Behind the Wheels Podcast
Episode 1: Industry's Darkest Secret

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You're listening to Behind the Wheels with Doug Mason, Dave Walters, and Mike Yagley. This is a show where we talk about heavy truck and medium duty axle ends. Doug, Dave, and Mike bring close to 100 years of experience and expertise in the transportation business.

Join us once a month to learn new things about axle ends. Sponsored by Alcoa® Wheels, the global leader in aluminum wheel innovation.

MIKE YAGLEY
Welcome to Behind the Wheels. This is Mike Yagley.

DAVE WALTERS
Dave Walters.

DOUG MASON
And Doug Mason here.

MIKE YAGLEY
So we're going to have this first episode where we're going to focus on wheel offs. Wheel offs are of huge industry interest. And so, let's just start off with Dave, what is a wheel off?

DAVE WALTERS
There's really two types that we can talk about, but today we're going to focus on more of one. But the two types are really when the dual sets, when you have a bearing failure, a hub failure, and the wheels come off as a dual. The other one will be where the nuts or the studs break or lose tension and the wheels will basically come off. So, there's really two types. And we're focused today just mainly on the wheels falling off the hub.

MIKE YAGLEY
So we've all seen wheel offs, plenty of videos online with wheel offs. Any anybody here had real world experience with a wheel off?

DOUG MASON
Yeah, I think it's good to tell a story about when I first started with the industry and the heavy truck industry. People talked about wheel offs. I really couldn't understand how that could happen. I came from a past car light truck industry and we really did not hear about a wheel off ever.

DOUG MASON
If that would've happened, it would have been the end of something. But I was driving down the road one day on Telegraph Boulevard and I was in a Jeep Commander. Pulled up to a stoplight and it's normal. Guy pulled up behind me sitting there. All of a sudden, I got rear-ended. I thought for sure there had been a multiple car crash, kind of a whiplash situation. I looked in my rear-view mirror and it doesn't look like there's any accident behind me. And the guy is looking at me shaking his head like, "I didn't do anything."

DOUG MASON
So I jump out of the car, he rolls down his windows, pointing into the boulevard. And sure enough, there's this large commercial vehicle wheel sitting there. And he goes, "Hey, that truck that just went down the road the other way, he lost his wheel. And somehow it came between us." And it nailed the back of my Jeep. It made a huge impression. Obviously, it wasn't going that fast because in those videos, the damage that can be done. But so yeah, it's a real-life situation.

DAVE WALTERS
I can add that I'm an active member at TMC and one of the shop talks, the subject of wheel offs came up and we call it the darkest secret in our industry. And at the meeting you have the mega fleets sitting, they're all there. And the moderator said, "Well, how many of you guys had wheel offs?" And there wasn't a single hand raised. But if you go into the back room and talk to some of these major fleets. And I talked to a major fleet one time and he said, "Hey, we kept it under a hundred wheel offs this year. It was a pretty good year." And you thought, wow. So, they're alive and well. So today we're going to address why they happen and how you can prevent them.

MIKE YAGLEY
So to understand a wheel off, you really need to understand the engineering theory around the wheel axle end. And when engineers are designing that axle end joint, that bolted joint is actually... We use clutch theory. And so, if you're a mechanic and you think about a clutch, really what's critical there is the friction between the hub and the wheel. What is really holding it together are those studs and the studs act as springs.

DOUG MASON
Yeah. They create a force, like you're saying, they create a force holding it together. And I like to think of it this way, just visually in your mind. I don't know how many out there have kids or remember playing with blocks as a kid, but when you had a line of blocks together and you wanted to pick that whole block up, you had to put a certain amount of force on each end and you could pick up six, seven, eight blocks at a time. Well, the reason they were staying together is because there was enough friction force between by the force you were pulling together and that's really kind of how the theory works. You're pushing the wheel and the hub surface together with, as you said, the stud acting as a spring with the nut.

DAVE WALTERS
And in the industry, when we go out and do a lot of training for the mechanics in the industry, we always talk about how important the stud is because most people don't understand that stud stretches every time that you put it under, again, clamp load. But in the real world they can't measure clamp load, so they have to measure torque. So that's why we tell them, every time you torque that nut down, you're stretching it to a certain point. If you stretch it too far, you yield it and it basically is not going to come back and you're going to have issues.

MIKE YAGLEY
That's like one of those springs. If you've ever taken a spring, pulled it apart, and it no longer springs back together again. That's a spring that has hit yield and that's a spring that will not come back to its original shape and that is the problem. When you over torque a nut, what you're doing is you're taking that spring, pulling it completely apart where it is no longer having any force to hold the whole thing together and you're losing that clamping force is what we call it.

