



## Considerations for Selecting and Using Aviation Life Support Equipment (ALSE)

### *Introduction*

This is the second part of a 2-part paper on Aviation Life Support Equipment (ALSE). Hopefully you had a chance to read the first one that focused on helmets. As a continuation, let me share the introductory remarks from the previous paper.

Wearing the proper flight gear during flight is critical for the safety of the crew members. While it can be argued that the absolute necessity of wearing a helmet, flight suit, proper boots and gloves all of the time is unnecessary, it is for that one time (that hopefully never happens to anyone) when the aircraft unexpectedly goes down. That is when all of this equipment's value may come into play. Essentially it is insurance, as are your automobile seat belts. Crash investigators often hear from crash survivors that they are able to speak to us singularly because they were wearing their ALSE. The FAA does not mandate use, but for survivability in numerous cases, this is not an option, it is an imperative and should be considered an industry standard.

This paper focuses on flight suits, underwear, gloves and boots.

### *Flight Suits*

It would be safe to say that flight suits are probably the most visible of items along with the crew members' helmet. It is unique and if a helmet is not being worn at the time, such as around the hangar, it is the one piece of ALSE that indicates the person is a crew member. The proper use of one, however, seems to be lost on some people. It is absolutely critical that the flight suit fit properly. Far too often flight suits are too tight; they are meant to be loose fitting. This is based on the 'Thermos Bottle Principle'. In other words, it is based on layers of material and air. The flight suit makes up the outer layer, then there needs to be a layer of air. The next layer of material will be the underwear (to be discussed next), then another layer of air. This layering is what protects the individual from the thermal attack. Remember, flight suits are NOT meant to fight the fires, merely to protect the crew member for a short period of time in order to quickly egress the aircraft.

First, let us consider the material. In talking with several individuals in the air ambulance community, it is apparent there is a great deal of confusion as to the types of material available what needs to be worn. As a top-level review, we will take a look at what is available.

#### Traditional Synthetic Fiber

These are the man-made fibers that have been produced over the years to improve on naturally occurring animal and plant fibers. Before synthetic fibers were developed, fibers were made from plants that were called cellulose fibers.

Synthetic fibers are made from synthesized polymers or small molecules. The compounds that are used to make these fibers come from raw materials such as petroleum based chemicals or petrochemicals. Just from this it becomes obvious why these types of fibers should not be used for flight suits. Differing chemical compounds will be used to produce different types of fibers.



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Examples of synthetic fibers would be Nylon, Rayon, Polyester and Spandex. A major disadvantage of these fibers are they have a low melting temperature. As it melts, it sticks to the body. Think of it as shrink wrap...it melts and adheres to the body. This is not the material one wants to wear in a post-crash fire.

### Natural Fiber

From an aviation perspective, natural fibers are normally animal hair, cotton, leather and/or silk.

Animal hair is essentially fiber or wool taken from animals or hairy mammals e.g. sheep's wool, goat hair (cashmere, mohair), alpaca hair, horse hair, etc.

Cotton is a fiber that grows in a boll, or protective capsule, around the seeds of cotton. The fiber is almost pure cellulose.

Leather is a durable and flexible material created by the tanning of animal rawhide and skin, often cattle hide.

Silk fiber is produced through secretions from glands of insects during the preparation of cocoons.

The main characteristic with these as they related to protection, they will burn for a short time, but will not melt.

### Aramid Fiber

While aramid fiber is also synthetic, it was developed specifically to be fire resistant (FR). By far, the most common is Nomex. This material will not melt or sustain a flame. While Nomex is the most common, it is not the only FR material that can be used.

Certainly we can all accept the the fact that it is best to have FR material for our flight equipment. By this it is meant that the material is totally or almost totally unburnable.

