

3M Transcript for the following interview: Ep 84-Respiratory

Protection Factors

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Welcome to the 3M Science of Safety podcast presented by 3M Australia and 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 am Mark Reggers, an occupational hygienist, who likes to ask the questions Why, How, and Please Explain. Whether you are a safety professional, occupational hygienist, or someone with any level of WHS responsibility in the workplace, maybe you are a user of safety equipment or maybe you are a bit of a safety nerd who finds this stuff really interesting, then this is a podcast for you.

(R) Today, we're talking all about respiratory protection factors with Mike Clayton. Welcome Mike.

(C) Good morning, Mark.

(R) Good morning for you, good evening for me, but we are chatting from different parts of the world, so great to use technology in such a way. But for our listeners, can you please introduce yourself? Who are you, where are you from and what do you do?

(C) Okay, so I'm based in the UK supporting 3M across EMEA (Europe Middle East Africa), I'm involved in supporting customers with their selection and implementation of personal safety solutions. So, in this role, I visit customers see their challenges, make recommendations, help with training etcetera. The goal for me is really to make sure that they can use the PPE and get the most out of that investment. So, that's what I do with 3M. But I also have some other side activities, and with those I chair the British Safety Industry Federation, Respirator Group, and as a member of the British Standards Respiratory Committee, I provide guidance and expertise to develop the British, European and International Standards. As regard to fit testing, I also hold the position of the assessor and technical advisor to the UK Respiratory Fit Testing Competency Scheme. I've been with 3M about two years now. My previous career was at HSE and that's the UK's health and safety regulator where I was the technical team lead. So, in that role, I managed research projects, provided technical support to developments of HSE regulations, policy, guidance etcetera. And also, involved in incident investigations and that's ... the sad part of that job, where I saw the effects, the results of what happens when PPE goes wrong. And just a final word is that there is a great international society called the International Society for Respiratory Protection. We have members over in Australia, New Zealand, and I was the president of that society for two years in 2014 to '16.

(R) So, sounds like you live, breathe respirators every day and for many years by the sounds of it.

(C) I do, and my wife complains at me when I look at these DIY programs and see people wearing respirators incorrectly and I start shouting at the TV screen and my wife goes, "Calm down, calm down." So, yes, I do live and breathe it.

(R) Love the passion. I'm much the same and yes, my wife says the same thing to me as well strangely enough. I don't know if that's a good thing or a bad thing. But

we are talking about respiratory protection factors. So, when it comes to respirators, what is a protection factor?

(C) Well, that's a good question and it's one that does cause a great deal of confusion. Put simply, it's a number that reflects how much protection a respirator is offering or is capable of offering to the wearer. So, let's take a protection factor of ten, and basically what that means is that it's reducing the wearer's exposure by a factor of ten. So, you have a tenth of the concentration of the contaminate that's outside the respirator inside the respirator. For our listeners who have come across protection factors before, they may have done so when they've been selecting respirators. But there's many types of different protection factors, which I'm sure we'll explore this morning.

(R) Which yeah, is actually one of first my questions I wanted to ask, because I've heard of these different terms; assigned protection factor, workplace protection factors, simulated workplace protection factors, effective protection factor, program protection factors, nominal protection factor, minimum required protection factors. So, they've all got that term 'protection factor' at the end of it, but different words at the start of it. What's the difference or what's the similar nature of all these different terms?

(C) Well, yes, it certainly can be confusing but let's just talk about how they're broadly calculated first. So, a protection factor, like I mentioned, is the concentration of contaminant outside the respirator, divided by the concentration of contaminants inside the respirator, and that sounds a simple equation, but obtaining the data and the conditions under which it's obtained or collected can be extremely difficult and challenging. And the different protection factors that you mentioned really refer to how that protection factor has been calculated. But let's just start at the first one. You mentioned nominal protection factor or NPF. So, a nominal protection factor is basically ... that's the performance specification set out

