9	4	13

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
0	7	6	0	0	2018
2	1	4	6	0	2018
1	2	1	9	0	2018
1	5	4	3	0	2018
0	1	0	7	5	2013
0	1	1	9	2	2013
0	0	1	9	3	2013
0	0	1	7	5	2013
0	0	1	6	6	2018
0	0	5	7	1	2013
0	0	1	8	4	2013
0	0	1	8	4	2018
1	1	5	5	1	2018
0	0	0	9	4	2013

Location 2, Round 1 - Scott

Score
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Score
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	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better		Sum check
Test No.	1	2	3	4	5		
1		2	5	5	1		13
2	1	9	2		1		13
3	7	5	1				13
4		6	4	3			13
5				4	9		13
6			1	8	4		13
7		1	3	5	4		13
8				5	8		13
9	9	2	2				13
10		1	5	6	1		13
11				5	8		13
12	2	7	4				13
13		9	2	2			13
14				8	5		13

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
1	5	5	2	0	2018
1	0	2	9	1	2018
0	0	1	5	7	2018
0	3	4	6	0	2018
0	0	0	4	9	2013
0	0	1	8	4	2013
0	1	3	5	4	2013
0	0	0	5	8	2013
0	0	2	2	9	2018
0	1	5	6	1	2013
0	0	0	5	8	2013
0	0	4	7	2	2018
0	2	2	9	0	2018
0	0	0	8	5	2013

Location 3, Round 1 - Draeger

Score						Sum check
2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better		

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better

Test No.	1	2	3	4	5		
<b>1</b>		1	12				13
<b>2</b>	2	8	3				13
<b>3</b>	11	2					13
<b>4</b>		7	5	1			13
<b>5</b>				6	7		13
<b>6</b>			1	6	6		13
<b>7</b>				7	6		13
<b>8</b>	1			5	7		13
<b>9</b>	9	3	1				13
<b>10</b>			1	8	4		13
<b>11</b>			1	6	6		13
<b>12</b>		4	9				13
<b>13</b>	1	9	2	1			13
<b>14</b>				5	8		13

0	0	12	1	0		2018
0	0	3	8	2		2018
0	0	0	2	11		2018
0	1	5	7	0		2018
0	0	0	6	7		2013
0	0	1	6	6		2013
0	0	0	7	6		2013
1	0	0	5	7		2013
0	0	1	3	9		2018
0	0	1	8	4		2013
0	0	1	6	6		2013
0	0	9	4	0		2018
0	1	2	9	1		2018
0	0	0	5	8		2013

Location 4, Round 1 - Avon

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
	1	2	3	4	5	
<b>1</b>	1	3	2	6	1	13

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
1	6	2	3	1	2018

<b>2</b>		7	4	2			13
<b>3</b>	3	9	1				13
<b>4</b>		8	3	1	1		13
<b>5</b>				7	6		13
<b>6</b>			1	7	5		13
<b>7</b>		1	4	5	3		13
<b>8</b>				7	6		13
<b>9</b>	8	3	2				13
<b>10</b>		3	3	4	3		13
<b>11</b>			1	9	3		13
<b>12</b>		5	6	2			13
<b>13</b>		6	5	2			13
<b>14</b>			1	8	4		13

0	2	4	7	0	2018
0	0	1	9	3	2018
1	1	3	8	0	2018
0	0	0	7	6	2013
0	0	1	7	5	2013
0	1	4	5	3	2013
0	0	0	7	6	2013
0	0	2	3	8	2018
0	3	3	4	3	2013
0	0	1	9	3	2013
0	2	6	5	0	2018
0	2	5	6	0	2018
0	0	1	8	4	2013

Location 1, Round 2 - MSA

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
<b>1</b>	1	2	3	4	5	13
<b>2</b>	2	9	2			13
<b>3</b>	8	3	2			13

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
0	0	7	6	0	2018
0	0	2	9	2	2018
0	0	2	3	8	2018