DOUG MASON
And that clamping force is significant as you can imagine. You're trying to hold a wheel onto a commercial truck and what you have to carry, the loads that you can carry, an 80,000-pound load capacity typically, every one of those studs has about 45,000 pounds of clamp force. And you think about that with the 10 studs that are going around, that's a significant amount of force that's needed to keep that wheel in place. And so how important it is to have that together.

DAVE WALTERS
Well, one of the big questions that is asked so frequently in the industry, how do I know when my studs are yielded? And at TMC, we work on literally thousands of RPs and one of the RPs we basically wrote saying, hey look, there are thread gauges out there. There are tools that you can measure that. But the simplest thing is you can take one of the flange cap nuts and if it doesn't go by hand on and off the studs, you probably stretched the studs. And the guys in the field, they're like, wow, I can never do that. Well, then you stretched the studs. That's what they're supposed to do.

DOUG MASON
But you're torqueing it on, Dave. I mean, how do you actually get to the point where you're stretching the stud. I mean, is there-

DAVE WALTERS
It's funny, I just did a show not long ago and the guy said, "And tires, it's about inflation, inflation, inflation." Well, in wheels, it's about torque, torque, and torque. And torque is basically when you stretch the stud to the point where we know that it's got the clamp load it needs, and a lot of things affect that. How new the studs are, did you properly oil them? Did you clean them?

DAVE WALTERS
But that torque... And the industry a couple of years ago, many years ago now came up with a standard torque. And that was the biggest thing because every manufacturer had a different torque at one time. So whatever wheel you had, whatever truck you had, we at TMC worked hard to make a standard rep, which is 450 to 500-foot pounds. And if you do that, you know you're putting the right stretch on those studs. And that's critical. And there's torque wrenches out there and we always say bring it up to torque. Now there are torque tools that actually can torque them to that setting. So, technology is going really great and has improved immensely over the years.

MIKE YAGLEY
So one of the big problems with all of this is that we keep talking about the stretch, we keep talking about the stretch. And then now we're moving into that torque discussion. But the torque is not a perfect representation of that stretch. When you're torqueing, you're measuring basically how hard it is to pull on that that spring. But the actual force can be... what torque can be not just the force of stretching that spring, stretching that stud. The torque can be affected by a lot of different things. Like dirt, if there's dirt in those threads.

DAVE WALTERS
Dirt, debris is critical. We've done so many studies and motor oil is what we use, as you should put two drops and motor oil on each stud and make sure your flange nut has a dropper to make sure that it swivels nice. And again, as Mike pointed out, you don't want to lose friction because of old hardware.

DAVE WALTERS
Years ago, we actually ran a study on old rusty hardware compared to new hardware. And if you maintain it by oiling the flange nut and oiling the threads, it actually works and gives you the clamp load you need. But if you don't do anything, you're going to lose friction and loss of torque just because you didn't clean your hardware and get into oil properly and do the things that you needed to do.

DOUG MASON
Yeah, it can be very significant. Like you're saying, Dave, I've done some of those studies as well, when we're taking a look at a number of different nuts from around the world. And I think it's something good to bring up that there is a standard out there.

DOUG MASON
The Society of Automotive Engineers, SAJ 1965 specification, is kind of what governs what these a nut and stud suppliers have to meet to ensure that at 450 to 500 for an M22 specifically... There's other size bolt and nut systems out there that would require different torques and would require then obviously a different tension to hold the wheel in place. But as you're saying, we took examples of studs and nuts that came straight out of the field, performed that test. And they did not meet the requirements, because you're eating up all of that... torque being put in there isn't going into stretch. It's going into the friction forces. It's forcing it down.

DOUG MASON
I liken it to, if you're going out to the garage and you pull a bolt out and you're trying to put something together, it's an old bolt, kind of rusty, and you start putting it on and you got it as tight as you can get hand tight, but you're not even close to getting the joint done-

DOUG MASON
Tight as you can get, hand tight, but you're not even close to getting the joint done. That's really kind of what's happening. You're using all that energy and you're not creating any type of tension on that stud.

MIKE YAGLEY
In that case, if you're measuring that torque, as you're tightening that up on that rusty nut, with that rusty stud, what you're going to do is you're going to be reading that 500 foot pounds on an M22. You're going to read it, but you're not going to have anywhere near that. And it was actually interesting, Dave, when I was looking at the data you brought, where it showed what kind of forces, what kind of stretch you had with all these different... Was it rusty studs, stud without oil, nut without oil, all these different variations. And what was great was the way your studies showed that it was oil. Oil really made a huge difference. Even with a rusty stud, you clean off the crud and you put a little bit of oil on there. And it showed something... I mean, what I saw, and maybe you're more familiar with it than I am, but that was pretty promising.

