

3M Transcript for the following interview: Ep 101 Maurice Gould – Protective Coveralls Part 2

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(R) Welcome to the 3M Science of Safety Podcast presented by 3M Australia & New Zealand Personal Safety Division. This is the podcast that is curious about the science and systems of all things Work, Health and Safety that keep workers safe and protect their health. I'm Mark Reggers, an Occupational Hygienist who likes to ask the questions. "Why?" "How?" And "Please explain." Whether you're a safety professional, Occupational Hygienist, someone with any level of WHS responsibility in the workplace, maybe you're a user of safety equipment, or maybe you're a bit of a safety nerd who finds this stuff really interesting – then this is the podcast for you.

Today, this is Part 2 about selecting protective coveralls with Maurice Gould. Welcome back, Maurice.

(G) Hello, Mark. Hi. Thanks for inviting me back.

(R) Well, we spoke about a lot of things last time. And there's still a lot more questions I do want to ask. But for those who may not have heard the first episode that we did together, can you please introduce yourself? Who are you? Where you from and what do you do?

(G) Okay, my name is Maurice Gould and I work for 3M, based in the UK and my area of specialty is chemical protective coveralls. My role, my job title is European Technical Specialist, which covers a whole array of exciting tasks to make sure that when a chemical protective coverall is out there on the market, it's been properly tested and approved, ready for use.

(R) So, last episode, Maurice, we spoke a lot about the different types and the hazards and understanding the form or the type of hazard that you're going to be working with. We spoke about breathability, but a very large risk and hazard in many workplaces is working with chemicals. So, when

it comes to chemical coveralls, what are the type of material tests that are conducted for this key hazard area?

(G) Most of the tests are carried out on all fabrics, regardless of the level of protection. Whether it's a Type 3, Type 4, Type 5 or Type 6 coverall, if the level of protection that's required is more than just against light splashes of chemicals, then a chemical permeation test is needed, as well as a gutter test - that's for penetration and repellency. I'll explain later more about the difference between a gutter test for chemical penetration and repellency, as opposed to a chemical permeation test. But, first let me explain a bit more about the physical tests. Basically, the physical tests of the fabric are to assess the strength of the fabric. This is to give the wearer an idea of the robustness of the fabric in their workplace. So, the physical tests include an abrasion resistance test, which is to assess how strong the fabric will be if it's rubbed against other surfaces. And this is particularly important for fabrics that have a polyethylene layer, because this is the part of the fabric that provides the most chemical protection - and maybe if we've got time, I could talk about the different types of fabric later on - but in the physical tests, we also have to do a puncture resistance test. And this is where you measure how much force is needed to push a spike through the fabric. Again, this is all to test the robustness of the fabric in the workplace. So, the puncture resistance test is relevant if you've got sharp areas, corners of tables, etc., that people are going to be walking past, you don't want the fabric to easily tear. Other physical tests are more clearly about the robustness of the fabric. So, we do a tensile strength test, which is where a sample of fabric is pulled at both ends to see how much force is needed to tear it. We do a trapezoidal tear test, which is similar to a tensile strength, but in this one, the fabric already has a small cut in it. We also do a flex cracking test, which is where a sample of the fabric is repeatedly crumpled. And this is supposed to replicate a wearer that's continually bending, for example, his arm or his leg to see if the fabric cracks at the fold, because again, you don't want any point of the fabric to become torn or fractured, and that's where any contaminant is most likely to go through. All of these tests have class levels that are based on a European classifications system and there are minimum levels that have to be reached. If a fabric doesn't meet those minimum levels, then it can't be used. The chemical tests also have a classification system, where there are minimum levels that have to be reached. For all fabrics, we have to do a test for penetration and repellency. These are known as a gutter test because the fabric sample is literally put into a half gutter at an angle of 45 degrees. The test is done against four standard chemicals; sulphuric acid at 30%, sodium hydroxide 10%, o-xylene and butan-1-ol. And we're measuring penetration and repellency. Penetration measures how much of the challenge