<b>4</b>		9	3	1			13
<b>5</b>				9	4		13
<b>6</b>			1	7	5		13
<b>7</b>				9	4		13
<b>8</b>			4	1	8		13
<b>9</b>	6	6	1				13
<b>10</b>		2		7	4		13
<b>11</b>				7	6		13
<b>12</b>	3	7	3				13
<b>13</b>		8	4	1			13
<b>14</b>			1	8	4		13

0	1	3	9	0	2018
0	0	0	9	4	2013
0	0	1	7	5	2013
0	0	0	9	4	2013
0	0	4	1	8	2013
0	0	1	6	6	2018
0	2	0	7	4	2013
0	0	0	7	6	2013
0	0	3	7	3	2018
0	1	4	8	0	2018
0	0	1	8	4	2013

Location 2, Round 2 - Honeywell

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
<b>1</b>	3		6	4		13
<b>2</b>		6	5	2		13
<b>3</b>	2	7	4			13
<b>4</b>		5	6	2		13
<b>5</b>			1	11	1	13

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
0	4	6	0	3	2018
0	2	5	6	0	2018
0	0	4	7	2	2018
0	2	6	5	0	2018
0	0	1	11	1	2013

<b>6</b>			2	8	3		13
<b>7</b>			7	6			13
<b>8</b>			1	10	2		13
<b>9</b>	5	3	5				13
<b>10</b>		1	6	6			13
<b>11</b>				9	4		13
<b>12</b>	7	5	1				13
<b>13</b>		5	3	5			13
<b>14</b>			5	5	3		13

0	0	2	8	3	2013
0	0	7	6	0	2013
0	0	1	10	2	2013
0	0	5	3	5	2018
0	1	6	6	0	2013
0	0	0	9	4	2013
0	0	1	5	7	2018
0	5	3	5	0	2018
0	0	5	5	3	2013

Location 3, Round 2 - Avon

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
<b>1</b>	1	2	4	6	1	13
<b>2</b>	2	5	4	2		13
<b>3</b>	5	6	2			13
<b>4</b>		5	2	6		13
<b>5</b>				9	4	13
<b>6</b>				9	4	13
<b>7</b>		2	6	4	1	13

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
1	6	4	2	0	2018
0	2	4	5	2	2018
0	0	2	6	5	2018
0	6	2	5	0	2018
0	0	0	9	4	2013
0	0	0	9	4	2013
0	2	6	4	1	2013

<b>8</b>		1	1	5	6		13
<b>9</b>	5	4	3	1			13
<b>10</b>		5	5	2	1		13
<b>11</b>			4	7	2		13
<b>12</b>	1	4	5	3			13
<b>13</b>		9	3	1			13
<b>14</b>			2	9	2		13

0	1	1	5	6	2013
0	1	3	4	5	2018
0	5	5	2	1	2013
0	0	4	7	2	2013
0	3	5	4	1	2018
0	1	3	9	0	2018
0	0	2	9	2	2013

Location 4, Round 2 - Scott

Test No.	Score					Sum check
	2nd Sound Much Worse	2nd Sound Worse	1st & 2nd Sounds Equal	2nd Sound Better	2nd Sound Much Better	
<b>1</b>		8	5			13
<b>2</b>		7	5	1		13
<b>3</b>	1	10	2			13
<b>4</b>		9	3	1		13
<b>5</b>				7	6	13
<b>6</b>				8	5	13
<b>7</b>				6	7	13
<b>8</b>			1	5	7	13
<b>9</b>		12	1			13

2018 Sound Much Worse	2018 Sound Worse	2013 & 2018 Sounds Equal	2018 Sound Better	2018 Sound Much Better	
0	0	5	8	0	2018
0	1	5	7	0	2018
0	0	2	10	1	2018
0	1	3	9	0	2018
0	0	0	7	6	2013
0	0	0	8	5	2013
0	0	0	6	7	2013
0	0	1	5	7	2013
0	0	1	12	0	2018

<b>10</b>				9	4		13
<b>11</b>				7	6		13
<b>12</b>		10	3				13
<b>13</b>		9	4				13
<b>14</b>				5	8		13