DAVE WALTERS
When you do a study and you realize that for years we tried to do... I'll give you an example, anti-seize, and everybody in the industry used anti-seize. Well what we found was, we bought different brands of anti-seize, but we try to compare them and there was no SAE spec. So, one was more lubricant than the other and the other was... So basically, that was a real negative. We had to go to something that was consistent. And then we went to motor oil and we knew the consistency. And once we did that, it really improved our clamp load. People was like, "Well, what is a couple of drops of oil on each stud? What is a couple of drops of oil in that nut?" And that nut has to basically be able to turn very freely. When I teach my training classes, it's grab the nut with both hands and freely turn it. If it doesn't turn, it puts... You got to lube that joint in between the flange and the nut body. And simple things like that is going to keep the wheels on.

MIKE YAGLEY
You know, one of the things that I'd like to take... Take a step back here and make sure that our listeners all understand what we're talking about when we talk about these nuts. Because the nuts that we're talking about are the typical nuts that are used in commercial vehicle applications. And those nuts have... When you think of a nut, you think of the standard nut that you see anywhere, but this has an additional piece that is... We call it a free spinning washer and it is exactly that. It's a washer that's connected to the bottom of the nut and it just spins freely. It's just something that spins around on there. And what this does, it's really a great invention because it really does help out with... You can put a little bit of oil on that surface in between, get that nice lubrication, not have things bind up, but that free spinning washer, once it touches the wheel, there needs to be no oil on that surface that's touching the wheel, because that needs to have that friction we talked about. That is part of the clamp load equation that we're considering.

MIKE YAGLEY
So no oil on the parts that touch the wheel, but just above that there's a little groove, and you put the oil in there, just a couple of drops, one or two drops, and then that'll allow that to spin freely and that... So, you get the nice friction where you need it and you get it spinning freely where you need it, where you get the maximum torque. You're getting a true torque measurement that will result in the kind of stretch that you're looking for.

DAVE WALTERS
And if you go back in the history of hub piloted wheels, when they first tried to come out with hub piloted wheels, it was in the 50s and basically they didn't have the two piece flange nut. So, they had one nut and what they did was they were driving that into the wheel, and it didn't work at all. So, they said, "Ah, this is not going to work." It's about 30 years later they come up with a two-piece flange nut, they bring the system back, and now it's industry standard. One little piece like the two-piece flange nut basically kept that system from taking over the US market for years.

DOUG MASON
Just to step back a little bit further, Mike, as you were talking about these nuts. These nuts are basically used on all dual wheel applications. We're talking heavy truck, but you could go down to a 350 or 3,500 that has a dual wheel. Anything that has a flat mounting surface, the two-piece flange nut is the way to go to ensure that you're getting the proper clamp load and the way the whole joint is designed. I think you'll see that coming on the OEM equipment. And again, back to your point, when you put that oil in there, you're going to have that nut as if it was coming from the OIE. It'll perform as it's supposed to perform.

MIKE YAGLEY
You're bringing up a great point Doug, because one of the things that our listeners may not be aware of is that when we're talking specifically, this whole discussion... Because wheel offs are typically happening in heavy truck applications or even medium duty, heavier medium duty type applications, and those kinds of applications are typically almost exclusively using hub piloted wheels. If you're looking at a wheel, a quick way to identify if it's hub piloted or stud piloted, which is a little different, it's a different system is you'll look at the lug holes. So, if the lug holes are just machined through, straight through, that's going to be a hub piloted system.

MIKE YAGLEY
If there's a shape around that, either a cone shape or a sphere shape, something that the nut settles into and goes... Where the nut has either a cone shape and that goes into that wheel, that's going to be stud piloted. The stud piloted stuff you're going to see on automotive. If you look at your automotive applications, if you go out, look at your vehicle, you're going to see a cone or typically a cone system in North America. But what we're talking about are those heavier applications where it's this hub piloted system, and we'll probably spend... We could spend a whole app episode talking about hub piloted because there's a lot more to it than that. But I just wanted to make sure everybody understood what we were talking about, because wheel offs are going to be these heavier applications, commercial vehicle and those commercial vehicle applications are going to be typically hub piloted.

DAVE WALTERS
One thing I'll throw in is here we're talking about how important the fasteners are, and you got to stress that there are counterfeit fasteners out there and counterfeit fasteners in our industry is alive and well. If they are marked 10.9, that means they are grade eight and it's great. And if they're marked that they have to be that. If there's no marking on your hardware, you got to be suspect because quality fasteners, we talk about the studs and nuts a lot, and that's so important and you cannot... You could do everything right, but if you don't have good fasteners to start with, it's not going to work. We really try to teach people, buy quality fasteners, clean them, put the right torque on them.

