

## BODY COOLING CONCEPT IN CONJUNCTION WITH CHEMICAL PROTECTION SUITS

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Performing work or rescue under hazardous conditions requires the use of special body protection equipment including breathing apparatus and chemical protection suits. Unfortunately, wearing such equipment *adds* weight and restricts movement, visual field, ability to communicate, and manual *dexterity*. Moreover, it inhibits evaporation of sweat, thereby, creating a humid micro-environment as part of the sweat is absorbed in the garment. All of this leads to *increased* cost of performing a task, which adds to the *heat stress* problem.

Effective body cooling equipment *can* alleviate the *stress* problem. This paper describes three different personal cooling systems, which have *been* developed and tested for use with the breathing apparatus and chemical protection suits.

1. Air ventilation system. A network of hoses attached to the inside of the chemical protection suit supplies fresh *dry* air to the entire surface of the body. Two different systems have been designed and tested. The SU 120 supplies breathing air and ventilation air from an external air line at a rate of 120 liters per minute. The SU 30 supplies ventilation air from a breathing equipment (e. g., CABA) with a maximum *flow* rate of 30 liters per minute.

Results *show that* the principal advantage of ventilating the suit is that it allows sweat to evaporate, which helps the body to lose heat without employing a sensible cooling system. The disadvantage of the SU 120 ventilation system is that it restricts movement due to the *air line connection*. That is not a problem *with* the SU 30 system, but it suffers from a relatively low ventilation rate and *short duration* time.

In spite of these disadvantages, these systems do offer the advantages of increased comfort of the test subjects and prolonged time available for work while wearing the chemical protective suit compared to the maximum *work time* without ventilation.

2. Water-ice vest. This system was also tested as a personal *cooling* device for use under a chemical *protection suit*. Test results indicate that *relatively* effective body *cooling* with the water-ice vest could be achieved only when the subject wears a closed circuit oxygen breathing apparatus having a duration time of 60 to 90 minutes.

3. Oil cooled tube suit. A system for providing whole body cooling with a *circulating* chilled *oil* as the cooling medium and *dry* ice as the cooling source has been developed and tested. Incorporated *into* the whole body cooling garment is approximately 100 meters of *tubing* through which a special *cooling oil* circulates. The tube suit is connected to a *dry* ice cooled *heat* exchanger which is *carried* in the back pack. The principal disadvantage of this system is the total weight of the system, especially when it is worn under a chemical protective *suit*. Nevertheless, a system has been developed which provides body cooling for *more* than 60 minutes.