0	0	0	9	4	2013
0	0	0	7	6	2013
0	0	3	10	0	2018
0	0	4	9	0	2018
0	0	0	5	8	2013

**NFPA 1982 Task Group on PASS Alarm "Testing at NIST" Page 9 of 9**

Participant	Years in service	Manufacturer	Distance reading	Distance reading	2013 Actual	2018 Actual	Differential (ft)	Total	223	
			2013	2018	Distance (ft)	Distance (ft)				
Strickland	27	Avon	-17.82	10.24	23.18	51.24	28.06	Measure Pt	41	
Brantley	10		-15.47	14.7	25.53	55.7	30.17			
Reed	20		-28.53	2.74	12.47	43.74	31.27			
Martin	10		-18.15	6.66	22.85	47.66	24.81			
Varner	49		-20.39	-1.88	20.61	39.12	18.51			
Grossnickle	20		16.53	22.89	57.53	63.89	6.36			
Black	28		-23.91	7.99	17.09	48.99	31.9			
Sipes	22		25.9	20.65	66.9	61.65	-5.25			
Schreiber	42		-18.74	17.95	22.26	58.95	36.69			
Ramey	20		-27.59	-1.87	13.41	39.13	25.72			
Bianchi	24		-29.95	-6.89	11.05	34.11	23.06			
Bonkoski	18		-5.45	13.57	35.55	54.57	19.02			*
Sampl	18		-23.31	4.87	17.69	45.87	28.18			*
					26.6246154	49.5861538	22.96153846	Averages		
Scott										
Sampl			9.17	86.86	50.17	127.86	77.69	*		
Strickland			-4.93	106.94	36.07	147.94	111.87	*		
Brantley			4.53	90.28	45.53	131.28	85.75	*		
Reed			-13.02	14.79	27.98	55.79	27.81			
Martin			11.2	27.26	52.2	68.26	16.06			
Varner			-20.45	1	20.55	42	21.45			
Grossnickle			5.82	21.85	46.82	62.85	16.03			
Black			-20.92	17.47	20.08	58.47	38.39			
Sipes			-3.65	60.17	37.35	101.17	63.82			
Schreiber			-6.62	22.85	34.38	65.8	31.42			
Ramey			-9.69	10.18	31.31	51.18	19.87			
Bianchi			-18.46	24.8	22.54	65.8	43.26			
Bonkoski			-4.31	25.68	36.69	66.68	29.99			
					35.5130769	80.3907692	44.87769231	Averages		
Honeywell										
Reed			34.75	9.8	75.75	50.8	-24.95	*		
Martin			29.42	19.69	70.42	60.69	-9.73	*		
Varner			0	10.82	41	51.82	10.82	*		
Grossnickle				18.42				*		
Black				-1				*		
Bianchi			-18.46	0	22.54	41	18.46	*		
Sipes			24.87	12.66	65.87	53.66	-12.21	*		
Schreiber			24.14	9.25	65.14	50.25	-14.89	*		
Ramey			10.51	71.66	51.51	112.66	61.15	*		
Bonkoski			31.73	87.68	72.73	128.68	55.95	*		
					58.12	68.695	10.575	Averages		

Notes:

All Tests: A leaky nitrogen tank was located 68 ft from the PASS Alarm. The volume of this leak changed over the course of the tests (see individual notes).  
 Test 1: 2018 was played first. A sampling pump on a side hallway (41 ft) was present for all measurements except Bronkoski and Sampl's 2013 reading.  
 Test 2: Sampl, Strickland, and Brantley ran 2018 then 2013 before any other people. All others ran 2013 first.  
 Test 3: 2018 run first. The nitrogen started leaking loudly during the 2018 run. 4 of the 2018 were rerun after the tank was drained and moved (Sipes, Schreiber, Ramey, Bonkoski).  
 All 2013 runs experienced no leak noise. Blank and Grossnickle were called away so never had a 2013 run.