Nomex is the standard partly because of longevity and partly because it is the most fire resistant (FR) fabric. It is a very tough fabric, lasts a long time, and was developed by DuPont.. The big disadvantages of Nomex are that it fades in UV light, doesn't breathe, and doesn't wick moisture as well as people would like. Nomex is inherently fire-resistant and is a relatively chemically-inert fabric. Because is relatively inert, it doesn't dye well. The dye coats the fiber more than it reacts chemically with the fiber. Nomex products are sold by several companies.

The one new fabric that is making inroads into the FR clothing business is Modacrylic. The military uses Modacrylic for its two-piece flight suit and for some ground crew clothing. It is comfortable, breathable, wicks moisture, and is nearly as fire resistant as Nomex. Modacrylic also does not fade in UV light. DuPont claims superior fire resistance for Nomex, but it appears the difference is not significant. TenCate, SSM Industries, and Springfield all make Modacrylic fabrics.



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Now that we have established the need for the flight suit, the materials to use, and the concept of how it protects, let us look at how it should be worn. The idea of the flight suit is to provide maximum coverage in order to provide maximum protection. So remember, long sleeve with sleeves down, and the collar up in order to protect the neck. Think of it this way...what ever is not covered could be at risk for being exposed to the flame. Along with this, there should be no metal on the flight suit. This could not only puncture the suit and injury the wearer on impact, but could melt and compromise the integrity of the flight suit.

### *Undergarments/Socks*

It is not wise to go commando! Undergarments should always be worn. Earlier we discussed various materials. In this case, any of the natural fibers or FR materials is acceptable. A good place to look for FR underwear is on a NASCAR website. Everything the drivers wear is FR. One can also check military clothing sights and look for Fire Resistant Operational Gear (FROG). Due to the Improvised Explosive Devices in the Middle East, the USMC has gone all FR clothing in the field.

The main thing to remember when dressing is to ensure the shirt is tucked into the pants. Never should there be any elastic material touching the skin. In the case of bras, it is advisable to wear jogging bras since they provide material over the elastic.

### *Gloves*

In the case of gloves, it is essentially the same as the flight suit. Most individuals use Nomex gloves, but the NASCAR websites provide a wide selection. When wearing gloves, remember to tuck them in under the flight sleeve, and Velcro the sleeve. Again, it is about coverage.

### *Boots*

The function of the boots is to provide stability and protection of the feet and ankles both during normal operations and egressing a burning aircraft. Boots generate some interesting discussions. There are areas that everyone agrees on, but there are a couple that can be contentious. For example, do they need to be all leather (remember natural fibers)? The answer is, what is the company policy. There are boots available that are flight approved that are a combination of leather and FR material, the largest selection of tested/approved boots are manufactured by Belleville.

Once we decide on the material of the boot, the next area of contention is the use of a zipper. At this time, there are NO boots flight approved with zippers. This is due to the fact that none have ever been tested. The US military provides all testing, and they do not allow zippers. Would they be adequate? The argument suggests that, like the flight suit, the boots are not meant to fight fires, merely to rapidly egress. It is understood that the zippers would eventually melt, but would they not last long enough to egress the aircraft? The bottom line is, if the company requires flight approved boots, then zippers are not an option.



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Beyond these points, most people agree on the characteristics for boots. The main ones are:

- Boots should be at least 8" high and have a good overlap by the flight suit
- Have a strong FR retention system (yes, the laces should be FR)
- Need to be laced to top for support

### *Summary*

Hopefully after reading this paper there is a better understanding of the need for wearing proper ALSE. Perhaps this has raised questions...it is certainly encouraged to research the products. But when considering flight gear:

#### Flight Suits

- Always worn
- FR material
- Sleeves down
- Collar up
- No metal on flight suit

#### Underwear

- Always worn
- Natural fibers or FR material
- Shirt always tucked in (never expose skin to the elastic material)

#### Gloves

- Always worn
- FR material
- Tucked in under the flight suit

#### Boots

- Always worn
- Flight approved

#### *About the Author*

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