



# AFRICA FIRE MISSION

## The Value of a Quality Breathing Apparatus Program

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### **Executive Summary**

Firefighters often fight fires in conditions immediately dangerous to health and life. In these circumstances, quality firefighting personal protective equipment (PPE) provides firefighters with critical protection that significantly improves firefighting effectiveness while also protecting firefighting personnel's health and safety. In particular, Self-Contained Breathing Apparatus, frequently referred to as Breathing Apparatus (BA), is a critical component of PPE that isolates the firefighters from hot and toxic gases. It is the single most beneficial piece of safety equipment for a firefighter.

Effective firefighting operations have the essential BA equipment needed to fight fires as well as staff trained in how to use BA equipment and conduct routine maintenance to ensure its proper functioning.

### **The Need for a Quality Breathing Apparatus Program: Case Study**

On August 7<sup>th</sup> 2013, a fire broke out at the international terminal of Jomo Kenyatta International Airport, (JKIA), in Nairobi, Kenya and quickly grew into an inferno. The fire was controlled within 13 hours and fully extinguished two days later.

During the response, the BA deployed was exhausted within the first hour of operations. There was no filling station of compressed air available to refill empty cylinders, leaving firefighters to fight the fire without any respiratory protection, including controlling the main inferno.

As a result, ten firefighters were injured and transported to a hospital. Two were admitted with severe smoke and toxic gas inhalation that required almost a year for them to fully recover. Additionally, lack of appropriate PPE, BA and BA filling station/compressor limited firefighting operations, resulting in complete destruction of the airport's international arrival and departure terminal.

## **The Need for a Quality Breathing Apparatus Program**

As the fire at the Nairobi airport illustrates, firefighters often fight fires in conditions that are immediately dangerous to health and life. In these circumstances, quality firefighting personal protective equipment (PPE) helps safeguard firefighters from these conditions during firefighting operations.

One component of PPE for firefighters is a Self-Contained Breathing Apparatus (SCBA), frequently referred to as Breathing Apparatus (BA). The BA is a critical component of PPE that isolates the firefighters from harmful gases as well as other airborne particles that are byproducts of a fire. BAs are used to protect the lungs from inhaling hot gases, toxic smoke, and fumes, all of which have been proven to cause cancer. They also protect the user's face, skin and eyes, some of the most vulnerable areas of a firefighter's body. It is the single most beneficial piece of safety equipment for a firefighter.

Fire brigades properly equipped with BAs are also critical for protecting the lives and property of civilians. A small fire can quickly produce high volumes of thick, dense smoke, preventing firefighters without BA from entering a building to rescue individuals and quickly extinguish the fire. Without the ability to work safely in a smoke-filled building, fires will spread from those that are small and easy to extinguish, to infernos engulfing an entire building or even multiple buildings.

BAs are also critical pieces of equipment when dealing with toxic chemical spills and toxic fumes. Multiple deaths can occur when firefighters, without respiratory protection, attempt to rescue victims overcome by toxic fumes. BAs allow firefighters to safely and quickly remove victims from toxic environments, maintaining the safety of firefighters while increasing the chances of recovery and survival for those exposed to toxic chemicals.

In short, BAs are clearly critical components for minimizing injuries and deaths related to fires, toxic chemicals, and toxic fumes. A well-established BA program allows firefighters to enter buildings to directly attack fires and allows exterior firefighting to occur more safely. Proper use of BAs not only allows for more effective firefighting, it reduces the risk of injury and death for both firefighters and civilians, resulting in significant personal and economic impact.

## Equipment

For a successful and quality breathing apparatus program, there are two primary pieces of equipment: the BA and all of its components, and a Breathing Air Compressor.

The Breathing Apparatus is a respiratory device that contains and delivers breathable compressed air. It consists of several pieces of equipment:

- A properly fitted face mask and regulator that provides a positive pressure air supply to ensure no outside air can enter the facepiece
- A carrying frame and harness
- A compressed air cylinder worn on the back of a firefighter

In combination, the equipment isolates the firefighter's face, eyes, and airway from hazardous and irritating smoke and toxic gases.

Breathing Air Compressors are machines used to compress breathing air for storage in BA Cylinders. They consist of a compressor, filters, pressure regulator, and fill pipes.