## National Fire Protection Association

1 Batterymarch Park, Quincy, MA 02169-7471  
Phone: 617-770-3000 • Fax: 617-770-0700 • www.nfpa.org

### MEMORANDUM

**TO:** Technical Committee on Electronic Safety Equipment  
**FROM:** Yvonne Smith, Project Administrator  
**DATE:** October 21, 2016  
**SUBJECT:** NFPA 1982 Proposed TIA No. 1247 **PRELIMINARY TC BALLOT RESULTS**

---

According to 5.6(a) in the NFPA *Regs*, the preliminary results show this TIA has achieved the  $\frac{3}{4}$  majority vote needed on both Ballot Item No. 1 (**Technical Merit**) and Ballot Item No. 2 (**Emergency Nature**).

**36 Eligible to Vote**  
**0 Not Returned**

**Technical Merit:**

0 Abstentions  
36 Agree (3 w/comment; *Gestler, Hogg, Morris, Weinstein*)  
0 Disagree

**Emergency Nature:**

0 Abstentions  
35 Agree (1 w/comment; *Townsend*)  
1 Disagree (*Morris*)

There are two criteria necessary to pass ballot [(1) simple majority (2) affirmative  $\frac{3}{4}$  vote]. Both questions must pass ballot in order to recommend that the Standards Council issue this TIA.

- (1) In all cases, an affirmative vote of at least a simple majority of the total membership eligible to vote is required.

$$[36 \text{ eligible} \div 2 = 18 = \mathbf{(18)}]$$

- (2) The number of affirmative votes needed to satisfy the  $\frac{3}{4}$  requirement is 26.

$$(36 \text{ eligible to vote} - 0 \text{ not returned} - 0 \text{ abstentions} = 36 \times 0.75 = 27)$$

Ballot comments are attached for your review.

This proposed TIA has been published for public comment in the October 7, 2016 issue of *NFPA News* with a Public Comment Closing Date of **November 9, 2016**. Any public comments received will be circulated to the committee. The Standards Council will consider the issuance of this TIA at their November 30-December 1, 2016 meeting.

Attachment

**TECHNICAL COMMITTEE ON ELECTRONIC SAFETY EQUIPMENT  
LETTER BALLOT**

**PROPOSED TENTATIVE INTERIM AMENDMENT LOG NO. 1247**  
To Revise Various Sections of the 2013 Edition of NFPA 1982,  
*Standard on Personal Alert Safety Systems (PASS)*

**Ballot Item No. 1:**

I agree with the **TECHNICAL MERITS** of the Proposed TIA Log No. 1247 to Revise Various Sections of NFPA 1982, 2013 Edition.

    X     AGREE                                 DISAGREE\*                                 ABSTAIN\*

**EXPLANATION OF VOTE** - Please type or print your comments:

\*An explanation shall accompany a "disagree" or "abstain" vote.

We agree with the technical merits; however, section 4.9 should be revised to the following:  
"Manufacturer shall be required to provide notice to the AHJ of the changes required to  
achieve the updated requirements contained in this TIA."

**Ballot Item No. 2:**

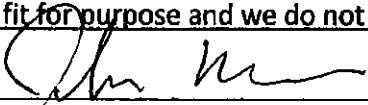
I agree that the subject is of an **EMERGENCY NATURE**.

           AGREE                          X     DISAGREE\*                                 ABSTAIN\*

**EXPLANATION OF VOTE** - Please type or print your comments:

\*An explanation shall accompany a "disagree" or "abstain" vote.

Scott Safety agrees that the 2018 PASS sound is an improvement over the 2013 PASS sound.  
However, based on feedback from our broad customer base, we feel that the 2013 PASS sound  
is fit for purpose and we do not feel this TIA is of an emergency nature.

