

# PPE CASE



## *Personal Protective Equipment Conformity Assessment Studies and Evaluations*

### **Evaluation of a Self-Contained Breathing Apparatus Involved in a Near Miss in the Fire Service**

#### **Rock Creek Idaho Fire Department Request for a Sperian TITAN™ unit**

As part of the *National Institute for Occupational Safety and Health (NIOSH)* the National Personal Protective Technology Laboratory (NPPTL) agreed to examine and evaluate one self-contained breathing apparatus (SCBA) identified as a Sperian TITAN™, 45 minute, 4500 psi unit.

This SCBA status investigation was assigned NIOSH Task Number 21014. The Rock Creek Fire Department was advised that NIOSH NPPTL would provide a written report of the investigation and any applicable test results.

The SCBA unit was delivered to the NIOSH facility in Morgantown, WV on August 31, 2016. The unit was transported to Lab H1513 for secured storage. The SCBA unit was removed from secured storage for inspection on October 25, 2016 and was placed back into secured storage until the performance testing was conducted on November 9, 2016.

*NIOSH evaluated an SCBA used by a fire fighter involved in a near miss incident. The SCBA was not found to contribute to the near miss.*

*A qualified service technician must inspect, repair, test, clean, and replace damaged components of any SCBA involved in an incident before it may be returned to service.*

## Disclaimer

The purpose of Respirator Status Investigations is to determine the conformance of each respirator to the NIOSH approval requirements found in Title 42, *Code of Federal Regulations*, Part 84. A number of performance tests are selected from the complete list of Part 84 requirements and each respirator is tested in its “**as received**” condition to determine its conformance to those performance requirements. Each respirator is also inspected to determine its conformance to the quality assurance documentation on file at NIOSH.

In order to gain additional information about its overall performance, each respirator may also be subjected to other recognized test parameters, such as National Fire Protection Association (NFPA) consensus standards. While the test results give an indication of the respirator’s conformance to the NFPA approval requirements, NIOSH does not actively correlate the test results from its NFPA test equipment with those of certification organizations which list NFPA-compliant products. Thus, the NFPA test results are provided for information purposes only.

Selected tests are conducted only after it has been determined that each respirator is in a condition that is safe to be pressurized, handled, and tested. Respirators whose condition has deteriorated to the point where the health and safety of NIOSH personnel and/or property is at risk will not be tested.

# NIOSH Task Number 21014

## Investigator Information

The SCBA performance tests were conducted by Jeremy Gouzd and Karis Kline of the Morgantown Testing Team (MTT), Evaluation and Testing Branch, National Personal Protective Technology Laboratory, National Institute for Occupational Safety and Health, located in Morgantown, West Virginia.

## SCBA Inspection

The unit was removed from the packaging in Lab H1513 and inspected on October 25, 2016 by Jeremy Gouzd and Karis Kline of the Morgantown Testing Team at NPPTL. The unit was identified as a Sperian TITAN™, 45 minute, 4500 psi unit with NIOSH Approval Number TC-13F-0809CBRN and as the unit submitted by the Rock Creek Fire Department. The SCBA was visually examined, component by component, in the condition received to determine conformance of the unit to the NIOSH-approved configuration. The visual inspection process was documented with photographs. Once the inspection was complete, the SCBA unit was repackaged and placed back in the secured storage area.

The complete SCBA inspection is summarized in **Appendix I**. Photos of the SCBA components are included in **Appendix III**.

## SCBA Testing

The purpose of the testing was to determine conformance of the SCBA to the approval performance requirements of Title 42, *Code of Federal Regulations*, Part 84 (42 CFR 84). Further testing was conducted to provide an indication of the conformance to the National Fire Protection Association (NFPA) Air Flow Performance requirements of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*, 1997 Edition.

**NIOSH SCBA Certification Tests** (in accordance with the performance requirements of 42 CFR Part 84):

1. Positive Pressure Test [§ 84.70(a)(2)(ii)]
2. Rated Service Time Test (duration) [§ 84.95]
3. Static Pressure Test [§ 84.91(d)]
4. Gas Flow Test [§ 84.93]
5. Exhalation Resistance Test [§ 84.91(c)]
6. Remaining Service Life Indicator Test (low air alarm) [§ 84.83(f)]

**National Fire Protection Association (NFPA) Tests** (in accordance with NFPA 1981, 1997 Edition):

7. Airflow Performance Test [Chapter 5, 5.1.1]

**Appendix II** contains the complete NIOSH test report for the SCBA. **Tables ONE and TWO** summarize the NIOSH and NFPA test results.

## Summary and Conclusions

An SCBA unit was submitted to NIOSH NPPTL by the Rock Creek Fire Department for evaluation following a request by telephone. The SCBA unit was delivered to NIOSH on August 31, 2016 and extensively inspected on October 25, 2016. The unit was identified as a Sperian TITAN™ 45 minute, 4500 psi unit with NIOSH Approval Number, TC-13F-0809CBRN. A corresponding facepiece was provided with the unit. The unit did not show any sign of heat damage and appeared to be in near new condition. An empty cylinder was delivered with the unit, with the valve open. The mask mounted regulator (MMR) and sealing areas of the unit were clean. The locking assembly functioned, and the inside flange had no to minimal scratching. The NFPA approval label on the unit was present and legible. The personal alert safety system (PASS) functioned.

In light of the information obtained during this inspection, NIOSH proposed no further action on its part at this time. The SCBA unit was returned to secured storage pending return to the Rock Creek Fire Department.

If this unit is to be placed back in service, the SCBA must be repaired, tested, cleaned and any damaged components replaced and inspected by a qualified service technician, including testing and other maintenance activities as prescribed by the schedule from the SCBA manufacturer. Typically a flow test is required on at least an annual basis, at a minimum.

## Actions to be taken by the Fire Departments with SCBAs Involved in an Incident

- Any SCBA unit involved in an incident may not be placed back in service until the SCBA has been repaired, tested, cleaned and any damaged components replaced and inspected by a qualified service technician, including such testing and other maintenance activities as prescribed by the schedule from the SCBA manufacturer.
- For all SCBA units, even those not involved in an incident, must undergo a flow test on at least an annual basis.

## Actions the PPE Users, Selectors, and Purchasers May Take to Further Protect Themselves and Others from Hazards

- Sign up for NPPTL’s Listserv at <http://www.cdc.gov/niosh/npptl/> to receive email notifications relevant to PPE.

For more information related to personal protective equipment, visit the [NIOSH NPPTL website](http://www.cdc.gov/niosh/npptl/) [www.cdc.gov/niosh/npptl](http://www.cdc.gov/niosh/npptl/)

To receive documents or other information about occupational safety and health topics, contact NIOSH:

Telephone: 1-800-CDC-INFO (1-800-232-4636)

TTY: 1-888-232-6348

CDC INFO: [www.cdc.gov/info](http://www.cdc.gov/info)

Or visit the NIOSH website at [www.cdc.gov/niosh](http://www.cdc.gov/niosh)

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# Appendix I

## SCBA Inspection Report



National Personal Protective Technology Laboratory/Evaluation and Testing Branch

## Respirator Field Problem Incoming Inspection Report Summary

<b>Task Number:</b> TN-21014	<b>Requestor:</b> Rock Creek Fire Department
<b>Date Received:</b> August 31, 2016	
<b>Date Inspected:</b> October 25, 2016	<b>Description:</b> Fire Department Requesting Technical Assistance
<b>Manufacturer:</b> Sperian	<b>Inspected by:</b> Jeremy Gouzd, Karis Kline
<b>Approval Number:</b> TC-13F-0809CBRN	<b>SCBA Type:</b> Open-Circuit, Pressure-Demand

The SCBA was received in a cardboard box (refer to **Figures 1 and 2** in **Appendix III**).