Breathing air compressors may be:

- Powered by electricity or petrol
- Located in a fixed stationary location or mounted in a vehicle for mobile use
- Used in conjunction with a system of larger volume storage cylinders

At the Nairobi airport fire, an after-action review found only four (4) complete sets of BA were available to the initial response of 12 firefighters, only eight (8) spare BA cylinders were available for use by the tactical team for back up, and the backup BA cylinders were not compatible with the four BA harnesses in use. Had the firefighters each had a complete BA and at least one spare cylinder, they could have worked up to six times longer<sup>1</sup> in the dangerous environment, and may well have been able to prevent such costly loss of property.

## Training

In addition to proper equipment, adequate training on the use of the BA is critical to an effective firefighting program and should be required before BA is put to use. During training, firefighters gain an understanding of the practical use of BA and confidence in how to use it. BA training should include the following elements:

- The functions of and how to use all parts of the BA
- Ability to gauge how much air is in the apparatus

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<sup>1</sup> Most BA's provide a firefighter with 20-30 minutes of breathing air, dependent upon exertion and firefighter fitness. With only 4 complete sets of BA and incompatible spare cylinders, there was only 80 to 120 minutes of breathing air time to fight the fire up close. That's up to 2 hours of active "work" fighting the fire. Had those 12 firefighters each been equipped with a complete BA and at least one spare cylinder, there would have been 480 to 720 minutes of breathing air time to fight the fire, up to 12 hours of active "work" fighting the fire.

- How to conduct a pre-use inspection
- Donning and doffing procedures
- After-use inspection and storage
- How to test all components of the BA
- The essentials of cleaning BA

Some or all of the training can be included in the contract when purchasing BA equipment. However, when developing a quality BA program, it is also essential to ensure all firefighters, new and veterans, are trained in the above elements. Consequently, quality programs ensure trained staff are always available to train firefighters and others regarding BA procedures and maintenance, well beyond the training received when equipment is initially purchased.

It is noteworthy that in the Nairobi airport fire of 2013, the after-action review found that – in addition to a lack of BA equipment – lack of appropriate training on its use led to some personnel not using BAs when available.

### **Maintenance**

Both BAs and Breathing Air Compressors require implementation of best practices in regular maintenance to ensure safe and reliable operation. Maintenance schedules are outlined below.

Monthly Maintenance Schedule: BAs should be checked prior to use, during cleaning, and at least monthly to ensure: 1) the cylinder pressure is full, 2) the gauges on the cylinder and frame show the same pressure, and 3) the bypass/purge valve is operational. In addition, the condition of following should be checked:

- Air hoses (for cracks, abrasions, leaks)
- Regulator and seals (for cracks, abrasions, leaks)
- Frame (for cracks, breaks, other damage)
- Straps (for rips, tears, burns, abrasions)
- Facepiece (for damage to the lens, condition of seals, condition of straps)

Additional Maintenance Schedules: In addition to monthly maintenance, the following maintenance should also be conducted:

- The BA should be inspected annually by a certified technician. A flow test is administered to ensure the BA is performing to the manufacturer's specifications.
- Breathing Air Cylinders are to be hydrostatically tested at the manufacturer's recommended interval.
- Breathing Air Compressors are to be maintained at intervals recommended by the manufacturer. This includes:
  - Air filter inspection, with replacement as needed or at required intervals

- Oil filter inspection, with replacement as needed or at required intervals
- Compressor oil inspection, with oil change at required intervals
- Motor bearing inspection
- Belt inspection, with replacement as needed
- Intake vent cleaning and inspection
- Air dryer inspection and replacement as needed
- Condensate collection container emptied
- Pressure relief valves inspection
- Inspection of entire unit for leaks, including all internal pipes and fill pipes
- Pressure gauge testing to ensure accurate readings

Underscoring the importance of regular maintenance, the after-action review of the Nairobi airport fire found BA back plates and cylinders had not been properly maintained so were not working correctly, becoming one more factor that prevented firefighting personnel from effectively fighting the fire.