  
\_\_\_\_\_  
Signature

✓ John Morris  
\_\_\_\_\_  
Name (Please Print)

10/13/2016  
\_\_\_\_\_  
Date

Please return the ballot on or before **Thursday, October 13, 2016.**

**PLEASE RETURN TO:**

Yvonne Smith, Project Administrator  
NFPA

1 Batterymarch Park  
Quincy, MA 02169

**FAX: (617) 984-7110**

**E-mail: ysmith@nfpa.org**

**TECHNICAL COMMITTEE ON ELECTRONIC SAFETY EQUIPMENT  
LETTER BALLOT**

**PROPOSED TENTATIVE INTERIM AMENDMENT LOG NO. 1247**  
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**Ballot Item No. 1:**

I agree with the **TECHNICAL MERITS** of the Proposed TIA Log No. 1247 to Revise Various Sections of NFPA 1982, 2013 Edition.

**AGREE**                       **DISAGREE\***                       **ABSTAIN\***

**EXPLANATION OF VOTE** - Please type or print your comments.

\*An explanation shall accompany a "disagree" or "abstain" vote

Suggest changing 4.9.1 to read

Manufacturers shall be required to provide notice of all available upgrades to the AHJ to meet this edition of the standard.

**Ballot Item No. 2:**

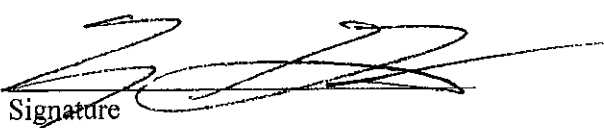
I agree that the subject is of an **EMERGENCY NATURE**.

**AGREE**                       **DISAGREE\***                       **ABSTAIN\***

**EXPLANATION OF VOTE** - Please type or print your comments:

\*An explanation shall accompany a "disagree" or "abstain" vote

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



Craig Gestler  
Name (Please Print)

12-Oct-2016  
Date

Please return the ballot on or before **Thursday, October 13, 2016**.

**PLEASE RETURN TO:**  
Yvonne Smith, Project Administrator  
NFPA  
1 Batterymarch Park  
Quincy, MA 02169

**FAX: (617) 984-7110**

**E-mail: [ysmith@nfpa.org](mailto:ysmith@nfpa.org)**

**TECHNICAL COMMITTEE ON ELECTRONIC SAFETY EQUIPMENT  
LETTER BALLOT**

**PROPOSED TENTATIVE INTERIM AMENDMENT LOG NO. 1247**

To Revise Various Sections of the 2013 Edition of NFPA 1982,  
*Standard on Personal Alert Safety Systems (PASS)*

**Ballot Item No. 1:**

I agree with the **TECHNICAL MERITS** of the Proposed TIA Log No. 1247 to Revise Various Sections of NFPA 1982, 2013 Edition.

  **YES**   AGREE                      \_\_\_\_\_ DISAGREE\*                      \_\_\_\_\_ ABSTAIN\*

**EXPLANATION OF VOTE** - Please type or print your comments:

\*An explanation shall accompany a "disagree" or "abstain" vote.

---

Draeger Safety fully supports the introduction of the new sound. This action addresses a concern that, although only reported verbally, has induced sufficient questions regarding the confidence in the safety provided by the 2013 standard alarm sound specification. Draeger Safety, as an organisation in support of fire-fighter safety and continuous improvement, will reach out and communicate the nature of the concerns so as to allay any fears in relation to the use of the existing equipment and to recommend an upgrade to all in-field units.

I request a review of the proposed wording for the section 4.9.1 to help direct the notice of any upgrades to the TIA in question. The suggested amended text is as follows: "Manufacturer shall be required to provide notice to the AHJ of all available upgrades to achieve the updated requirements contained in any TIAs."

---

**Ballot Item No. 2:**

I agree that the subject is of an **EMERGENCY NATURE**.

  **YES**   AGREE                      \_\_\_\_\_ DISAGREE\*                      \_\_\_\_\_ ABSTAIN\*

**EXPLANATION OF VOTE** - Please type or print your comments:

\*An explanation shall accompany a "disagree" or "abstain" vote.

---

This is based on the belief that a TIA represents an urgent need to improve the shortcomings of the existing specification and that there needs to be a measured response which should address such concerns in the equipment already in use and also in newly ordered equipment.