Contact Agency: Rock Creek Fire Department

### As received:

- SCBA unit and cylinder were in a cardboard box with packing materials, facepiece was also included, in a separate fire department bag.
- Cylinder received empty and open.
- Bypass was closed.
- Mask mounted regulator (MMR) was attached to waist belt with the donning switch in the off position and inactive.

### Components and Observations

NOTE: All references to “right” or “left” are from the user’s perspective.

#### 1. Facepiece: (refer to **Figures 3 - 7** in **Appendix III**)

Facepiece rim assembly P/N: SVA Z87, 975540      Size: Large      Model: TITAN™

Facepiece seal P/N: 962176      Manufacture date: 03/08

Nosecup P/N: 962144      Size: Medium      Manufacture date: 11/08

Lens P/N: 272032      Lot #: 1442162

Other markings: 022 engraved on facepiece seal

- Overall condition very good.
- Facepiece housed in a red Rock Creek Fire Department bag with “25” marked on it.

- Lens good with no scratches.
- Hairnet good.
- Hairnet straps good, straps moved freely held in place, and held securely to facepiece.
- Attachment points for straps good.
- The facepiece skirt in excellent condition.
- Regulator interface area good, with no debris.

**2. Mask Mounted Regulator (MMR): (refer to **Figures 8 - 10** in **Appendix III**)**

MMR assembly P/N: 1604190440

U.S. Patent # 6966316- B2 and 5097826, 6899101-B2

On sticker: 921250, 33, and 1508180044 (last number was also engraved on MMR)

Other markings: 917688

- Overall condition good, with no sign of heat damage.
- Outer case in good condition and front label legible.
- Donning switch in good condition.
- Quick Disconnect present and attached.
- Bypass open, bypass knob in excellent shape.
- Inside flange had minimal scratches, clean.
- Sealing area mostly clean and in excellent shape.
- Regulator could be attached and removed.
- Locking assembly functioned.

**3. Low Pressure Regulator Hose: (refer to **Figures 11 and 12** in **Appendix III**)**

P/N: could not be read due to hose cover.

- Overall condition excellent.
- Attached to unit at Quick Disconnect
- Quick Disconnect in good condition and functioned.
- Line ran through the shoulder strap to the pressure reducer.

**4. Pressure Reducer Assembly: (refer to **Figures 13 - 15** in **Appendix III**)**

P/N: 1604200174

S/N: 921389

- Overall condition good.
- All air-line connections secured with no sign of heat damage.
- Low pressure line and dual manifold assembly were in pouch and in good condition.

**5. High Pressure Hose and Cylinder Attachment: (refer to **Figures 16 - 18** in **Appendix III**)**

Quick-Fill marking: Eaton FD17-1082-1004

Other marking: 544

- Overall condition good.
- Cylinder attachment thread clean, threads on and off, and “O” ring was in place.
- Quick-Fill cover in good condition, connection clean.

**6. Console Assembly PASS: (refer to **Figures 19 and 20** in **Appendix III**)**

Barcode: 921313 4500-2013

P/N: 1603230064

Other marking: Tested 421

- Overall condition good.
- Pressure and electrical lines in good condition.
- Gauge lens good and readable.
- Protective casing good.
- Rubber attachment strap present, attached to the PASS console and shoulder strap.
- SEI label present.

**7. PASS Control Module: (refer to **Figure 21** in **Appendix III**)**

Sperian P/N: 921333, 4500-2013, 1604070343

Other marking: sticker with 10 on it

- Overall condition good.
- Held securely to backframe.
- Wire connection connected to PASS.
- Wire held secure to backframe and ran to console assembly.

**8. Backframe Assembly: (refer to **Figures 22 - 24** in **Appendix III**)**

NIOSH label present and legible: TC-13F-0809CBRN

P/N: 1604190361 (also engraved on backframe)

NFPA 1982 2013 edition

- Overall good condition, no bends/cracks in wire frame, or plate.
- Shoulder straps attached to the frame.
- Cylinder strap latch in excellent condition and functioned.

**9. Straps and Buckles: (refer to **Figure 25 and 26** in **Appendix III**)**

- Overall strap condition in excellent condition.
- Both shoulder straps attached at the top of the backframe.
- Hose lines and wires passed through shoulder straps.
- All adjustable buckles moved and held in place.
- Waist area buckle latched and released.
- Lumbar strap in good condition.

**10. Auxiliary Hose: (refer to **Figure 27** in **Appendix III**)**

Dual manifold hose assembly

- Overall condition good and rubber protective boots in good shape.
- Straps attached to covers and cylinder attachment assembly.
- Fittings clean.

**11. Cylinder and Cylinder Valve Assembly: (refer to **Figures 28 - 31** in **Appendix III**)**

Markings on cylinder:

Sticker: P/N 917145, LOT # 2823757

DOT-SP-10915-4500

TC-SU-5134-310

IL 532109

Sperian P/N: 917147

Luxfer I65G-1

REE: 110

Hydrostatic date: 6/2015

45 Minute, 4500 psi

- Overall condition good.
- Gauge was readable.
- Threads clean, but some were damaged.
- As received, the cylinder was empty with valve open.
- Rubber bumper at base of cylinder valve in excellent condition.
- Markings on stem: F11, 715, 1601250206.

# Appendix II

## SCBA Test Results



National Personal Protective Technology Laboratory/Evaluation and Testing Branch

## SCBA Test Report

**Task Number:** TN-21041  
**Manufacturer:** Sperian  
**NIOSH Approval Number:** TC-13F-0809CBRN  
**Tests Performed by:** Jeremy Gouzd, Karis Kline  
**Report written by:** Karis Kline  
**Date of Report:** November 9, 2016

### I. Background

On August 31, 2016, an SCBA unit from the Rock Creek Fire Department was delivered to the NIOSH facility in Morgantown, West Virginia. The unit was initially removed from the packaging in Lab H1513 and inspected on October 25, 2016 by Jeremy Gouzd and Karis Kline, of the NPPTL Morgantown Testing Team (MTT). The SCBA was visually examined, component by component, in the condition received to determine the conformance of the unit to the NIOSH-approved configuration. The unit was identified as a Sperian TITAN™, 45 minute, 4500 psi unit with NIOSH Approval Number TC-13F-0809CBRN, and as the unit submitted by the Rock Creek Fire Department. The visual inspection process was documented with photographs.

### II. Test Outlines

#### 1. **POSITIVE PRESSURE TEST – NIOSH Standard Test Procedure Number 120, 42 CFR Part 84**

**Reference:** Subpart H, § 84.70 (a)(2)(ii)

**Requirement:**

*The pressure inside the facepiece in relation to the immediate environment is positive during both inhalation and exhalation.*

**Procedure:**

A breathing machine with a 622 kg-m/min cam operating at 24 RPM with a 40 liter per minute flow rate (115 liters per minute peak flow) was connected to an anthropometric head for cycling. A pressure tap in the head was connected to a transducer which in turn connected to a strip chart recorder for determining the pressure in the facepiece.