### **Considerations When Acquiring BA**

Not all BA systems operate similarly, and they require certain infrastructure in order to ensure proper operation and maintenance. Consequently, there are several considerations important to determine prior to purchasing BAs and a Breathing Air Compressor. These include:

- Ensuring that a working compressor is readily available to fire brigades at the fire (in addition to a compressor at the fire station) to fill tanks with compressed air.
- Determining, given the above, whether portable and/or fixed compressors are needed for effective firefighting operations.
- Ensuring the facilities in which the BA will be housed have the capacity to power the compressor and that voltage, frequency, and amperage on the compressor are compatible for the purchasing country.
- Identifying whether there is in-country availability of compressors. Although compressors come in various sizes and manufacturers, the compressor system(s) recommended by the air tank manufacturer should be considered to assist in compatibility and reliability.
- Ensuring compressor component connectivity.
- Identifying whether there is a need for filling stations.
- Contracting with manufacturer or local BA dealer to ensure equipment can be properly maintained.

Accepting Used or Donated BA: Similarly, there are also considerations when determining whether to accept used or donated BA. These are largely focused on air compressors, and include the following:

- Electrical Power Considerations

- Are the voltage, frequency, and amperage compatible?
- Does it use single phase power or three phase power?
- Does it have a compatible power plug or does it need to be changed?
- Petrol Power Considerations
  - Is a supply of fresh petrol available for use?
  - Has the engine been maintained?
  - Are oil, oil filters, air filters and spark plugs readily available?
- General Considerations
  - Does the compressor produce enough pressure to fill the cylinders?
  - Are the threads on the fill hose compatible with the cylinders?
  - Is there a source for air dryers and air filters?
  - Is there a source for air quality testing?
  - Will the donation come with all of the required components?
  - Are all of the components being donated compatible with each other?

At the Nairobi airport fire in 2013, in addition to lacking complete sets of BA equipment, training, and maintenance, lack of BA filling stations also hindered the response to the fire.

## **Conclusion**

While firefighting is an inherently dangerous profession, the safety factor increases exponentially when the firefighters conduct operations with proper PPE, including BA. As the Nairobi airport fire makes all too clear, without the necessary BA and supporting equipment needed, firefighting abilities are significantly compromised. Equipping and training firefighters with properly fitting equipment, as well as ensuring the equipment is in working order through regular maintenance, minimizes the economic damage while also preventing injuries and saving lives.

Key considerations to implementing an effective and comprehensive BA system include:

- Purchasing an adequate number of BA systems for fire personnel, and ensuring the system purchased will work within the parameters of existing infrastructure.
- Ensuring firefighters are not only initially trained on the BA system, but that program personnel always include individuals able to retrain/train new and existing staff as needed.
- Implementing a regular schedule of maintenance, in accordance with best practices and manufacturer guidelines.

Since the 2013 fire at Jomo Kenyatta International Airport, (JKIA), in Nairobi, Kenya, Kenya Airports Authority has committed to improving PPE for its firefighting operations including developing a breathing apparatus program. BAs and a Breathing Air Compressor have been purchased and are in service at JKIA. Ongoing training and maintenance continue to be developed for their BA program in order to ensure that the equipment is able to be used well into the future. As capacities in PPE and the BA program have grown, firefighters are able to more effectively respond to fires preserving lives and property.

### **About Africa Fire Mission:**

Africa Fire Mission is committed to increasing the sustainable capacity of fire departments across Africa. We accomplish this through training, empowerment, support and encouragement:

**Train**– We partner with African governments, NGO's, missionaries, schools and corporations to provide education and training to firefighters and local communities. We use Community Health Education to teach firefighters and community members in Africa to protect themselves from the dangers of fire. We provide fire prevention training & fire safety assessments to schools ensuring the students are able to learn in an environment safe from fires.

**Empower**– We work to increase the ability of communities in Africa to respond to disasters and provide relief when disasters occur.

**Support**– We provide personal protective equipment and communication tools to fire services throughout Africa to allow fire departments to operate in a safer and more coordinated manner.

**Encourage**– We build the capacity of African fire services so that local communities are able to provide sustainable public safety and disaster management services.

### **Contact Us:**

If you need additional consultation regarding developing your Breathing Apparatus program, please contact [info@africafiremission.org](mailto:info@africafiremission.org) or go to our website: [www.africafiremission.org](http://www.africafiremission.org)