World vision

Johnson Controls is undertaking an ambitious project to align the seat validation programs at its five test centers worldwide

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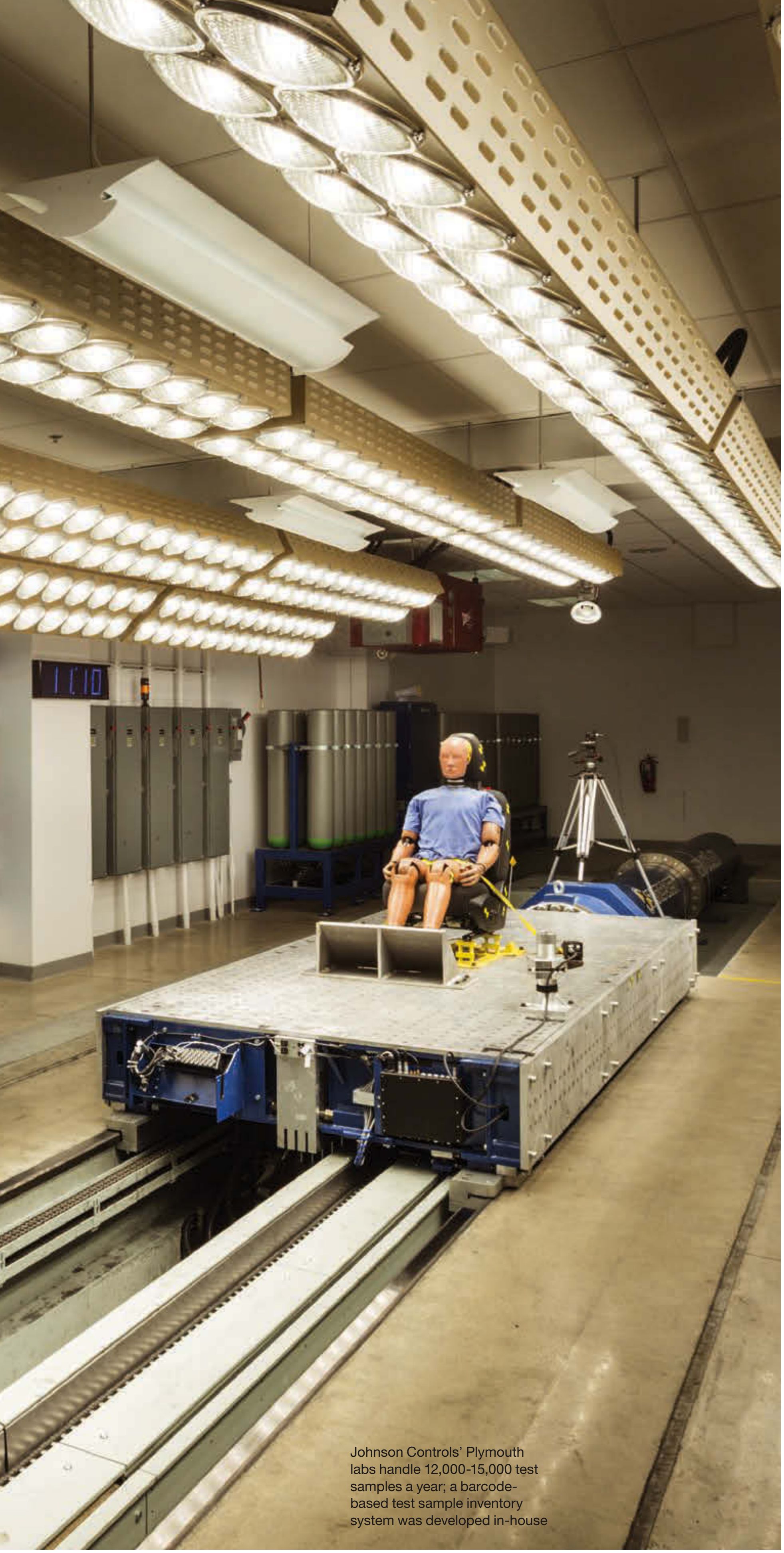


Johnson Controls' Plymouth labs handle 12,000-15,000 test samples a year; a barcode-based test sample inventory system was developed in-house

The rise of global OEM development organizations such as the One Ford model and the reuse of vehicle platforms around the world have presented a challenge for Tier 1 suppliers, who had traditionally opened local test and development operations in order to be closer to their customers. Now Johnson Controls, one of the automotive industry's biggest seating suppliers, has embarked upon a program to align the test programs – requirements, specifications, methods, equipment, data and analysis – at each of its five Automotive Seating development centers worldwide.