**Results:** The unit was tested on November 9, 2016 and met the test requirement. The heads-up display (HUD), remote gauge, and donning switch functioned normally.

<b>Inhalation Breathing Resistance: (inches of water column)</b>	<b>0.10</b>
<b>Pass/Fail:</b>	<b>Pass</b>

**2. RATED SERVICE TIME TEST – NIOSH Standard Test Procedure Number 121, 42 CFR Part 84 Reference:** Subpart F, § 84.53 (a) and Subpart H, § 84.95 (a) and (b)

**Requirement:**

*Service time will be measured while the apparatus is operated by a breathing machine as described in § 84.88. The open-circuit apparatus will be classified according to the length of time it supplies air or oxygen to the breathing machine. Classifications are listed in § 84.53.*

**Procedure:**

A breathing machine with a 622 kg-m/min cam operating at 24 RPM with a 40 liter per minute flow rate was connected to an anthropometric head for cycling. A pressure tap in the head was connected to a transducer which in turn connected to a strip chart recorder for determining the pressure in the facepiece. The breathing machine was run until the inhalation portion of the breathing curve fell below the minimum requirement.

**Results:** Tested on November 9, 2016. The SCBA met the test requirement.

**Test Notes:** The measured service time (adjusted to correspond with the recorded breathing cycles) was more than the rated service time of 45 minutes. The PASS unit functioned during the test. The SCBA did not go negative on inhalation but maintained positive pressure in the facepiece at the same level.

	<b>Minutes</b>	<b>Seconds</b>
<b>Measured Service Time:</b>	<b>46</b>	<b>19</b>
<b>Pass/Fail:</b>	<b>Pass</b>	

**3. STATIC PRESSURE TEST – NIOSH Standard Test Procedure Number 122, 42 CFR Part 84 Reference: Subpart H, § 84.91 (d)**

**Requirement:**

*The static pressure (at zero flow) in the facepiece shall not exceed 38 mm. (1.5 inches) water column height.*

**Procedure:**

The facepiece was fitted to an anthropometric head for testing. A pressure tap in the head was connected to a calibrated manometer. Full cylinder pressure was applied to the unit at zero flow and a reading from the manometer was recorded.

**Results:** Tested on November 9, 2016. The SCBA met the test requirement.

<b>Facepiece Static Pressure: (inches of water column)</b>	<b>0.78</b>
<b>Pass/Fail:</b>	<b>Pass</b>

**4. GAS FLOW TEST – NIOSH Standard Test Procedure Number 123, 42 CFR Part 84 Reference: Subpart H, § 84.93 (b) and (c)**

**Requirement:**

*The flow from the apparatus shall be greater than 200 liters per minute when the pressure in the facepiece of demand apparatus is lowered by 51 mm. (2 inches) water column height when full container pressure is applied. Where pressure demand apparatus are tested, the flow will be measured at zero gage pressure in the facepiece.*

**Procedure:**

A pressure tap in the anthropometric head was connected to a manometer for determining when the pressure inside the facepiece reaches zero. A mass flow meter was connected in line between the anthropometric head and an adjustable vacuum source to measure flow. The SCBA cylinder was replaced by a test stand which was adjusted initially to full cylinder pressure. The vacuum source was adjusted during the test to maintain the desired pressure inside the facepiece. Once the proper facepiece pressure stabilized, a flow reading was recorded. The procedure was then repeated with the test stand adjusted to 500 psi.

**Results:** Tested on November 9, 2016. The SCBA met the test requirement. The bypass appeared to function normally.

Applied pressure	Airflow (liter per minute)	Pass/Fail
4500 psi	353.97	Pass
500 psi	356.79	Pass

**5. EXHALATION RESISTANCE TEST – NIOSH Standard Test Procedure Number 122, 42 CFR**

**Part 84 Reference:** Subpart H, § 84.91 (c)

**Requirement:**

*The exhalation resistance of pressure-demand apparatus shall not exceed the static pressure in the facepiece by more than 51 mm. (2 inches) water column height.*

**Procedure:**

The facepiece was mounted on an anthropometric head form. A probe in the head form was connected to a slant manometer for measuring exhalation breathing resistance. The airflow through the apparatus was adjusted to a rate of 85 liters per minute and the exhalation resistance recorded.

**Results:** Tested on November 9, 2016. The SCBA met the test requirement.

<b>Exhalation Breathing Resistance: (inches of water column)</b>	<b>2.20</b>
<b>Static Pressure: (inches of water column)</b>	<b>0.78</b>
<b>Difference: (inches of water column)</b>	<b>1.42</b>
<b>Pass / Fail:</b>	<b>Pass</b>

**6. REMAINING SERVICE LIFE INDICATOR TEST – NIOSH Standard Test Procedure Number 124, 42 CFR Part 84 Reference:** Subpart H, § 84.83 (f) and Subpart G, § 84.83 (c)

**Requirement:**

*Each remaining service life indicator or warning device shall give an alarm when the remaining service life of the apparatus is reduced to a minimum of 25 percent of its*

*rated service time or pressure.*

This requirement is modified under § 84.63(c) as follows: *For apparatus which do not have a method of manually turning off remote gage in the event of a gage or gage line failure the remaining service life indicator is required to be set at a minimum of 25% of the rated service time or pressure.*

**Procedure:**

A calibrated gauge was connected in line between the air supply and the first stage regulator. The unit was then allowed to gradually bleed down. When the low air alarm was activated, the pressure on the gauge is recorded. This procedure was repeated six times. The average of the six readings was calculated and recorded.

**Results:** Tested on November 9, 2016. The 2013 test requirement is 35% ± 2%.

<b>Run #</b>	<b>Mechanical Alarm Point (psi)</b>	<b>Electronic Alarm Point (psi)</b>
<b>1</b>	<b>1610</b>	<b>1560</b>
<b>2</b>	<b>1610</b>	<b>1560</b>
<b>3</b>	<b>1610</b>	<b>1560</b>
<b>4</b>	<b>1610</b>	<b>1560</b>
<b>5</b>	<b>1610</b>	<b>1560</b>
<b>6</b>	<b>1610</b>	<b>1560</b>
<b>Average</b>	<b>1610</b>	<b>1560</b>
<b>Pass/Fail</b>	<b>Pass</b>	<b>Pass</b>

**7. NFPA AIR FLOW PERFORMANCE TEST NFPA 1981 (1997 Edition) Reference:**

Chapter 5, Performance Requirements, Section 5.1.1, Airflow Performance.

**Requirement:**

*SCBA shall be tested for air flow performance as specified in Section 6.1, Airflow Performance Test, and the SCBA facepiece pressure shall not be less than 0.0 in. (0.0 mm) water column nor is greater than 3½ in. (89 mm) water column above ambient pressure from the time the test begins until the time the test concluded.*

**Procedure:**

The required equipment specified in the NFPA standards was used to conduct the test on this unit. A pressure tap in the head was connected to a transducer which in turn was connected to a flatbed chart recorder for determining the pressure in the facepiece.

**Results:** The SCBA failed this test.

**Test Notes:** \*For the first 20 breaths, the inhalation recording was off the charts.\* PASS unit functioned. HUD functioned. Alarm systems functioned.

