

Smoke Hoods and Human Factors

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Dr. Vant was a luncheon speaker at the ISRP Biennial Conference in Winchester England, November 4, 1991. His experience is broad. His consideration of the choice of emergency escape respirators together with the training necessary for their use is interesting. It makes one wonder about occasional-use Emergency Escape Respirators in industry and the training provided for their users. For those not familiar with smoke hoods, they are, in this context, collapsible hoods, easy to don, and with a compressed-air supply adequate, it is hoped, to permit the users to find their way to safety.

Introduction

I was delighted to receive an invitation to join you today and talk about smoke hoods and touch—briefly—on my views regarding the relationship of human factors to the user-friendliness of smoke hoods.

Some of you present today may be aware that after the Manchester accident six years ago, the Air Transport Users Committee became interested in the life-saving potential of smoke hoods. At that time, the Committee invited speakers to brief them on products and medical

matters related to the development of Passenger Protective Breathing Equipment (PPBE). I became aware that no one seemed to be sure if there were smoke hoods currently available that could be useful in the circumstances of an aviation fire. In my work with the oil industry I had been associated over a period of some years with the Offshore Fire Training Centre. Therefore I was delighted to gain the support of the Commandant, his staff, and the oil industry, with a view to ascertaining if there were any smoke hoods which, at that time, seemed to provide the desired level of protection.

Initial Product Trials

With the cooperation of manufacturers, it was possible to have a number of products available at the Montrose Training Centre. With the aid of press and television, we managed to encourage a number of people to come and spend the day with us while the product trials, using kerosene smoke, took place. The smoke hoods were obtained from Europe, the United Kingdom, and North America. The appearance of some was what one would expect—others could be described as unusual and at least one could, at best, be stated as still in the course of development. Not all of this worked and one—when exposed to

heat—melted on the head of the wearer. At this time it was quite clear that manufacturers had some way to go if they were to achieve the required level and duration of protection and also ensure that they provided a user-friendly product.

Even at this early stage, opinions related to human factors were being expressed without any data supporting such views. Representatives of the regulatory authority were saying that the donning of smoke hoods would delay passengers leaving an aircraft fire and therefore were dangerous. They also indicated that it would be impossible to get people to understand—with only a brief form of

instruction—how to don such equipment. They failed to realize that the real hurdle to be overcome was the development of an inexpensive, light-

weight product **affording** the required level of protection that could be readily donned by both sexes.

Donning Time

There was a need for a substantial field trial aimed at ascertaining if the donning of smoke hoods was likely to adversely impact the aircraft evacuation times in a simulated emergency. At this point it transpired that the Regulatory Authority was unable to fund such a study. Thus, it fell to Linacre College to raise the necessary funds, develop and obtain agreement on the protocol, make the insurance arrangements with the Civil Aviation Authority, and then undertake the testing programme.

In all, the money and resources required for the project was well in excess of 250,000 pounds. Nevertheless, the required financial support and resources for the project were obtained from many parts of the world in a matter of weeks. Significant contributions of money and resources were made by manufacturers of breathing equipment, trade unions in the aviation industry, local government organizations, the **CAA**, airlines, newspapers, consumer groups, and individuals.

Test Subjects and Support Staff

The tests took place at Tees-side in the Northeast of England. Human testing requires human beings, and over 1000 members of the general public volunteered to take part in the tests. People were also needed to supervise, monitor, and run a wide range of activities, and these were drawn from volunteers from the Fire

Service, the Offshore Fire Training Centre at Montrose, St. John's Ambulance, the WRVS, British Airways, the French Cabin Attendants Union, the Medical Profession, and many other organizations. The aircraft required for the tests—a Trident **III**—was provided by the CAA Fire School at Tees-side.

Selection of the Smoke Hood

At that time the PELLIS Smoke Hood was used on many corporate aircraft in North America

as PPBE. A ventilated version of this hood was selected for the testing programme.

Safety Briefing

A vital aspect of the trials was to provide a donning demonstration that could readily be incorporated into the normal passenger safety briefing by cabin attendants. Because of the location selected for housing the equipment and the design of the smoke hoods concerned, this proved less difficult than had been anticipated.

The initial format for the demonstration was devised and outlined after taking into account passenger behavior in the current safety equipment briefing on three **different** airlines. It was subsequently further developed with the aid of those charged with presenting it to the test subjects. In all, it was possible to contain the time

required for this aspect of a total safety briefing to just under three and a half minutes.