DAVE WALTERS
A couple of years ago, we wrote an RP saying there used to be a retorque. Well now you can run five miles, run around after you first torque them, come back the shop, check them again, and you might never have to retorque them wheels for the whole life of the vehicle if you do it correctly. That's saving fleets a lot of time and money by writing that one RP. One company told me it saved them $250,000 a year getting away from torque checks because doing it right the first time, buying quality fasteners, cleaning, oiling, torqueing. If you do all that right, you won't have wheel offs, you don't have to do the retorques if you follow your procedures. It's just a great thing to get rid of that process.

DOUG MASON
And just to follow up on that, Dave, again from the lab side, we want to make sure that we understand exactly how fasteners are working and we've done quite a bit of testing, and we've brought in a number of different nuts that are out on the market, and there is a wide range of what you will actually achieve and when they have the markings on them, like you said, and many of them will have actually the torque that they are expecting for, 5,500 foot pounds on them as well. So take a look at the nut, make sure it is a high quality nut, and know that if there's no markings or no information, it may not hold the tension that you want in place.

MIKE YAGLEY
I'd like to take a minute here and go a little bit more... We've talked about lubrication, but I want to go a little bit more deeply into that. I was talking to a friend of mine and he was telling me that he ran into a fleet, they were having all sorts of trouble. He visited their site and he looked at their nut and it looked like they just coated the whole nut in lubricant. It was like they just took the nut, they threw it into a bucket of oil or something and they pulled it out and now they're having problems with torque, and that... Either one of you guys... Dave, you probably have the most experience. We all know what we're thinking, but why don't you talk a little bit about that.

DAVE WALTERS
When you tell people, anytime you get any type of lubricant on the faces of that flanged nut, the faces of the wheel, face of the hub, any of that stuff is going to cause not to get the correct torque. So it is critical, it is critical to have no oil or lubricant on the faces of your wheel, nuts, hub when you put the system together.

DOUG MASON
Just to follow up on that, so that you can understand what this is. You can take a look at service manuals for some of the major wheel suppliers, and in that, that'll show you specifically where to place the oil, and again, how much oil to put in each location so that you can have a visual representation of that if you want to take a look at it. You can probably find that online as well.

MIKE YAGLEY
Typically, at least-

DOUG MASON
-that online as well.

MIKE YAGLEY
Typically, just at least what are, what the Alcoa wheels manual says, two drops here, two drops on the stud, two drops, one or two drops in the freeze [crosstalk 00:22:13] and that's it. More is not better no more.

MIKE YAGLEY
It's sort of like, well if two drops is good, 10 drops is better and a whole bucket is the best. And that's not true. You need just a couple of drops here, a couple of drops there and everything's going to work out great because you're really want to maintain that friction. You want the friction in the right places. You want the friction on the hub, on the wheel face and on that surface of the nut that touches the wheel.

DAVE WALTERS
And as Mike brought up, that's true in torque too. We call this in our industry, the good and tight method where these guys take the one inch gun, they run these nuts down, they take a torque wrench, they go click, click, click and they say, "Life's good."

DAVE WALTERS
All you know is you torque that thing 500 pounds or more. I was actually at a transit company and the guy's so proud that he did everything right. We found out that he torqued those nuts to about 1100-foot pounds and he basically ruined every stud in the whole assembly. And that is common. The industry, as we say the tighter, better. No, it's not. There's a specific torque that you need. And as I go out and tell people that and show them, they understand the spring, the studs, the spring. So, that's very important. So out of this lesson, understand that that stud acts like a spring.

MIKE YAGLEY
So we've talked a little bit about dirt and corrosion on the studs and the nut threads and how that can create a wheel off that increases the friction while you're torqueing down the nut. And so the torque wrench is going to read that there's enough when there isn't or like Dave was just mentioning, we've talked about not enough lubricant and just like dirt, that also increases friction or too much lubricant where now you have surfaces that are moving that you don't want moving, where there are surfaces that you want that friction and you've introduced oil in there so you're getting movement on that and that's going to cause a wheel off. Anything else that you guys have seen that can, can possibly cause an issue with that would result in a wheel off?

DOUG MASON
Well again, what we're talking about is anything that will give you a false reading initially and then as you start driving the truck, things change and you can think about a joint settling and one of the things that can happen in there is if you have a coating or a paint on a wheel, depending on the thickness that that paint or coating is, you could have a situation that occurs.

