

**From George Korch**

**26 Jan 04**

Working in a BSL-4 facility

One starts by removing all clothing and jewelry and then donning a pair of loose fitting cotton "surgical scrubs". Hopefully, you have also remembered to go to the bathroom because the process of getting out of the suit once you are inside is not amenable to emergency situations of this sort. The scrubs have a button-down blouse with jersey stretch cuffs, while the trousers have a cloth rope draw string. At USAMRIID, these scrubs are color-coded by size, so if you are a hulking, tall person, the suit color is brown. If you are of average size, they are green, and for smaller frames, the color can be blue or a yellow. These garments have generally been autoclaved from once to many times, since this is the method by which discarded clothing come out of the hot-suite. With greater frequency of autoclaving, the fabric begins to break down, and sometimes they become so fragile that a tug or a long stretch motion will cause them to rip apart. So, you look for a pair that seems sturdy, lest you bend over and have the seat give way. Socks are also a necessary part of the ensemble to keep the feet warm. These cotton socks have also been through the cooker a number of times, and begin to assume a "toasted" feel and look with time. This can all be done in the antechamber under BSL-2.

You now proceed into the BSL-3 side change room. You have entered your PIN code in to release the magnetic lock for this. The next step in the process is to cut about four 1 ½ foot strips of 1.5 inch wide black electrical tape, which will be used to tape down socks and gloves to the fabric scrubs. Putting your socks on, you tape them to the scrub pants to prevent them from slipping down and falling off your feet while walking around in the blue plastic booties of the positive pressure suit. You then put on a pair of surgical gloves and tape them to the sleeves of the blouse.

Each person generally has his or her own suit, and the suits of course come in several sizes from extra small to extra, extra large. The type of suits that we used for many years were the Chemturion suits manufactured by ILC Dover. I believe that they were about 20 mil polyethylene and weighed about 6-7 pounds. The visor or faceplate was of a heavier transparent plastic, and in the older suits, they cut off the peripheral vision. The newer suits now have about 300° view. You may be inclined to wipe the interior of the visor with an alcohol pad, since oils from your skin may have left marks on the visor from earlier wearings. The heavy plastic is not that supple, so adjusting and handling the suit to inspect for holes and general condition is not all that easy.

Once one visually checks the suit for anything like holes, then the next step is pulling it on. You put on hearing protection before starting out the process and then you put your feet into the suit. After you slip the headpiece over your head and hearing protection, you put your arms through the sleeves of the suit and then pull the zipper across the front of the suit. This zipper extends from upper left to lower right. The next step is to close the white gasket strip that overlies the zipper. You are now completely encased in a nearly seamless heavy blue plastic ziplock. Your hearing is impaired, and your vision is slightly

distorted, since the plastic visor as it bends does not provide absolute clarity. Also, in the older suits, you did have a sense of tunnel vision (largely corrected with newer suit models).

You are now ready to pull on a heavier butyl rubber glove and will use the remaining amount of tape to firmly tape the edge of the gloves to the suit. This seals off the suit interior as well, so that positive pressure air will now cause the suit to inflate. You have now also caused a reduction in tactile sensation, and as you sit in this large plastic bag, you start to exhaust the air that you captured with you in the suit. The temperature can begin to rise and it can get steamy inside the suit, so time to hook up to a compressed air line. You have about 5 minutes of breathable air in the suit however if there is a problem.

Before entering the actual BSL-4 you test your suit with a pressurized air line of the sort that occur in the maximum containment suite. You could have earlier used a kit that seals off the sleeves of the suit, closes off the exhaust ports and then inflated the suit to see if it maintains pressure like a large balloon. You can also use a soapy water solution sprayed as a thin stream on the suit from a squeeze bottle to inspect suspected pinholes to see if there is leakage.