in a particular standard. So, we have ANSI, New Zealand Standards, we have Australian Standards we have the European Standards and they set out a requirement for the protection that needs to be achieved by a certain class and type of respirator and that requirement in the standard will set a certain performance level and that's referred to as the nominal protection factor. So, that isn't measured. That's like a criteria. And then we have the term assigned protection factor. Now, this is a protection factor that we tend to use when we are selecting respirators and this value has been determined from a dataset. Now, that dataset would've been achieved from conducting studies in the workplace on how effective that respirator is. And so, in that type of activity, you would identify the workplace site, identify volunteers you would then probe the mask to take a sample from inside the respirator, a sample outside the respirator and let the worker go about their normal activities. And you would measure the concentration inside the mask and outside the mask during the workplace activity and that would be measure of workplace protection factors. But quite often, actually doing these tests, this research in the field can be very challenging and so often you can do this in the laboratory and that's called a simulated workplace protection factor. And then, you can take that data and the results of the data, you calculate the 5<sup>th</sup> percentile and that's generally considered to be assigned protection factor, which is then what we use as users to select respirators that hopefully will deliver and achieve that protection in the workplace. You mentioned another couple as well. One was the effective protection factor. Now, that is the protection factor in the workplace that's been measured but occasionally, people don't always wear their respirators correctly or they may not wear it for a period of time. So, that would reflect that misuse for want of better words. And then there's also something called a program protection factor. Now, if you've invested in respiratory protection and you want to really understand what level of protection that is achieving, then you can conduct a study which would determine the effectiveness of your own particular respirator program, and that's called a program protection factor. So, there's quite a lot of them, but the ones we really need to concentrate

on when selecting respirators is the assigned protection factor or often in some areas around the world, we refer to that as the minimum & required protection factor.

(R) I know that last term you just used, Mike, minimum & required protection factor is the one actually used in our Australia New Zealand Standard, so quite familiar with that one. But where do workplaces go to find out what assigned protection factor ... which is that main one that you mentioned ... that they should be using for the type of respiratory protective equipment they may have in the workplace?

(C) Okay, well you mentioned your Standard 1715 which of course does set out the minimum & required protection factors related to the different types and class of respirators. And similarly, other standards and guidance like we have here in the UK ... we have HSG 53 which sets out the assigned protection factor for each type and class of respirator. So, you will have a value for filtering face piece, FFP1, FFP2, FFP3, a value for half masks with P1, P2 or P3 type filters. Then a value for supplied air and for powered respirators etcetera, and you can see those build up and in European Standard EN529, we also have a full list covering the whole range of different types of respirators, breathing apparatus and the types and classes and they set out the assigned protection factors. But not all countries use assigned protection factors. Some still operate on the nominal protection factor which I mentioned earlier, which is the specification requirements built into the performance standard.

(R) So, we've got these different assigned protection factors that there's different standards. Obviously, you've mentioned some of those UK ones. In Australia and New Zealand, we've got that 1715. So, how is that number for that different class or type of respirator actually used in selecting a respirator for a task?

(C) The first thing you need to do in your workplace is really to understand what your hazard is. So, you need to understand the nature of that hazard, are you talking particulates or is it a gas or vapour hazard, and they need to understand how much you've actually got. And so, if you then measure the concentration of your contaminants and then refer to your national published occupational exposure levels or occupational exposure standards or workplace exposure limits or workplace exposure standards, they all mean the same thing, just slightly different titles there. And then, you need to look at how much you would then need to reduce your contaminant by to be able to bring the worker's exposure down below that level. So, for example, if you've measured your concentration and it's ten times above the workplace exposure standard, then you need to select a respirator which has got an Assigned Protection Factor (APF) of at least ten.

(R) I know in our Standard in Australia and New Zealand, that's that required & minimum protection factor. So, when workplaces are working out what is the amount of reduction required, so what is the minimum amount to get us right down to that number. Now, obviously, we would like our workplaces and workers to be well underneath that line, but in high level principles, what's that minimum amount to get us down underneath that particular number there? So, what would be the situation if a workplace doesn't actually know what the exposure level is to work out what that minimum amount of reduction that is required? How do they approach that situation?

(C) Well, there are a number of other mechanisms that one could follow, one of these would be to see whether there's any guidance that's been published that provides the type and class of respirators that should be appropriate and adequate in that situation. And secondly, there's a process call controlled banding, which is one that we here in the UK introduced to really help those small and medium enterprise who may not have the capability to be able to really take those measurements and understand what their hazards are, and this is based on

understanding the amount of substance you use, it's volatility or its dustiness, really to understand what's the likelihood of creating an airborne hazard from that task or that application. And then, depending on the nature of the substance, the hazard ratios, the hazard statements, the risk statements or risk phrases for those materials, then you can select an appropriate respirator that should offer that adequate level of protection.

