

SCOTT AIR-PAK 4.5



Figure 1: Numbered Components of Air-Pak

The Scott Air-Pak is a self-contained breathing apparatus (SCBA) that is commonly chosen by firefighters because of its rugged construction and ability to withstand heat. The Air-Pak 4.5 is the most common SCBA used by fire departments in the United States. Its Success is largely due to the Scott's track record quality products, but can also be attributed to the simple design. This product has been optimized for simplicity and weight saving. The parts of the Scott Air Pak 4.5 are shown in figure 1 and listed below.

- | | |
|---------------------------|-------------------------|
| 1) Back Frame | 5) Regulator Assembly |
| 2) Harness | 6) Face Piece (or Mask) |
| 3) Integrated PASS Device | 7) High pressure hose |
| 4) Cylinder | 8) Pressure Reducer |

Specifications of the parts listed will be explained in the text to follow. Some the parts in this list function regularly with other parts, for this reason they are grouped for explanation.

Back Frame and Harness

The back pack of the Scott Air-Pak provides a foundation for the rest of the components to build on and offers comfort and protection to the firefighter. The back frame is constructed of a lightweight aluminum alloy. This strong alloy offers protection from piercing objects and can hold its shape in the event of a collapse. Due to its strength and central location, the frame provides strong anchor points to the components of the pack. This can be seen in figure 2. At the frame / firefighter interface, the frame is contoured to fit the natural shape of a user's back. Special consideration was given to the design of the contour to ensure that the majority of the weight is directed to the user's hips. By doing this, Scott minimized stress on the shoulders and back of the user.



Figure 2: Harness and back frame. Note regulator and low pressure line missing.

The abrasion, cut, and general wear resistance of the harness as well added comfort features keep the user safe and comfortable while working with the pack on. The shoulder straps, waist straps, and cylinder restraint are constructed from Kevlar, which is known for its extreme resistance to cuts, tears, wear and heat. The upper shoulder straps are 4" wide, contain padding for comfort, and integrate a cover for wires and air piping that pass through them. A 1.5" wide piece makes up the lower shoulder strap that allows for adjustment to fit users of varying builds. Waist strap components are similar: a lower back pad 6" wide 22" long and thinner 1.5" tether at either end for adjustment.

The Harness and back frame work in unison allowing them to help the other complete its function. The back frame completes the harness by attaching the top of the shoulder straps to the lower back pad. Harness components help to keep the back frame in the correct position on the user. They also help to secure components to the frame. The harness they create can be used to lift a user in an emergency situation.

Cylinder, High pressure hose, Pressure Reducer

Cylinders provide the supply of air to the rest of the system; their size and working pressure determine the amount of air they can supply. The Scott Air-Pak 4.5 has a working pressure of 4500 psi. Scott offers 4 different sized cylinders at this working pressure:

30 minute cylinder: 21.7 L x 5.53 D weight: 11.01 lb

45 minute cylinder: 23.5 L x 6.30 D weight: 14.61 lb

45 minute cylinder: 21.3 L x 6.84 D weight: 15.39 lb

60 minute cylinder: 24.8 L x 7.05 D weight: 18.92 lb

All of the cylinders at this pressure have an aluminum alloy inner shell and are wrapped with carbon fiber. This construction increases the strength of the cylinder and allows for the high working pressure. Figure 3 shows the design of a 45 minute short cylinder for a reference; notice the carbon fiber strips that wrap the exterior. The connection of the cylinder, located on the valve at the base, can be either a Scott Quick Connect or threaded.

Before reaching the user, air pressure must be reduced as it would not be wise to attempt to breathe air at 4500 psi. The pressure reduction is achieved by using a two stage pressure reducer (Component 8 in figure 1). The first stage of the reducer lowers the pressure from cylinder pressure to 100 psi. This stage is active when the cylinder pressure is more than 1125 psi (1/4 of total capacity). Below 1125 psi, the second stage is active and only reduces pressure to 150 psi. At 150 psi, VibraAlert is activated in the face piece (see Face Piece and regulator section for explanation of VibraAlert).

Air is transported from the cylinder to the pressure reducer through a high pressure line. This line is made of braided steel and given a Kevlar cover. Along this line a buddy breather and a universal RIT connection are connected to assist with emergency air operations.



Figure 3: Carbon Wrapped SCBA Cylinder

Integrated PASS Device

A PASS device is a Personal Alert Safety System or a device that, when activated, makes a loud noise to assist rescuers find your location. Older PASS devices were not attached to air packs and could be detached from an individual. This would lead to rescuers searching for a person in the wrong location. The Scott Air-Pak 4.5 has a PASS device that is woven into the pack itself. The control and display (pictured in figure 4) for the PASS is attached to the right shoulder strap, wiring passes through the shoulder strap, and the power supply and speaker are attached to the back frame. The control allows the user to manually activate or disable the device.



Figure 4: PASS Control and Display

Regulator and Mask

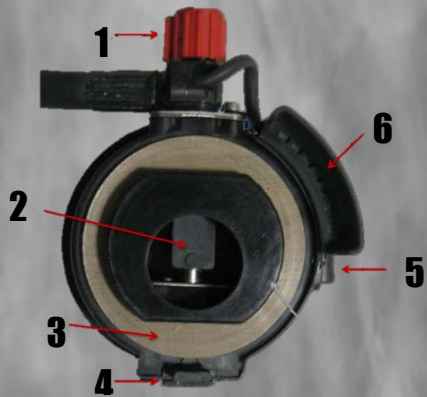


Figure 5: Labeled inside of regulator

The regulator is a complicated component that is made up of 6 subcomponents shown in figure 5. The bypass/purge valve lets a user bypass the don/doff switch to allow air to flow regardless of switch position. The VibraAlerts activation was talked about earlier. Once activated, this vibrates the mask to alert the user that only $\frac{1}{4}$ of his/her air is remaining. The gasket and Retention pin work to keep the regulator mated to the mask firmly, with no leakage. Proper mating can be seen in figure 6. The don/doff switch is activated by negative pressure of a user trying to take a breath. It is then deactivate by pushing sown on the switch. The HUD shows approximately how much air is remaining in the cylinder by using different colored lights.

Parts of the Regulator:

- | | |
|-----------------------|--------------------|
| 1) Bypass/Purge Valve | 4) Retention Pin |
| 2) VibraAlert | 5) Don/Doff Switch |
| 3) Gasket | 6) HUD |



Figure 6: Mated regulator and mask



References

Figure 1: http://www.wfrfire.com/scba/scott/airpak_specifications.pdf

Figure 2: <http://thumbs.ebaystatic.com/images/g/btkAADSwd4tULZ9U/s-l225.jpg>

Figure 3: <https://www.northernsafety.com/Product/26759/Scott-Safety-30-min-4500-psig-Carbon-SCBA-Respirator-Cylinder>

Figure 4: <http://traditionstraining.com/is-that-your-p-a-s-s-device/>

Figure 5: <http://discovercorona.com/CityOfCorona/files/94/9493ab4b-43f0-4a90-bd26-31676b1cf747.pdf>

Figure 6: <http://dalmatianfire.com/scba-options/>