There is a metal coupling that uses a ball bearing type of push in locking mechanism. The airline coupling hangs from the front right lateral torso as I recollect. Grabbing the tightly spring-coiled, yellow tubing, you snap your airline into the coupling and you hear the sound of air coming into the suit. There is an air stream that comes over your head and may also enter through arm and leg air delivery tubes. The sound is like when you first let air out of an inflatable air cushion. It is persistent but you eventually habituate to it and it does not hinder operations too much, especially while with hearing protection. But it is difficult to communicate verbally. There are groups that use microphone systems within the suit, but we found that reception was difficult and have not been standardly used.

You are now like the Michelin tire man. Depending on the airflow from the compressed air line, your suit bellows out and sitting down sometimes causes the suit to bulge up in front of you. The air is at ambient temperature, but has come from a compressor, so as the air releases, it can have a slight cooling effect.

Once you finish testing / inspecting the suit for pinhole leaks by using the wash bottle method described above, you are free to go through the shower doors and into the high containment suite. If you were unlucky enough to find a pin hole, you can slap a piece of the tape on it that I described before and be on your merry way.

You step from the shower room at BSL-3 where you changed into your positive pressure suit, through the chemical decon shower, closing the door behind you before you open the door to the actual hot suite space. You now need to don heavy plastic boots to protect the boots on the suit. You have just entered BSL-4. Each time you move around you are tethered to an air line, except when walking down a long hallway to get to other rooms within the suite. At USAMRIID, as an older facility, the walls are heavy concrete block,

with glossy epoxy paint sealants and few windows. It is actually a fairly depressing work environment, and it is best not to be prone to claustrophobia. We have had people that just cannot adjust mentally and you generally are able to identify them, or they self identify very early (like during suite training). At CDC, there is a wall of windows that allows others to see you operating in the suite and probably makes this an easier environment (I have only seen into the BSL-4 at CDC, I have never been inside).

Each time you click off a line, the air in the suit slowly lets out and you get that silence that makes you feel like you are sort of cut off from the world. Hooking back on line brings back that connection to air and therefore to the support system around you.

Performing delicate manipulations is obviously an interesting experience, but can be mastered. You are still of course doing manipulations, like pipet transfer of materials, under a biosafety cabinet, even though you are completely encased. So you are looking through a glass plate on the cabinet and as you sit with your arms stretched out in front of you performing these delicate procedures, you find your visor pushing up against the glass and frequently, your forehead against the inner side of the visor. Communication with others generally amounts to writing down quick items, hand signals and shouting really loud to get through your own stream of air and that of the other person. Generally, you crimp your airline to stop the rush of air, thus allowing better conversation.

You must be conscience of the position of your airline relative to equipment or items in the room that you do not want to knock over, as well as relative to other people working in the room, lest you tangle up lines. While there are a number of these lines within any given room, they have a limited reach, so you must also be aware of the distance that you have stretched the airline.

Exiting the suite requires that everything happen in reverse order. Boots come off and you step into the chemical decontamination shower. You pull a chain and a misting spray of detergent wafts at you from multiple nozzles above and running vertically along the walls. There is of course an airline in the shower that you hook up to. During the spray process, you take a brush that is located there and clean down the outside surface. There is a water spray that comes next. After about 5-7 minutes, you emerge through the other door. You now remove the heavy suit, taking gloves off first and then pulling open the gasket and zipper. As you take off the suit, you check to see if there are any "wet spots" inside the suit that could have indicated a pinhole and make a note of this in case there are. This should be reported to the safety office, and of course, it is a good idea to place a piece of tape on this newly identified problem.

The suit is hung to dry and all clothing comes off and deposited into a laundry bag for autoclave action. A standard water shower with soap and hair wash is needed. People can cough, spit and sneeze as you have mentioned, but in BSL-4 you have really not been exposed to the agent due to the suit, so this is really not needed.

You can now take your place back among society.

If there is an emergency in the suite, like the air lines go off, emergency supply air comes from tanks. Yellow flashing lights go off to tell you that you are on emergency air. You have about 30 minutes to get everyone out through the shower procedures. Under drastic emergency, we now have a digital message marquee in the suites to tell the participants what is happening and informs them what steps to take. There is a crash door for truly dire emergency.