<b>Maximum Facepiece Pressure: (inches of water column)</b>	<b>N/A</b>
<b>Minimum Facepiece Pressure: (inches of water column)</b>	<b>0.22</b>
<b>Pass/Fail:</b>	<b>Fail</b>

**III. Disposition:**

Following testing, the SCBA unit was returned to the package it was received in and placed in secured storage pending return to the Rock Creek Fire Department.

**The results of all tests are summarized in Tables One and Two.**

**TABLE ONE – Summary of NIOSH Test Results**

**Task Number:** 21014  
**Manufacturer:** Sperian  
**NIOSH Approval Number:** TC-13F-0809CBRN  
**Tests Performed By:** Jeremy Gouzd, Karis Kline  
**Dates of Tests:** November 9, 2016

TEST / 42 CFR PART 84 REFERENCE	STANDARD	RESULT	PASS	FAIL
<b>1. POSITIVE PRESSURE TEST Reference:</b> Subpart H, § 84.70 (a)(2)(ii)	≥0.0 INWC	0.10 INWC	<b>X</b>	
<b>2. RATED SERVICE TIME TEST Reference:</b> Subpart F, § 84.53 (a), Subpart H, § 84.95 (a) and (b)	≥ 30 min	46 min 19 s	<b>X</b>	
<b>3. STATIC PRESSURE TEST Reference:</b> Subpart H, § 84.91 (d)	<1.5 INWC	0.78 INWC	<b>X</b>	
<b>4a. GAS FLOW TEST (at Full Cylinder Pressure) Reference:</b> Subpart H, § 84.93 (b) and (c)	≥ 200 LPM	353.96 LPM	<b>X</b>	
<b>4b. GAS FLOW TEST (at 500 psi) Reference:</b> Subpart H, § 84.93 (b) and (c)	≥ 200 LPM	356.79 LPM	<b>X</b>	
<b>5. EXHALATION RESISTANCE TEST Reference:</b> Subpart H, § 84.91 (c)	Difference ≤ 2.00 INWC	1.42 INWC	<b>X</b>	
<b>6a. REMAINING SERVICE LIFE INDICATOR TEST (mechanical alarm) Reference:</b> Subpart H, § 84.83 (f) and Subpart G, § 84.63 (c)	Between 1485 and 1665 psi	1610 psi	<b>X</b>	
<b>6b. REMAINING SERVICE LIFE INDICATOR TEST (electronic alarm) Reference:</b> Subpart H, § 84.83 (f) and Subpart G, § 84.63 (c)	Between 1485 and 1665 psi	1560 psi	<b>X</b>	

**NOTE: The Positive Pressure Test and Rated Service Life Test are run simultaneously.**

**TABLE TWO – Summary of NFPA Test Results**

<b>TEST / REFERENCE</b>	<b>STANDARD</b>	<b>RESULT</b>	<b>PASS</b>	<b>FAIL</b>
<b>7a. NFPA AIR FLOW PERFORMANCE</b> <b>Reference:</b> NFPA 1981 (1997 Edition), Chapter 5.1.1	≤ 3.50 INWC Exhalation Resistance	N/A		<b>X</b>
<b>7b. NFPA AIR FLOW PERFORMANCE</b> <b>Reference:</b> NFPA 1981 (1997 Edition), Chapter 5.1.1	≥ 0.00 INWC Inhalation Resistance	0.22 INWC	<b>X</b>	

# The Data Logger Information

Log Number: 040

Log Recorded: 08/08/2016 20:39:38 (08/09/2016 00:39:38 GMT)

Time		Event Name
20:39:38	-Event1	SCBA pressurized pressure=4366psi
20:40:10	-Event2	Pre-alarm initiated
20:40:11	-Event3	Pre-alarm reset automatically
21:01:00	-Event4	Low air pressure detected
21:09:40	-Event5	Pre-alarm initiated
21:09:41	-Event6	Pre-alarm reset automatically
21:10:02	-Event7	Pre-alarm initiated
21:10:02	-Event8	Pre-alarm reset automatically
21:11:17	-Event9	SCBA turned off

Log Number: 039

Log Recorded: 08/04/2016 13:57:20 (08/04/2016 17:57:20 GMT)

Time		Event Name
13:57:20	-Event1	SCBA pressurized pressure=4298psi
13:58:09	-Event2	Pre-alarm initiated
13:58:13	-Event3	Pre-alarm reset automatically
13:58:17	-Event4	Low air pressure detected
13:58:39	-Event5	Pre-alarm initiated
13:58:42	-Event6	Pre-alarm reset automatically
13:59:12	-Event7	Pre-alarm initiated
13:59:14	-Event8	Pre-alarm reset automatically
13:59:34	-Event9	Pre-alarm initiated
13:59:37	-Event10	Pre-alarm reset automatically
13:59:47	-Event11	Low air pressure detected
14:00:14	-Event12	Pre-alarm initiated
14:00:16	-Event13	Pre-alarm reset automatically
14:00:37	-Event14	Pre-alarm initiated
14:00:39	-Event15	Pre-alarm reset automatically
14:00:45	-Event16	Low air pressure detected
14:01:00	-Event17	Pre-alarm initiated
14:01:01	-Event18	Pre-alarm reset automatically
14:01:19	-Event19	Low air pressure detected
14:01:42	-Event20	Pre-alarm initiated
14:01:44	-Event21	Pre-alarm reset automatically
14:01:59	-Event22	Low air pressure detected
14:02:05	-Event23	Pre-alarm initiated

14:02:06 -Event24 Pre-alarm reset automatically  
 14:02:19 -Event25 Low air pressure detected  
 14:02:43 -Event26 Low air pressure detected  
 14:02:44 -Event27 Pre-alarm initiated  
 14:02:48 -Event28 Pre-alarm reset automatically  
 14:02:50 -Event29 SCBA turned off

Log Number: 038

Log Recorded: 08/04/2016 13:42:36 (08/04/2016 17:42:36 GMT)

Time	Event Name
13:42:36 -Event1	SCBA pressurized pressure=538psi
13:42:56 -Event2	Pre-alarm initiated
13:42:58 -Event3	Pre-alarm reset automatically
13:43:19 -Event4	Pre-alarm initiated
13:43:21 -Event5	Pre-alarm reset automatically
13:43:41 -Event6	Pre-alarm initiated
13:43:43 -Event7	Pre-alarm reset automatically
13:44:03 -Event8	Pre-alarm initiated
13:44:06 -Event9	Pre-alarm reset automatically
13:44:26 -Event10	Pre-alarm initiated
13:44:30 -Event11	Pre-alarm reset automatically
13:44:37 -Event12	Low air pressure detected
13:44:45 -Event13	Low air pressure detected
13:45:21 -Event14	Pre-alarm initiated
13:45:23 -Event15	Pre-alarm reset automatically
13:45:25 -Event16	SCBA turned off

Log Number: 037

Log Recorded: 08/04/2016 12:38:26 (08/04/2016 16:38:26 GMT)

Time	Event Name
12:38:26 -Event1	SCBA pressurized pressure=3488psi
12:38:47 -Event2	Pre-alarm initiated
12:38:50 -Event3	Pre-alarm reset automatically
12:39:10 -Event4	Pre-alarm initiated
12:39:12 -Event5	Pre-alarm reset automatically
12:39:33 -Event6	Pre-alarm initiated
12:39:35 -Event7	Pre-alarm reset automatically
12:39:55 -Event8	Pre-alarm initiated
12:39:58 -Event9	Pre-alarm reset automatically

