Interview:
Use of high voltage in agricultural technology, protection easier than expected!

Anja Meyer-Caspari in conversation with:
Jens Liebold & Dr. Tobias Töpfer

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Interview leader:
Anja Meyer-Caspari,
Coordination Agricultural Systems

Interview partner:
Dr. Tobias Töpfer, Director Agricultural Systems
Jens Liebold, Product Manager Test and Measurement Products

Anja Meyer-Caspari: Today we meet here at the IAV in Berlin to discuss the testing of e-components together with my two colleagues Jens Liebold and Tobias Töpfer. Jens is the product manager responsible for the testing products at IAV. Tobias is the head of our agricultural activities.

Tobias, how do you think about the topic of e-traction or also electric drives in general in the field of agricultural machinery?

Dr. Tobias Töpfer: Electrification is definitely a topic! For some agricultural applications, it can be the key to deossification. In general, I would like to distinguish between two areas of application: Traction and power take-offs as well as process drives. For the former, established drive systems, i.e. usually the diesel engine and, if necessary, the gearbox, are replaced by electrical concepts. For process drives, mechanical or hydraulic drive units are replaced in favor of the electric drives. In this case, however, the main energy converter can continue to be an internal combustion engine.

Battery-electric or hydrogen-based concepts can be used as energy storage systems for the electrification of traction and power take-offs. Both concepts have in common the low energy density compared to diesel. For machines with a high power requirement in specific applications, it is therefore currently difficult to implement a similar application as with a diesel concept.

Anja Meyer-Caspari: That sounds like electrification is a viable option for smaller tractors and self-propelled harvesters, do I see it right?

Dr. Tobias Töpfer: Here you can only answer with a clear "it depends". In principle, it makes sense to start with small tractors. I think here we can roughly assume the 100 kW threshold as the limit. In the end, however, it must be clear to the customer that the use of the machine makes sense especially where the power requirement is cyclical or generally rather low.

In addition to small tractors, machines from the agricultural robotics sector are also very exciting and have great potential for electrification. Currently, however, combustion engines are still being installed here, to make the applications not too complex and too expensive to enter the market. I am sure that this will change in the future.

In general, the costs of the e-components are a major obstacle to electrification when there are small quantities and extreme requirements.

Anja Meyer-Caspari: Tobias: From your point of view, what are the most important differences between a passenger car and an agricultural application in terms of e-traction.

Dr. Tobias Töpfer: The main differences are certainly the comparatively small quantities, as previously described. Then we have completely different requirements in the agricultural machinery, which are also derived from the load profiles. The subject of nominal power share is certainly very concise here: A passenger car has a small amount of time in which it calls up the installed nominal power. This occurs, for example, in the case of strong accelerations. In the case of agricultural machinery, these full-load shares are significantly more pronounced. Depending on the attachment and work task, the full-load share for a daily use can also quickly exceed 80%. Another important difference is the system design: Installation space and the number of drives for traction and process drives are to be mentioned here.

Anja Meyer-Caspari: Let's get more detailed: Jens, you as product manager for measurement and test technology products: What are the challenges when validating electric components compared to passenger cars?

Jens Liebold: Tests similar to those used in passenger cars apply to the validation of high-voltage components. For example, there are special requirements/standards, such as ISO 21498 or LV148 for 48 V components, which are similar to those used in agricultural machinery.

But Tobias has already mentioned the big challenge: The requirements for intrinsic safety and robustness of the systems are much higher.

Anja Meyer-Caspari: Can you give an example of this?

Jens Liebold: The environmental conditions, such as vibrations, temperatures, UV radiation, dust and dirt and so on, are significantly rougher than is required by most standards. In addition, vehicles drive very slowly. We can't use the wind to cool down. All this must be taken into account.

Anja Meyer-Caspari: And in terms of the higher voltage, what should be considered?

Jens Liebold: First of all, we are dealing with potentially dangerous voltages. This means that workers need different equipment and, of course, additional qualifications when working on agricultural machinery. Whether in the field or in the workshop. But that also applies to all machines connected to a socket.

Testing is different. Very few laboratories that can do this have experience with voltage-bearing parts. There is no know-how and qualification; test benches are missing or are specialized in combustion engines.

Dr. Tobias Töpfer: It must be possible to qualify existing test benches for this. Retrofitting, so to speak.

Jens Liebold: Of course, we have developed IAV Auros for precisely such tasks. A small, mobile test bench. It contains everything you need to test HV components: Power supply, automation, safety monitoring and so on. We typically use it as follows:

1. As a flexible system for automating various inspection tasks

2. Retrofitting of existing test benches, e.g. also as an HV source

3. Or as a basis for special and flexible test containers: Test bench in the box. "Test what you want, when you want, where you want".

Anja Meyer-Caspari: Now you need to be more precise, how exactly is the protection done?

Jens Liebold: For high-voltage systems in a network. All components are attached to the same battery. Failure of a component can bring the entire system to a standstill. That must be safeguarded!

The trend toward modularization of components and components is leading to many different mergers, all of which need to be verified. However, the safe operation always depends on the respective setup.

This can only be done efficiently with a fully automated composite test bench, as developed by IAV. Stationary at the Stollberg and Sindelfingen locations, as well as mobile as a "test bench in the box".

Anja Meyer-Caspari: Thank you for your insights, if I need more information, where can I find it?

Jens Liebold: The easiest way is via our homepage www.iav.com/auros. Here you can find information, white papers and publications on exactly these topics.

Anja Meyer-Caspari: Thank you Tobias and Jens for the interesting interview.