chemical goes through the fabric. This is done by weighing an absorbent piece of fabric that's been placed under the sample of our fabric in the gutter both before and after the test. Repellency measures how much of the challenge chemical rolls off the fabric into a beaker that you put at the bottom of that gutter. I said at the start that these gutter tests are done on all fabrics, but if the fabric is being used for protection against the risk of a spray of a chemical - that's a Type 4 coverall - or even a heavy jet spray - that's a Type 3 - then a chemical permeation test must be done. This is a much more complex test and what it's doing is it's measuring the time it takes for the challenge chemical to break through the fabric. Again, there are class levels for this test, so that a wearer can compare one fabric to another. The minimum time is 10 minutes for a Class 1, so if you get breakthrough in less than 10 minutes, the fabric can't be used for that type of protection. The maximum for a permeation test is Class 6, and that's greater than 480 minutes, which is equivalent to a typical working day. And you also do the test on the seam of the fabric. So, it's not just a permeation test through the fabric. It's also through the seam.

(R) You mentioned that last episode about how critical the seams are. We can't forget about the seams, because that's most likely going to be the weak point if it's not joined, sewn together to meet that appropriate testing criteria, as you have mentioned. Now, so really, there's no limit to the number of chemicals that could be tested with the coverall. So, if somebody wants to check a specific chemical against, say, one of our coveralls, is there a place they could go to try and see if that test has been done to check the suitability?

(G) Yes, certainly. I mean, we've done a lot of chemical testing. There are many chemicals that we've not tested. It's impossible to have tested all of them, but we do have a library and that can be accessed at <http://go.3m.com/CHTL>.

(R) We'll make sure we put that link up on our blog post to make it nice and easy for people in case you've just missed the website there. But, as you say, there's a whole bunch there. It's not going to be everything because there is an abundant amount of chemicals that could be found in the workplace, but a really good starting point. So, that's chemical coveralls, and you've given a really good overview of some of the tests that these products have to go through. Are there other tests that may be done to different products for other types of hazards? You sort of alluded very briefly to biohazards and microorganism hazards last time. Is there anti-static tests and nuclear particles? If I recall, what I've read in the past is correct?

(G) Yes, very good. There are tests for all of those, so infective agents or microorganisms, biohazards. And there are four different tests that can be done to test how well a fabric may protect against that sort of hazard. Obviously, this has been particularly relevant with the coronavirus pandemic. The most relevant of those tests is one called EN ISO 16604 and that's a test that's carried out on the fabric using a blood-borne pathogen. If a fabric meets the minimum requirements for a biohazard test, then the coverall will have a special shield on the neck label symbolizing this. And it will also have the letter 'B' after the type number, so you might see Type 5B, Type 6B, Type 3B and that indicates that as well as the Type protection, it should also offer some level of protection against infective agents. You mentioned nuclear particles and yes, a coverall can be certified for protection against radioactive particulates. This test is actually based on the Type 5 test data for dust particulates. A claim for radioactive particulates, however - and this is a really important point - doesn't mean that the coverall will protect against radiation.

(R) We've done some previous episodes about ionizing radiation and non-ionizing radiation last year. So, yes, there are different types of radiation, so just to be really clear, this is radioactive particulates. It's not stopping the radiation, but once again you really have to understand the hazards and what you're working with or in the environment you're working in, to have that selection right on point. Anti-static? How does that work with coveralls?

(G) Yes, anti-static is a key hazard to protect against. Many fabrics are treated with an anti-static treatment. This means that if they meet minimum requirements that are set out in an anti-static standard EN 1149 then they may reduce the likelihood of static electricity building up on the coverall which may reduce the risk of a spark, causing an explosion. So, anti-static treatments on fabrics - really important and a lifesaver in many cases.

(R) Are there other types of treatments that coveralls may be given to give other sort of characteristics that may be desirable in certain work environments?