(R) We've mentioned a few times on our podcast, control banding. So yeah, for those that don't know what the exposure levels are, that's one approach, or you may be looking at maybe a supplied air respiratory solution when we start talking about unknown levels of contaminants. But to go back, Mike, to the setting of the assigned protection factor, so you mentioned they base them on workplace protection factor studies. Is that correct? That's how these bodies set the number?

(C) Well that again is a very good question and one would assume that all these regulatory or standards bodies would set the APF following the same principles, but unfortunately, that's not the case. So, let's start off with the US. They have mainly set their APF based upon workplace studies. The UK followed a similar approach to the US and based ours on workplace protection factor studies, but other countries took a different approach. They may have applied a safety factor to the nominal protection factor, or a mix of all the workplaces and safety factors. And that has resulted, unfortunately, in us having a lack of harmonisation on APFs. And so, it seems strange that if you're selecting a respirator in Europe ... take UK, selecting a respirator in UK, we may end up with selecting a respirator to one that can be used in Germany, one that can be used in France, one that can be used in US, to potentially one that can be used in Australia. But it's the same respirator, it's the same performance that that can achieve, and this is something that we've been striving for in our discussions at an international level during the ISO Standards development. We've developed a suite of new standards and one thing that we've

been trying to tackle there is to bring some harmony to how assigned protection factors were calculated.

(R) That's the challenge with any international approach; different countries have different approaches and we get sometimes these different numbers. And I know from an Australian point of view, a lot of the industries will look around the world and see what numbers are being used and it can be really quite confusing. But what's the concern if a country or a standards body sets an assigned protection factor quite low versus what's the risk if they're actually set quite high?

(C) All right, let's take the situation where it's set too high. Now, that could have the potential of assuming that a respirator is offering more protection than it actually can provide. The result of that of course is that our workers may be more exposed than we believe they are. So, that's something that we don't want to happen. We want to set those APFs so they're at the right level and we've got some confidence in them. However, if you set them too low, then again, that's not good, because you can be pushing workplaces to select different types of respirators higher up the assigned protection factor numbers and it may reduce the choice of what's suitable for their particular application. And as you go further up, if you think about moving from a disposable filtering face piece to a half mask to a full face mask, as you move up, there's more training required, there's more care and maintenance required etcetera and so we need to pitch the APFs that are just right to give us confidence that yes, they are protecting the workforce and secondly, they are the most adequate and suitable type of respirator for the application.

(R) Now, achieving this assigned protection factor for whatever class and type of respirator, are there any provisos or provisions that it is expected that a workplace or workers have in place to be able to achieve these numbers?

(C) Yeah, well if you think about the definition of assigned protection factor, in the European Standard EN 529 we have a definition and there's also one in the OSHA regulations. In essence, they're all saying the same thing, that the APF is the level of protection that a respirator can provide, provided it is selected correctly, it is used correctly, it is maintained correctly. And so, the wearer should be fit tested, they should be trained, they should be supervised, and the respirator filters changed on time, it's cared for, it's maintained, it's cleaned, etcetera. So, these numbers apply to when you are implementing an effective respiratory protection program. So, if you were to fail in any of those elements like not conducting fit testing on tight-fitting respirators or not replace the filters when they have reached their end of service life, then you may not be achieving the assigned protection factor that you are hoping to achieve.

(R) Can you tell what assigned protection factor may be getting achieved in that situation where it may be a worker who's not clean shaven or haven't been fit tested to get that confirmation a fit is able to be achieved? What level of protection may be provided then?

(C) Well, a good question, and anyone's guess really. As mentioned before, it can be very difficult to measure how effective your program is. 20, 30 years down the line, if someone has not contracted any respiratory illnesses, then you can say, "Well yeah, I think my program works." But we can't do that, so the best we can do is really to concentrate on implementing an effective program. So, that means we need to really concentrate on selecting respirators for the workforce, considering the requirements of each and every individual, making sure that it's suitable for the task, making sure that it's compatible with other PPE that's worn, making sure that someone's trained, someone's responsible for making sure the wearers wear respirators and care and maintenance etcetera. And so, like I've just said, it's very difficult to actually measure what you're actually achieving so we need to do our best and implement the best we can in all the elements of the RPE program.