DOUG MASON
As you can imagine, think about paint. If it's very, very thin and you press on it, you're not going to do anything. But if you had a thick piece of paint and you put a lot of force, you're going to create an indention, right? And so you torque it up, you can get relaxation, we'll call it of the joint, and you'll lose that tension that you originally had in place.

DOUG MASON
I think primarily 3.5 mils would be about what would be the most expected. You could see that in a number of different places.

MIKE YAGLEY
And that's not a lot. That's like a sheet of paper.

DOUG MASON
Right. Exactly. It's very thin. So people who are going around deciding to paint the wheels and then put nuts over top of that paint, you have to be very, very careful.

DAVE WALTERS
And the other big thing is when you do paint you have to let the paint cure. And most of the time when these professionals do it, they hate the paint backup. They cure the paint. And when you see a guy take a spray can out in the shop and spray paint it and then put the wheels on, you're asking for a problem, a big problem. And you almost say, hey, this is the worst practice in the world. So, paint is a very big factor.

DOUG MASON
Now most of these things that we're talking about really aren't visual, right? You can't visually see that it doesn't have enough tension in there. Is there a way and that you can tell when you're going down the road if you might have a possible issue?

DAVE WALTERS
The big tell-tale sign I tell everybody, rough streets coming from a stud will tell you that maybe you have a loose fastener and that's critical. And DOT will actually give you a, basically give you a violation for having rust streaks.

DAVE WALTERS
Now what I always tell somebody, maybe the wheels loose before they fixed the problem and you don't know that that all happened. So, make sure you clean all that backup before you go back down the road. Because like I said, an officer or a CVS officer can actually give you a violation for rust streaks because that's an indication that those are loose. So, when you look at the vehicles, look for rust streaks.

MIKE YAGLEY
So last thing we're going to talk about is cocked wheels. When you're mounting the wheels, this is probably the last issue that could give you false readings on that torque. So, Dave, you want to talk a little bit about cocked wheels and how that happens and-

DAVE WALTERS
yeah, when you, when you're putting on the wheel, the first wheel goes on and sets up straight. The second wheel when you put it on will lean back over and so the industry, once you have one of the pilot tangs at 12 o'clock and then what you do with your air gun is you snug that top one up. You go 180 degrees and you snug that one up and then you go in the pattern across, a crisscross pattern to kind of make sure that the wheels. Then you can almost look at the pilot pads of the hub and the wheel and make sure that everything is that.

DAVE WALTERS
You can also look at the threads, how many threads are sticking out on each stud and make sure they're even. Getting wheels cocked is when a guy normally takes that air impact, hits that bottom one, and he cocks the wheel to where he thinks he can pull that in with the top one. But he can't because he's already cocked the wheels because he's tightened the bottom one. And that's a big thing in the industry. And you try to tell somebody hitting that top nut first is critical when you put on dual wheels.

MIKE YAGLEY
I want to highlight the one thing you mentioned there, which is to have that mounting pad, that tang at the 12 o'clock position. So, everything is sort of hanging from that to begin with. And that's really going to help the way this all goes together.

DAVE WALTERS
Yeah, I mean yeah, the hub pilot pads, all they do is line up the wheels. But if you have that wheel kind of hanging on that you want to slide it up on that pad and that helps you line them up and you know there are tools out there, lineup sleeves that we make that will help you line up the wheels perfectly every time.

DAVE WALTERS
And those are all critical. I mean our lineup sleeves can actually be put on before you put the wheels on. Put the first one on, put the second one and you can't cock it. So, I mean there's a lot of vantages with certain tools out in the market to help you get the wheels on where you cannot do that. You technically can hot cock wheels with our lineup sleeves.

MIKE YAGLEY
Right.

DOUG MASON
Yeah. The bottom line is, what we're saying though is if you do cock it and you do torque it down, you could conceivably reach the proper torque on your gun. Everything could be fine. You double check it, everything's fine, but then you go drive down the road and that joint will now settle and then all of a sudden you have lost all of the tension in those studs that you thought you had put in there. So the points that you were making, Dave, about that double-check, taking a look at how many threads are sticking out, whether or not the hub tangs are evenly distributed, very important to make sure that you don't get down the road and the technician thinks, yes, I got everything done right, but-

MIKE YAGLEY
And there's that wheel wobbling.

DOUG MASON
Yeah, exactly. Exactly.

MIKE YAGLEY
Well, I think that does it. Thanks a lot for joining us on this first episode of Behind the Wheels. We'd love to hear from you. If you'd like to contact us, catch us at Alcoa Wheels at arconic.com with any questions or comments. We'll see you next time.

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