12:40:18	-Event10	Pre-alarm initiated
12:40:21	-Event11	Pre-alarm reset automatically
12:40:56	-Event12	Pre-alarm initiated
12:40:58	-Event13	Pre-alarm reset automatically
12:41:18	-Event14	Pre-alarm initiated
12:41:24	-Event15	Pre-alarm reset automatically
12:41:44	-Event16	Pre-alarm initiated
12:41:48	-Event17	Pre-alarm reset automatically
12:42:09	-Event18	Pre-alarm initiated
12:42:16	-Event19	Pre-alarm reset automatically
12:42:37	-Event20	Pre-alarm initiated
12:42:43	-Event21	Pre-alarm reset automatically
12:43:04	-Event22	Pre-alarm initiated
12:43:16	-Event23	Alarm activated automatically
12:43:28	-Event24	Alarm reset
12:43:48	-Event25	Pre-alarm initiated
12:44:00	-Event26	Alarm activated automatically
12:45:59	-Event27	Alarm reset
12:46:42	-Event28	Low air pressure detected
12:46:53	-Event29	Pre-alarm initiated
12:46:58	-Event30	Pre-alarm reset automatically
12:47:18	-Event31	Pre-alarm initiated
12:47:25	-Event32	Pre-alarm reset automatically
12:47:46	-Event33	Pre-alarm initiated
12:47:48	-Event34	Pre-alarm reset automatically
12:48:09	-Event35	Pre-alarm initiated
12:48:13	-Event36	Pre-alarm reset automatically
12:48:33	-Event37	Pre-alarm initiated
12:48:38	-Event38	Pre-alarm reset automatically
12:48:58	-Event39	Pre-alarm initiated
12:49:00	-Event40	Pre-alarm reset automatically
12:49:21	-Event41	Pre-alarm initiated
12:49:24	-Event42	Pre-alarm reset automatically
12:49:44	-Event43	Pre-alarm initiated
12:49:47	-Event44	Pre-alarm reset automatically
12:50:07	-Event45	Pre-alarm initiated
12:50:10	-Event46	Pre-alarm reset automatically
12:50:30	-Event47	Pre-alarm initiated
12:50:33	-Event48	Pre-alarm reset automatically
12:50:53	-Event49	Pre-alarm initiated
12:50:54	-Event50	Pre-alarm reset automatically
12:51:15	-Event51	Pre-alarm initiated
12:51:27	-Event52	Alarm activated automatically

12:51:29	-Event53	Alarm reset
12:51:49	-Event54	Pre-alarm initiated
12:52:01	-Event55	Alarm activated automatically
12:52:04	-Event56	Alarm reset
12:52:24	-Event57	Pre-alarm initiated
12:52:30	-Event58	Pre-alarm reset automatically
12:52:52	-Event59	Pre-alarm initiated
12:52:55	-Event60	Pre-alarm reset automatically
12:53:15	-Event61	Pre-alarm initiated
12:53:17	-Event62	Pre-alarm reset automatically
12:53:39	-Event63	Pre-alarm initiated
12:53:40	-Event64	Pre-alarm reset automatically
12:54:00	-Event65	Pre-alarm initiated
12:54:03	-Event66	Pre-alarm reset automatically
12:54:42	-Event67	Pre-alarm initiated
12:54:44	-Event68	Pre-alarm reset automatically
12:55:05	-Event69	Pre-alarm initiated
12:55:08	-Event70	Pre-alarm reset automatically
12:55:43	-Event71	Pre-alarm initiated
12:55:45	-Event72	Pre-alarm reset automatically
12:56:06	-Event73	Pre-alarm initiated
12:56:13	-Event74	Pre-alarm reset automatically
12:56:33	-Event75	Pre-alarm initiated
12:56:35	-Event76	Pre-alarm reset automatically
12:56:56	-Event77	Pre-alarm initiated
12:56:59	-Event78	Pre-alarm reset automatically
12:57:20	-Event79	Pre-alarm initiated
12:57:22	-Event80	Pre-alarm reset automatically
12:57:43	-Event81	Pre-alarm initiated
12:57:45	-Event82	Pre-alarm reset automatically
12:58:05	-Event83	Pre-alarm initiated
12:58:08	-Event84	Pre-alarm reset automatically
12:58:29	-Event85	Pre-alarm initiated
12:58:31	-Event86	Pre-alarm reset automatically
12:58:52	-Event87	Pre-alarm initiated
12:58:57	-Event88	Pre-alarm reset automatically
12:59:18	-Event89	Pre-alarm initiated
12:59:20	-Event90	Pre-alarm reset automatically
12:59:41	-Event91	Pre-alarm initiated
12:59:43	-Event92	Pre-alarm reset automatically
13:00:04	-Event93	Pre-alarm initiated
13:00:06	-Event94	Pre-alarm reset automatically
13:00:27	-Event95	Pre-alarm initiated

13:00:28 -Event96 Pre-alarm reset automatically  
13:00:49 -Event97 Pre-alarm initiated  
13:00:51 -Event98 Pre-alarm reset automatically  
13:01:12 -Event99 Pre-alarm initiated  
13:01:20 -Event100 Pre-alarm reset automatically  
13:01:41 -Event101 Pre-alarm initiated  
13:01:43 -Event102 Pre-alarm reset automatically  
13:02:03 -Event103 Pre-alarm initiated  
13:02:07 -Event104 Pre-alarm reset automatically  
13:02:28 -Event105 Pre-alarm initiated  
13:02:32 -Event106 Pre-alarm reset automatically  
13:02:53 -Event107 Pre-alarm initiated  
13:02:57 -Event108 Pre-alarm reset automatically  
13:03:19 -Event109 Pre-alarm initiated  
13:03:23 -Event110 Pre-alarm reset automatically  
13:03:30 -Event111 Low air pressure detected  
13:03:43 -Event112 Pre-alarm initiated  
13:03:54 -Event113 Pre-alarm reset automatically  
13:04:17 -Event114 Pre-alarm initiated  
13:04:20 -Event115 Pre-alarm reset automatically  
13:04:40 -Event116 Pre-alarm initiated  
13:04:42 -Event117 Pre-alarm reset automatically  
13:05:03 -Event118 Pre-alarm initiated  
13:05:06 -Event119 Pre-alarm reset automatically  
13:05:27 -Event120 Pre-alarm initiated  
13:05:31 -Event121 Pre-alarm reset automatically  
13:05:51 -Event122 Pre-alarm initiated  
13:05:55 -Event123 Pre-alarm reset automatically  
13:06:15 -Event124 Pre-alarm initiated  
13:06:20 -Event125 Pre-alarm reset automatically  
13:06:41 -Event126 Pre-alarm initiated  
13:06:44 -Event127 Pre-alarm reset automatically  
13:07:05 -Event128 Pre-alarm initiated  
13:07:12 -Event129 Pre-alarm reset automatically  
13:07:32 -Event130 Pre-alarm initiated  
13:07:35 -Event131 Pre-alarm reset automatically  
13:08:16 -Event132 Pre-alarm initiated  
13:08:19 -Event133 Pre-alarm reset automatically  
13:08:40 -Event134 Pre-alarm initiated  
13:08:45 -Event135 Pre-alarm reset automatically  
13:09:05 -Event136 Pre-alarm initiated  
13:09:10 -Event137 Pre-alarm reset automatically  
13:09:30 -Event138 Pre-alarm initiated