(G) Yes, I've mentioned the anti-static treatment, but there's also treatments that can limit the risk of the fabric igniting or, if they do catch fire, of the flames spreading across the coverall. But for a coverall to be truly flame spread resistant, other parts of the coverall than the fabric, have to be tested as well. So,

for example, this might mean that the coverall has to be made with threads or with cuffs and zippers that are also flame retardant. So, not just the fabric, but also the other component parts that make up the finished product. And then there's also what we call an AR or Alcohol Repellency treatment. There are generally two types of fabrics. There's polypropylene SMS or fabrics that are laminated with a polyethylene film. A laminated fabric is generally better at giving chemical protection than an SMS type of fabric, but they're also generally less breathable, and so many people prefer wearing SMS coveralls, which can be more comfortable. It's possible to treat these SMS types of fabrics with a special treatment to improve the level of chemical protection they may give, particularly against alcohols and solvents. So, that's an AR treatment that can be given to the fabric.

(R) Now, you mentioned SMS and for those familiar with protective coveralls, might have heard of SMS, or SMMS, or SMSS. What does that actually mean? I'm sure that's telling us something for those in the know. So, what is that? What's that all about?

(G) Okay. These acronyms are used to describe the way that the polypropylene fabric has been made. So, the 'S' stands for 'spun bond' and the 'M' for 'melt-blown'. And as you said, you can get different combinations of these. So, for example, an SMS fabric is a sandwich of two layers of spun bond polypropylene with the middle layer of melt blown polypropylene. And SMMS has two layers of spun bond, then a layer of melt blown, then another outer layer of spun bond. And generally, the spun bond layers give the fabric the physical strength and the durability and the melt-blown layers the chemical protection.

(R) Now I know there's lots of different materials coveralls can be commonly made from, and we've spoken a lot about the different ratings. So, depending on what product or rating is to be desired, what are some of these other common materials that people may come across?

(G) Okay, so polypropylene is the most common component of coveralls. Many coveralls are made from polypropylene because it's lightweight and very breathable, but they can also be quite complex in the way they're constructed with different layers of melt-blown or spun bond to change the physical or the chemical performance of the fabric. There's also microporous PE laminates. These are coveralls that are made with a polypropylene layer on the inside - so that's nearest to the wearer - with a polyethylene layer on the outside. And as I said earlier, these do tend to give better chemical

protection, but they may also be less breathable. There's also non-microporous polyethylene laminates, and the size of the micropores can be altered to make the polyethylene film more or less breathable. So, a microporous PE laminate can be quite breathable, and we've got some very breathable coveralls and non-microporous PE laminate is less breathable, but that sort of fabric with the lower breathability levels might be more suitable for a Type 3 or Type 4 coverall where they need to pass the chemical permeation test that I talked about earlier. And then the fourth type of fabric is high density polyethylene (HDPE). And one of the biggest coverall suppliers outside of 3M is DuPont, who make coveralls out of this high density polyethylene.

(R) So, a range of different materials people may come across depending on the characteristics they may require. Now we've touched on it a couple of times, or I've alluded to about how important the seam is as being the weak point. Now, are there different types of seam constructions that you might find on different types of coveralls, depending on the performance that's required?

(G) Absolutely, the basic seams are sewn with a simple overlocking stitch, so that gives the cover all a high degree of strength, but depending on the type of fabric, it may be easy for liquids to leak into the coverall through the seams. So, sometimes we use a length of binding over the seam. So, that's just a narrow length or a narrow strip of fabric that's sewn over the edges of the seams. For a Type 3 or Type 4 coverall where the coverall may be subjected to heavier sprays than a Type 6, the seams usually have a layer of chemical protective tape that's applied to the outside of the fabric. So, that goes over the stitch seams and actually, for a Type 3 or Type 4 coverall the seams have to have that chemical permeation test as well as the fabric. So, without that chemical tape, it would just immediately pour through those seams.

(R) I've touched on a couple of times about the breathability from a comfort and heat stress point of view. But how is the breathability of a coverall evaluated? Because it is such a critical aspect when thinking about the selection and what may or may not be suitable for a work environment and task?