During the course of the test programme, involving some 750 test subjects, only two individuals failed to don a hood before leaving the aircraft. One had managed to find and consume a quantity of alcohol before entering the aircraft **and—regrettably—was** too drunk to follow the instructions. The other sat directly opposite an exit and did the sensible **thing—when** the emergency evacuation was signalled, he stepped straight out of the doorway without donning the equipment.

Test Results

The test programme confirmed that with suitable, correctly located, user-friendly smoke hoods, donning time is not a significant factor in the time taken by those leaving an aircraft in a

simulated emergency using theatrical smoke. Further tests undertaken by the United States Federal Aviation Administration (FAA) in the state of Oklahoma confirmed these findings.

Impact of Human Factors

In the past I have been confronted by executives proudly demonstrating that they can don their product in a very short time. Yet when individuals are confronted with such equipment for the first time, they encounter considerable difficulty in getting the smoke hood over their heads. It would seem that while practice "makes perfect," it does not help the uninitiated. Moreover, in the early days, many manufacturers seemed unaware that a successful product needed to be one that had universal application. Ladies hair styles—especially plaited hair—men's beards, glasses, or turbans could readily defeat such a requirement.

More than six years after the Manchester accident, the only item of safety equipment that can provide passengers escaping from aviation fire with the necessary protection from toxic fumes and gases is one that passengers are expected to purchase for themselves. Furthermore, the Regulatory Authorities continue to suggest that a long-term unproven solution—water-based fire-suppression systems—must be pursued. One wonders if a lack of interest in demonstrating to the general public that available equipment can readily be used by all concerned is the reason why both the airlines and the regulatory authorities feel they can maintain their present stance on smoke hoods. It may also be the reason why the regulatory authorities continue to suggest that donning smoke hoods will impact adversely on passengers ability to evacuate an aircraft in situations of aviation fire.

Over the years, breathing equipment manufacturers have tended to look upon their markets as being those related to the needs of specialized services, such as the armed forces, fire services, mining and specific industrial requirements. Certainly personnel required to use such equip-

ment will be trained in its donning and application. Thus the need to consider human factors and user friendliness did not arise. In the past the need for equipment that can be readily worn in almost the same simple way that one puts on an item of clothing has never been considered.

The publication by EUROCAE of their document ED-65 in April 1991, provided the first international specification for passenger protective breathing equipment. This comprehensive document was developed over some eighteen months by the EUROCAE Working Group 36. Members of the SAE A-10 Oxygen Equipment Committee were also involved in its preparation.

It provides a very full statement of the qualification and acceptance criteria the test centres must apply when undertaking the certification of such equipment. The specification also covers in detail:

- Donning and doffing times
- Orientation and adjustment
- Wearing of spectacles
- Communication
- Field of vision
- Optical quality
- Condensation
- Breathing resistance
- Inhalation temperature
- Facial and neck hair and hair styles
- Human test subjects

The manner in which the manufacturer meets these aspects of the specification will inevitably impact on the degree of user-friendliness of the equipment. Moreover, the way in which these criteria are met will impact on the ability of a concern to market their product.

The Marketplace

At this point, the CAA only accept that individuals may carry their own smoke hoods when they travel by air. It was interesting to observe the alacrity with which many of their employees purchased whatever equipment they could obtain for this purpose. Many thousands of smoke hoods have been sold to intending air travelers. In addition, smoke hoods are now provided for those who work on the offshore oil fields.

Manufacturers recognize that consumer demands dictate product development and sales.

In turn, investment in a new product must relate to the size of the potential market and the anticipated return on capital employed. The potential markets for smoke hoods are worldwide and immense. They include hotels, railways, offices, prisons, hospitals, ships, and aircraft. Some consider that the mandatory fitting of smoke hoods in aviation will open the door to a general acceptance of such equipment.

Conclusion

The potential market for a user-friendly smoke hood is vast, and sales will be dependent on the consumers' acceptance that such equipment is not only effective but readily and easily usable. Notwithstanding all the opinions that many business schools propound, managers are paid to make things happen! It is the managers who must

act in order to gain the confidence of the general public in their products. Therefore, it falls to the management of protective breathing equipment manufacturers to ensure that the human factors are fully taken into account to insure that the smoke hoods they develop provide the necessary level of protection and are user-friendly.