13:09:42 -Event139 Alarm activated automatically  
 13:09:49 -Event140 Alarm reset  
 13:10:10 -Event141 Pre-alarm initiated  
 13:10:17 -Event142 Pre-alarm reset automatically  
 13:10:38 -Event143 Pre-alarm initiated  
 13:10:45 -Event144 Pre-alarm reset automatically  
 13:11:06 -Event145 Pre-alarm initiated  
 13:11:08 -Event146 Pre-alarm reset automatically  
 13:11:29 -Event147 Pre-alarm initiated  
 13:11:31 -Event148 Pre-alarm reset automatically  
 13:11:59 -Event149 Pre-alarm initiated  
 13:12:02 -Event150 Pre-alarm reset automatically  
 13:12:39 -Event151 Pre-alarm initiated  
 13:12:45 -Event152 Pre-alarm reset automatically  
 13:13:06 -Event153 Pre-alarm initiated  
 13:13:17 -Event154 Pre-alarm reset automatically  
 13:13:37 -Event155 Pre-alarm initiated  
 13:13:49 -Event156 Alarm activated automatically  
 13:14:16 -Event157 Alarm reset  
 13:14:36 -Event158 Pre-alarm initiated  
 13:14:41 -Event159 Pre-alarm reset automatically  
 13:15:03 -Event160 Pre-alarm initiated  
 13:15:12 -Event161 Pre-alarm reset automatically  
 13:15:32 -Event162 Pre-alarm initiated  
 13:15:37 -Event163 Pre-alarm reset automatically  
 13:15:58 -Event164 Pre-alarm initiated  
 13:16:00 -Event165 Pre-alarm reset automatically  
 13:16:21 -Event166 Pre-alarm initiated  
 13:16:23 -Event167 Pre-alarm reset automatically  
 13:16:44 -Event168 Pre-alarm initiated  
 13:16:48 -Event169 Pre-alarm reset automatically  
 13:17:00 -Event170 Low air pressure detected  
 13:17:04 -Event171 Low air pressure detected  
 13:17:21 -Event172 SCBA turned off

Log Number: 036

Log Recorded: 08/04/2016 12:16:11 (08/04/2016 16:16:11 GMT)

Time	Event Name
12:16:11 -Event1	SCBA pressurized pressure=3342psi
12:16:32 -Event2	Pre-alarm initiated
12:16:37 -Event3	Pre-alarm reset automatically

12:16:58	-Event4	Pre-alarm initiated
12:17:00	-Event5	Pre-alarm reset automatically
12:17:21	-Event6	Pre-alarm initiated
12:17:23	-Event7	Pre-alarm reset automatically
12:17:43	-Event8	Pre-alarm initiated
12:17:46	-Event9	Pre-alarm reset automatically
12:18:06	-Event10	Pre-alarm initiated
12:18:08	-Event11	Pre-alarm reset automatically
12:18:29	-Event12	Pre-alarm initiated
12:18:34	-Event13	Pre-alarm reset automatically
12:18:54	-Event14	Pre-alarm initiated
12:18:59	-Event15	Pre-alarm reset automatically
12:19:20	-Event16	Pre-alarm initiated
12:19:23	-Event17	Pre-alarm reset automatically
12:19:44	-Event18	Pre-alarm initiated
12:19:47	-Event19	Pre-alarm reset automatically
12:20:08	-Event20	Pre-alarm initiated
12:20:10	-Event21	Pre-alarm reset automatically
12:20:31	-Event22	Pre-alarm initiated
12:20:37	-Event23	Pre-alarm reset automatically
12:20:58	-Event24	Pre-alarm initiated
12:21:00	-Event25	Pre-alarm reset automatically
12:21:22	-Event26	Pre-alarm initiated
12:21:24	-Event27	Pre-alarm reset automatically
12:21:45	-Event28	Pre-alarm initiated
12:21:47	-Event29	Pre-alarm reset automatically
12:22:07	-Event30	Pre-alarm initiated
12:22:13	-Event31	Pre-alarm reset automatically
12:22:34	-Event32	Pre-alarm initiated
12:22:37	-Event33	Pre-alarm reset automatically
12:22:58	-Event34	Pre-alarm initiated
12:23:01	-Event35	Pre-alarm reset automatically
12:23:22	-Event36	Pre-alarm initiated
12:23:26	-Event37	Pre-alarm reset automatically
12:23:47	-Event38	Pre-alarm initiated
12:23:49	-Event39	Pre-alarm reset automatically
12:24:10	-Event40	Pre-alarm initiated
12:24:16	-Event41	Pre-alarm reset automatically
12:24:22	-Event42	Low air pressure detected
12:24:55	-Event43	Pre-alarm initiated
12:25:07	-Event44	Alarm activated automatically
12:25:14	-Event45	Alarm reset
12:25:34	-Event46	Pre-alarm initiated

12:25:39	-Event47	Pre-alarm reset automatically
12:25:59	-Event48	Pre-alarm initiated
12:26:03	-Event49	Pre-alarm reset automatically
12:26:40	-Event50	Pre-alarm initiated
12:26:43	-Event51	Pre-alarm reset automatically
12:27:04	-Event52	Pre-alarm initiated
12:27:10	-Event53	Pre-alarm reset automatically
12:27:31	-Event54	Pre-alarm initiated
12:27:34	-Event55	Pre-alarm reset automatically
12:28:08	-Event56	Pre-alarm initiated
12:28:10	-Event57	Pre-alarm reset automatically
12:28:33	-Event58	Pre-alarm initiated
12:28:35	-Event59	Pre-alarm reset automatically
12:28:56	-Event60	Pre-alarm initiated
12:29:00	-Event61	Pre-alarm reset automatically
12:29:21	-Event62	Pre-alarm initiated
12:29:26	-Event63	Pre-alarm reset automatically
12:29:46	-Event64	Pre-alarm initiated
12:29:50	-Event65	Pre-alarm reset automatically
12:30:10	-Event66	Pre-alarm initiated
12:30:13	-Event67	Pre-alarm reset automatically
12:30:34	-Event68	Pre-alarm initiated
12:30:37	-Event69	Pre-alarm reset automatically
12:31:21	-Event70	Pre-alarm initiated
12:31:28	-Event71	Pre-alarm reset automatically
12:31:31	-Event72	SCBA turned off

Log Number: 035

Log Recorded: 08/04/2016 11:51:20 (08/04/2016 15:51:20 GMT)

Time		Event Name
11:51:20	-Event1	SCBA pressurized pressure=3420psi
11:51:56	-Event2	Pre-alarm initiated
11:51:58	-Event3	Pre-alarm reset automatically
11:52:27	-Event4	Low air pressure detected
11:52:32	-Event5	Pre-alarm initiated
11:52:36	-Event6	SCBA turned off

Log Number: 034

Log Recorded: 08/03/2016 11:43:56 (08/03/2016 15:43:56 GMT)