(G) You're absolutely right that the breathability and the comfort of a chemical protective coverall is critical. I've always been surprised that generally there are no requirements for breathability referenced in any of the standards. As I've said, breathability varies enormously, depending on the actual fabric that's used in a coverall. Generally speaking, an SMS coverall is going to be more breathable than a

laminated Type 6 coverall, which in turn is generally going to be more breathable than a laminated Type 4 coverall. And a Type 4 coverall is probably going to be more breathable than a Type 3 coverall, because the fabrics are so different. But having said that, we are continuously working to develop new Type 3 and Type 4 fabrics that are more breathable. In recent years, we've seen how critical the breathability of a cover all can be, particularly with the Ebola crisis in West Africa. Breathability is measured in a number of ways. At 3M, we tend to favour a test method that's ISO11092 and this is a measurement of the thermal resistance of the water vapour resistance of the fabric. It's also known as the sweating, guarded hotplate test, because what it tries to do is to simulate the heat and moisture transfer process close to the human skin. And the test gives a value that's called the Ret value for a fabric. And there's an institute in Germany called the Hohenstein Institute that have developed a table to give some meaning to those values. Where, for example, they say that if a fabric has a Ret value of between 0 and 6, then it's described as being very good or extremely comfortable, and comfortable for higher activity work rates, whereas at the other extreme, a Ret value that might be more than 30 is considered to be not breathable and may be suitable for use for only short periods of time. And there are different levels between that, 0 to 6 and the over-30, with different performance ratings in terms of both the breathability and also relevance to how long they might be suitable to be worn in the workplace.

(R) Certainly something for people to keep in the back of their mind when we're looking at coveralls for different tasks and how long they're actually wearing a coverall. But are there other things? We've covered a lot, are other things that workplaces should be aware of when it comes to selecting coveralls in general?

(G) Yes, I mean, I'm glad that you asked that question because, you know, so many people think that all coveralls are the same. We've looked at some of the key considerations, such as the level of protection that's required. So, whether it's splash or spray or jet spray. We've touched on some of the additional protective properties, such as biohazard, anti-static, flames spread resistance and the special alcohol repellency treatment. And we've looked at the breathability of fabrics as a way of comparing the comfort of one coverall compared to another. But there are many other factors that need to be considered and you know, an obvious one, but one that's often overlooked is making sure that you choose the right size. If you wear one that's too small, it's more likely to tear with movement. If you wear a coverall that's too big, you could actually be causing additional hazards, such as trips or part of the

coverall getting caught up in machinery, so size is really critical. But other features to look out for things like elasticated cuffs or knitted cuffs? The size and the fit of hoods? Or even whether they have a hood. Two-way or one-way zips? Storm flaps over the zipper or not? Some of these might be considered to be comfort factors rather than protection factors, but I'd say that they're just as important, given the length of time a coverall may be worn. And we know from experience that if a worker isn't comfortable in the coverall that they're wearing, they're going to take it off or they're going to, you know, we've seen people take the top part of the coverall off and just tie the arms around the waist. The legs are protected. They're upper part of the body isn't.

(R) That comfort, criteria or comfort consideration goes across all types of PPE. If it's not comfortable or bearable enough to do the task, they going to take it off, as you say or not wear it correctly. When it comes to wearing coveralls correctly, when it comes to the donning and doffing, are there sort of key things that listeners should be aware of when going through that process?

(G) Yes, and I think over recent years we've seen an increasing emphasis on the importance of following the correct donning and doffing procedures, particularly with doffing to make sure that the wearer doesn't contaminate himself, when you're taking off the coverall. Putting a coverall on is relatively straightforward; making sure that it's the right coverall for the intended purpose, the right size, checking to make sure that it's not damaged before you put it on, removing your shoes or boots before putting it on and then taping it up where necessary. So, for example, taping at the wrists over gloves, taping at the ankles, taping up the storm flap and if a full-face mask is worn, making sure that it's taped around the hood. Taking a coverall off is more tricky, and it's... really I can't stress this enough, it shouldn't be rushed. Wherever possible, a second person should try and assist with removing the coverall, to minimize the risk of contamination. And I think the best thing is to suggest or recommend that listeners go to our website, where we've got videos on how we recommend the donning and the doffing of a coverall should be followed.