P1

The PASS alarm Task Group assessed the 2013 standard alarm sound performance risk to fire-fighter operations with the result being low (ref Dec 2015 TG minutes). The validation testing and results that have been completed (copies included with the TIA) supports this risk assessment with objective data and will allow the fire-fighting community to judge for themselves the level of risk demonstrated by the range of tests.

The PASS alarm task group was charged to implement the improvement as quickly as possible in a formal TIA so as to allow existing equipment to be upgraded, benefiting from the improvement and at the same time to maintain their NFPA approval. This is in support of continuous improvement and to legitimately permit the field updates to be made to equipment as requested.

I believe the best mitigation action to minimise or eliminate a risk to fire-fighters is the measured response described above.

---



Signature

Simon Hogg

Name (Please Print)

12<sup>th</sup> October 2016

Date

Please return the ballot on or before **Thursday, October 13, 2016.**

**PLEASE RETURN TO:**

Yvonne Smith, Project Administrator

NFPA

1 Batterymarch Park

Quincy, MA 02169

FAX: (617) 984-7110

E-mail: [ysmith@nfpa.org](mailto:ysmith@nfpa.org)

P2

**TECHNICAL COMMITTEE ON ELECTRONIC SAFETY EQUIPMENT  
LETTER BALLOT**

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**AGREE**                       **DISAGREE\***                       **ABSTAIN\***

**EXPLANATION OF VOTE** - Please type or print your comments:

\*An explanation shall accompany a "disagree" or "abstain" vote.

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**Ballot Item No. 2:**

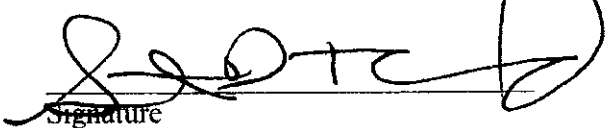
I agree that the subject is of an **EMERGENCY NATURE**.

**AGREE**                       **DISAGREE\***                       **ABSTAIN\***

**EXPLANATION OF VOTE** - Please type or print your comments:

\*An explanation shall accompany a "disagree" or "abstain" vote.

VERY MUCH SO. THIS IS A  
MISSION CRITICAL LIFE SAFETY ISSUE!

  
Signature

STEVE D. TOWNSEND  
Name (Please Print)

10/11/2016  
Date

Please return the ballot on or before **Thursday, October 13, 2016.**

**PLEASE RETURN TO:**  
Yvonne Smith, Project Administrator  
NFPA  
1 Batterymarch Park  
Quincy, MA 02169

**FAX: (617) 984-7110**

**E-mail: [ysmith@nfpa.org](mailto:ysmith@nfpa.org)**

**TECHNICAL COMMITTEE ON ELECTRONIC SAFETY EQUIPMENT  
LETTER BALLOT**

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**Ballot Item No. 1:**

I agree with the **TECHNICAL MERITS** of the Proposed TIA Log No. 1247 to Revise Various Sections of NFPA 1982, 2013 Edition.

    X     AGREE                                 DISAGREE\*                                 ABSTAIN\*

**EXPLANATION OF VOTE** - Please type or print your comments:

\*An explanation shall accompany a "disagree" or "abstain" vote.

*Agree with Comment:* Add "to meet this edition of the standard" at the end of 4.9.1.

\_\_\_\_\_  
\_\_\_\_\_

**Ballot Item No. 2:**

I agree that the subject is of an **EMERGENCY NATURE**.

    X     AGREE                                 DISAGREE\*                                 ABSTAIN\*

**EXPLANATION OF VOTE** - Please type or print your comments:

\*An explanation shall accompany a "disagree" or "abstain" vote.

\_\_\_\_\_  
\_\_\_\_\_

*Steven H. Weinstein*  
Signature

Steven H. Weinstein  
Name (Please Print)

10/13/16  
Date

Please return the ballot on or before **Thursday, October 13, 2016**.

**PLEASE RETURN TO:**

Yvonne Smith, Project Administrator  
NFPA  
1 Batterymarch Park  
Quincy, MA 02169

**FAX: (617) 984-7110**

**E-mail: [ysmith@nfpa.org](mailto:ysmith@nfpa.org)**