Time		Event Name
11:43:56	-Event1	SCBA pressurized pressure=4100psi
11:44:26	-Event2	Alarm activated manually
11:44:44	-Event3	Alarm reset
11:44:44	-Event4	Alarm activated manually
11:44:50	-Event5	Alarm reset
11:44:50	-Event6	Alarm activated manually
11:44:58	-Event7	Alarm reset
11:44:58	-Event8	Alarm activated manually
11:45:08	-Event9	Low air pressure detected
11:45:32	-Event10	Alarm reset
11:45:32	-Event11	Alarm activated manually
11:45:49	-Event12	Alarm reset
11:45:49	-Event13	Alarm activated manually
11:47:00	-Event14	Low air pressure detected

Log Number: 033

Log Recorded: 08/02/2016 15:06:00 (08/02/2016 19:06:00 GMT)

Time		Event Name
15:06:00	-Event1	SCBA pressurized pressure=4434psi
15:08:36	-Event2	Pre-alarm initiated
15:08:42	-Event3	Pre-alarm reset automatically
15:11:52	-Event4	Pre-alarm initiated
15:11:53	-Event5	Pre-alarm reset automatically
15:13:15	-Event6	Pre-alarm initiated
15:13:15	-Event7	Pre-alarm reset automatically
15:13:37	-Event8	Pre-alarm initiated
15:13:38	-Event9	Pre-alarm reset automatically
15:17:29	-Event10	Pre-alarm initiated
15:17:30	-Event11	Pre-alarm reset automatically
15:19:01	-Event12	Pre-alarm initiated
15:19:04	-Event13	Pre-alarm reset automatically
15:24:13	-Event14	Pre-alarm initiated
15:24:16	-Event15	Pre-alarm reset automatically
15:24:44	-Event16	Pre-alarm initiated
15:24:52	-Event17	Pre-alarm reset automatically
15:25:13	-Event18	Pre-alarm initiated
15:25:18	-Event19	Pre-alarm reset automatically
15:25:57	-Event20	Pre-alarm initiated
15:26:03	-Event21	Pre-alarm reset automatically
15:26:24	-Event22	Pre-alarm initiated

15:26:30	-Event23	Pre-alarm reset automatically
15:26:51	-Event24	Pre-alarm initiated
15:26:56	-Event25	Pre-alarm reset automatically
15:27:17	-Event26	Pre-alarm initiated
15:27:25	-Event27	Pre-alarm reset automatically
15:27:46	-Event28	Pre-alarm initiated
15:27:51	-Event29	Pre-alarm reset automatically
15:28:12	-Event30	Pre-alarm initiated
15:28:18	-Event31	Pre-alarm reset automatically
15:29:12	-Event32	Pre-alarm initiated
15:29:18	-Event33	Pre-alarm reset automatically
15:30:09	-Event34	Pre-alarm initiated
15:30:14	-Event35	Pre-alarm reset automatically
15:30:35	-Event36	Pre-alarm initiated
15:30:41	-Event37	Pre-alarm reset automatically
15:31:01	-Event38	Pre-alarm initiated
15:31:07	-Event39	Pre-alarm reset automatically
15:31:44	-Event40	Pre-alarm initiated
15:31:51	-Event41	Pre-alarm reset automatically
15:32:33	-Event42	Pre-alarm initiated
15:32:35	-Event43	Pre-alarm reset automatically
15:33:47	-Event44	Pre-alarm initiated
15:33:53	-Event45	Pre-alarm reset automatically
15:34:47	-Event46	Pre-alarm initiated
15:34:52	-Event47	Pre-alarm reset automatically
15:35:17	-Event48	Pre-alarm initiated
15:35:18	-Event49	Pre-alarm reset automatically
15:37:02	-Event50	Low air pressure detected
15:37:17	-Event51	SCBA turned off

Log Number: 032

Log Recorded: 07/25/2016 22:24:10 (07/26/2016 02:24:10 GMT)

Time		Event Name
22:24:10	-Event1	SCBA pressurized pressure=3734psi
22:25:05	-Event2	Pre-alarm initiated
22:25:06	-Event3	Pre-alarm reset automatically
22:26:01	-Event4	Low air pressure detected
22:26:31	-Event5	SCBA turned off

Log Number: 031

Log Recorded: 07/25/2016 22:10:29 (07/26/2016 02:10:29 GMT)

Time		Event Name
22:10:29	-Event1	SCBA pressurized pressure=3870psi
22:12:21	-Event2	Low air pressure detected
22:12:49	-Event3	SCBA turned off

# Appendix III

## SCBA Inspection Report

Figure 1: Cardboard box containing SCBA as received.  
Figure 2: SCBA and facepiece out of box.  
Figure 3: Facepiece in bag.  
Figure 4: Facepiece out of bag.  
Figure 5: Top view of facepiece.  
Figure 6: Inside view of facepiece, skirt, and nosecup.  
Figure 7: Bottom view of facepiece.  
Figure 8: Top view of MMR.  
Figure 9: Bottom view of MMR.  
Figure 10: MMR side view and labels.  
Figure 11: Low pressure line.  
Figure 12: Quick Disconnect on low pressure line.  
Figure 13: Pressure reducer assembly.  
Figure 14: Top view of pressure reducer.  
Figure 15: Side view of pressure reducer with markings.  
Figure 16: High pressure line.  
Figure 17: Cylinder attachment and threads.  
Figure 18: Quick-Fill port.  
Figure 19: PASS console.  
Figure 20: Back view of PASS console.  
Figure 21: PASS control module.  
Figure 22: Backframe.  
Figure 23: Labels on backframe.  
Figure 24: NIOSH label on backframe.  
Figure 25: Straps and buckles.  
Figure 26: Cylinder strap.  
Figure 27: Auxiliary hose out of pouch.  
Figure 28: Top view of cylinder.  
Figure 29: Cylinder label.  
Figure 30: Cylinder gauge and threads.  
Figure 31: Cylinder threads.