(R) We'll put some of those links up again on our blog post, for those donning and doffing videos. I know in my prior life, working in the asbestos removal industry, you're taking the time because there's that risk of, you know, contaminating other parts of a workplace or an environment, if they're not doing it the right way and rolling it down. So, some really important stuff. You're wearing that coverall as a barrier, but if you don't take it off correctly and be considerate of that, you're going to spread that

contaminant and potentially create more of a hazard or a risk for yourself or other workers, or take stuff home to your family as well, which is what we're trying to avoid. Like most PPE, it's fantastic to what we've spoken about, where it may be suitable. Are there environments or applications where coveralls would not be suitable?

(G) Yes, definitely. I think what I've tried to highlight is that it's not a matter of one coverall being suitable for all applications and that you do need to do a proper assessment, to make sure that you're selecting the right coverall, suitable for the particular specific job or application. And yes, there will be some applications where a coverall may not be suitable. So, for example, when the hazardous contaminant is unknown, or when the concentration or volume is unknown. In conditions of exposure to flames or excessive heat or certain explosive or flammable atmospheres. Maybe in areas where the protection levels are beyond a Type 3 or Type 4/5/6 level of protection is required. So, you know, maybe if you wanted protection against gasses, then a liquid protective coverall isn't going to be suitable. Don't use a Type 5/6 suit where you actually need a Type 4 coverall. And don't use a coverall or a disposable coverall in areas where there's a high risk of mechanical damage. So, things like abrasion or cuts or tears. You know, a chemical protective coverall, that's a Type 6 may not actually be suitable or withstand that type of damage.

(R) It really does come back to understanding what's the hazard? What the risk, in making appropriate selection, whatever that may be, not just in the coverall space, but whether it's respiratory or eye or face protection. I can't stress that enough, it really is understanding what those hazards and risks are. We've spoken about a lot, but to tie this all up as one key final takeaway point - not to put too much pressure on yourself, there Maurice - but what would you want to leave with our listeners today?

(G) I think carry out a full assessment of the potential health and safety hazards that are being faced in the workplace and then select the most appropriate coverall - and other PPE - to protect yourself or your workers, whichever it may be.

(R) And for those who want to get a bit more information on coveralls in general, where would be a good place they could head online?

(G) Yes, go to our website: www.3m.com.au and from there, if you select Personal Protective Equipment and then Protective Apparel, you can see the full range of 3M coveralls.

(R) And for those listeners that may have some nice, curly, juicy technical questions for you, which I know you do quite enjoy sinking your teeth into, what would be the best way to get in contact with yourself.

(G) Probably best by email, so email address: mgould@mmm.com

(R) Excellent. Well, thank you so much for your time again today, coming in and filling us all in about these important aspects about selecting protective coveralls.

(G) Okay, it's my pleasure. I hope it's been interesting.

(R) Well, thanks for listening, everyone. You can get in contact with a show by sending an email to ScienceofSafetyANZ@mmm.com if you have any questions, topic suggestions or you would like some assistance in your workplace when it comes to the appropriate selection of maybe protective coveralls or and other type of PPE in the workplace, 3M are certainly here to help. You can also visit our website <https://3m.com.au/sospodcast> for further resources on protective coveralls, as well as a transcript of the chat Maurice and I have just had, as well as all the other previous episodes we have released. Be sure to subscribe, rate, review and share through Apple Podcast, Spotify, Google Podcast or wherever you get this podcast from.

And as Wayne Dyer said "Conflict cannot survive without your participation." Thanks for listening and have a safe day.