(R) I know when I'm doing training, I always talk about, "You've got to put all these things in place that you've just mentioned to have a high level of confidence that that assigned protection factor is being achieved, if not a lot higher than that." But we need to do those things each and every time to have that confidence as an individual or for our workforce as well. Now, there's this other term 'a fit factor' which comes up quite often in the fit testing side of things. So, what's the difference between a protection factor and a fit factor?

(C) Well, a fit factor is the output of the fit test and in a fit test, you are only measuring the performance or the degree of fit of that face piece seal on the wearer. You're not looking at any of the other aspects of the performance of that respirator. And so, if you're to take a powered respirator, for example, with a tight-fitting face piece: in a fit test you would just measure the face piece on itself to measure the degree and quality of that fit. And then that's referenced to the pass/fail criteria of the fit factor requirements in your particular region. When you look at the performance of the whole piece of the powered respirator, of course then you've got the turbo unit, you've got the high efficiency filters and you've got that flow that's going through the respirator, offering that higher degree of protection. And so, they're very different, but one of the terms that people do confuse particularly when fit testing is relatively new.

(R) So, I know sometimes we'll get asked a question down here in our area of the world that, "Gee, I've done a fit test and my worker got a really high fit factor. That must mean they're actually achieving a very high level of protection." But from what you're saying, that isn't the case because they're similar in inside outside, but it doesn't actually correspond directly to the workplace. Would I be correct in that little statement there?

(C) Yes, because under a fit test, it's a set activity that you follow during the fit test procedure, and you do that under controlled conditions and it's very different to the workplace. In the workplace, you may be working a lot harder, breathing a lot harder, more physical work, there's different ambient temperatures etcetera. That all will impact on the potential performance that that respirator can offer.

(R) So, Mike, to try and wrap this topic up, because we've used a lot of terms and a bit of information, but to leave a key takeaway point with our listeners, what would that be when it comes to respiratory protection factors and using them in the workplace?

(C) Well, as an occupational hygienist, I'm sure you will know Mark that PPE comes at the bottom of the hierarchy of controls, with elimination at the top and substitution, engineering, and administration controls, and then finally PPE. But as we all know, PPE, respiratory protection is essential in many applications. So, we've talked about numbers. We've talked about data. We've talked about measuring performance, but the key points I would like to make is that ... and I've said this already I believe ... it can be very difficult to measure the actual performance in use. It would be great if some time in the future, and I'm sure we'll be there in a few years to come, if we had real time monitoring of the protection that the wearer is getting. But until that time, we need to yes, consider the numbers when we are selecting respirators, but when we are wearing them, we need to really focus on ensuring that we train our workers properly, they are clean shaven, and we certainly look after our RPE. When we use RPE, we're making an investment to protect people, so of course, we want to make a return on that investment and so, the return in the case of respirators is keeping our workforce and healthy as possible.

(R) And I always talk about PPE being at the bottom. We are relying on those behaviours to protect the workers. As you say, we can talk about this data and the

science behind all of it, but it all comes crashing down if the worker doesn't put it on their face and put it on correctly and use it each and every time. We're relying on that to happen for protection to occur. So, I think it's a great summary there, Mike. Thank you so much for that. But for our listeners that may want a bit more information about respirators and these different protection factors you've mentioned, where's a couple of places they can head online, potentially?

(C) Well, the first place to go is to go to your national standards. So, look for Australian Standards, Work Safe Australia, state and territory regulations, but also internationally. NIOSH have some good data, some good resources, OSHA, ISO and of course, HSE. But then of course, 3M. Go to the 3M website where there's a great resource across the whole range of PPE and there is content on there about protection factors. So, head down that way.

(R) Excellent. And if listeners would like to get in contact with yourself, what would be the best way to do that?

(C) I'm on LinkedIn, so search for Mike Clayton, 3M, on LinkedIn and send me an invite. It'd be great to talk with your listeners.

(R) Well, thanks for your time, today, Mike. Much appreciated.

(C) You're welcome, Mark. Great to talk with you.

(R) Well, thanks for listening, everyone. You can get into contact with the show by sending an email to [scienceofsafetyanz@mmm.com](mailto:scienceofsafetyanz@mmm.com) if you have any questions or topic suggestions or you need some assistance in your workplace around the appropriate selection, use and maintenance of respiratory protective equipment, 3M are certainly here to help. You can also visit our website [3m.com.au/sospodcasts](http://3m.com.au/sospodcasts) for further resources on respiratory protection factors, as

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