**Figure 1: Cardboard box containing SCBA as received.**



**Figure 2: SCBA and facepiece out of box.**



**Figure 3: Facepiece in bag.**



**Figure 4: Facepiece out of bag.**



**Figure 5: Top view of facepiece.**



**Figure 6: Inside view of facepiece, skirt, and nosecup.**



**Figure 7: Bottom view of facepiece.**



**Figure 8: Top view of MMR.**



**Figure 9: Bottom view of MMR.**



**Figure 10: MMR side view and labels.**



**Figure 11: Low pressure line.**



**Figure 12: Quick Disconnect on low pressure line.**





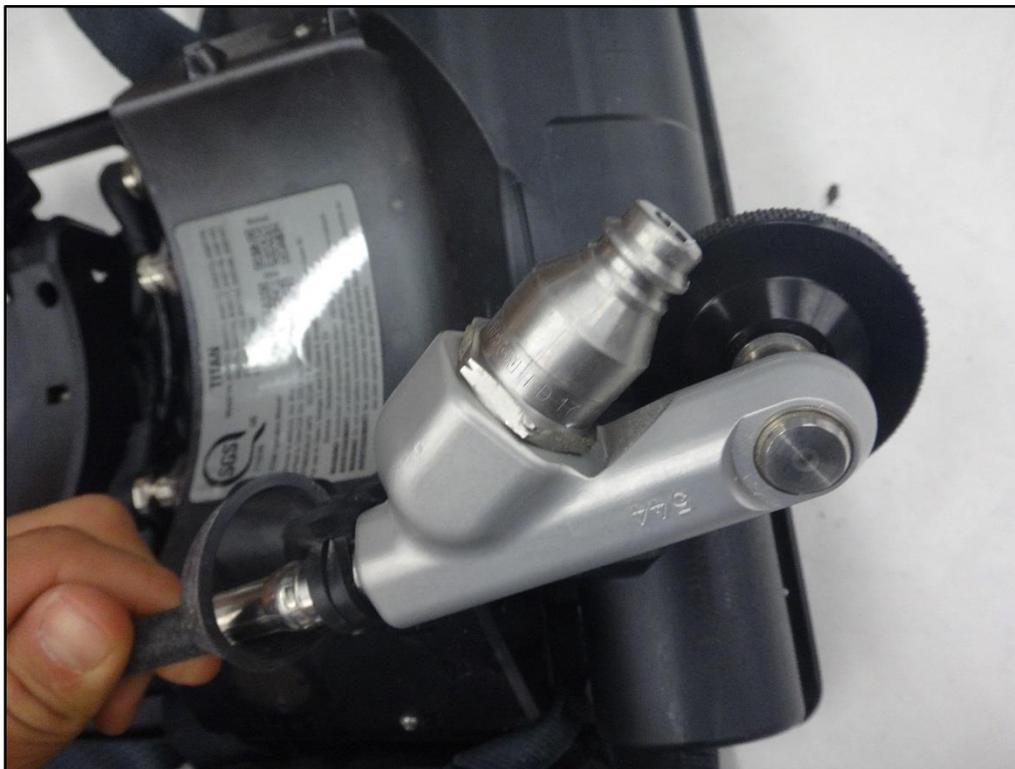
**Figure 15: Side view of pressure reducer with markings.**



**Figure 16: High pressure line.**



**Figure 17: Cylinder attachment and threads.**



**Figure 18: Quick-Fill port.**



**Figure 19: PASS console.**



**Figure 20: Back view of PASS console.**



**Figure 21: PASS control module.**

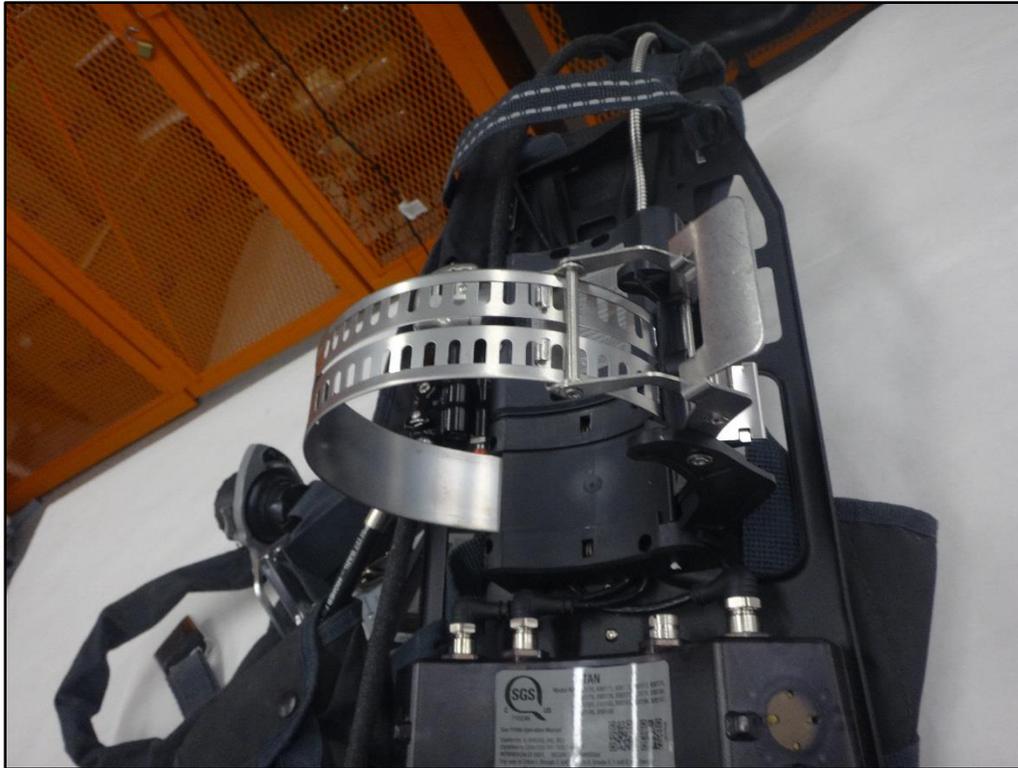


**Figure 22: Top view of backframe.**





**Figure 25: View of all straps and buckles.**



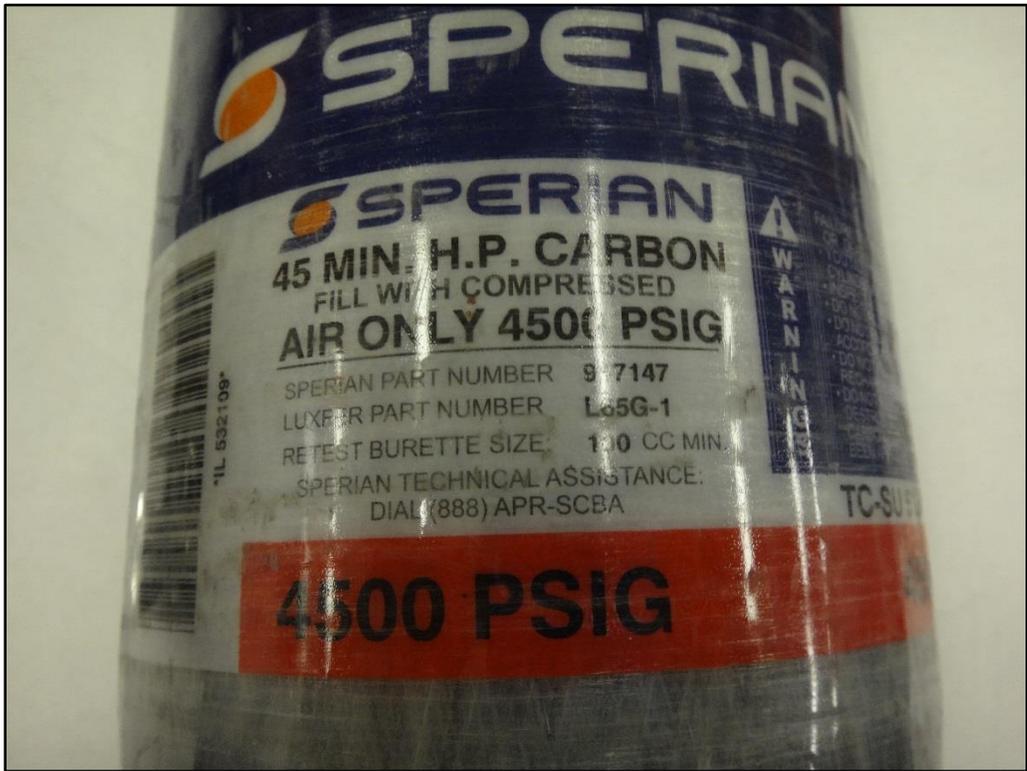
**Figure 26: Cylinder strap.**



**Figure 27: Auxiliary hose out of pouch.**



**Figure 28: Top view of cylinder.**



**Figure 29: Cylinder label.**



**Figure 30: Cylinder gauge and threads.**



**Figure 31: Cylinder threads.**