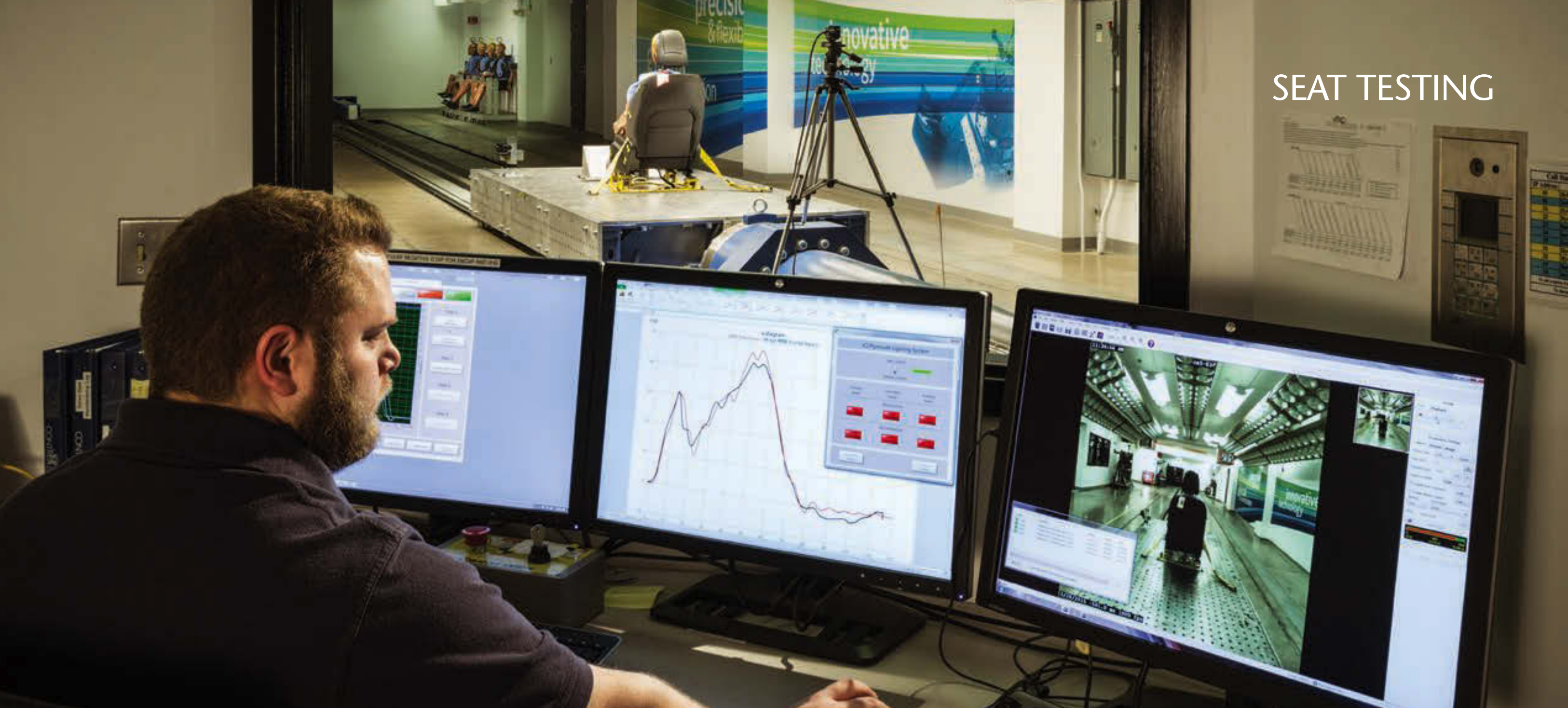
The new approach means that Johnson Controls no longer has to test several versions of the same product in different regions. "We get consistent results, so that if a product is [core] developed in Europe, it can still be applied in North America and there will be no surprises at the end," says Rodney Szerlag, the director of engineering and validation for Johnson Controls Automotive Seating, who is overseeing the test standardization program. The first candidates to undergo the process have been the major regulatory and/or safety-critical tests, such as seatbelt anchorage testing.

"The elimination of variation, waste and inefficiency starts with understanding the global requirements," he explains. "From there, our global network gets together and works to identify common test methods for executing these requirements. We have 10 projects ongoing for test method alignment, targeted at understanding all the critical elements of each test method – including the things that never show up in test specifications – in a drive for consistency. Nobody's right or wrong, we just need to do it the same."

These test integration projects have been running for some years now; an example of a complete one is the seatbelt anchorage static test, which puts loads on torso, lap and seat at the same time.

"We went through and identified all the factors that could influence the test," Szerlag explains. "We used a combination of analysis, lab tests and studies to determine what was critical – the same loading device dimensions, for example. From that, standards were created for everything from buckle locations to the load forms themselves and the stretch values of the webbing used. All potential sources of variation were checked to ensure we were delivering those common goals."

As some projects become mature, new ones come online: at any one time, some are mature, some are active and some are just beginning. The team at the company's Plymouth, Michigan facility, for example, has developed a bespoke camera boom for the ServoSled that was installed just over a year ago. Johnson Controls is looking at taking this boom design to the four other test centers – in Burscheid, Germany; Shanghai and Changchun, China; and Yokohama, Japan – as part of the project being led from Plymouth by Rick Junttonen (sled lab lead engineer) to standardize ECE-R17 cargo retention testing. That project has examined areas such as video analysis methods, camera placement and the



ABOVE: Control room for the ServoSled. The ServoSled has no special gas requirements for the pneumatics, whereas the HYGE uses air and nitrogen

cargo fixture itself, and is more than halfway to completion.

The newly installed Seattle Safety ServoSled represents another step along the way to global test alignment. Brought online in January 2014, the Plymouth facility now operates one of the largest of the distinctive blue sleds within the Johnson Controls global test network.

"The ServoSled enables us to duplicate high-frequency vehicle pulses for front and rear impacts," explains Szerlag. "Before, when we only had a HYGE sled, we were able to simulate the amount of energy in the system but couldn't duplicate the pulse. Now we can – in all regions – duplicate the pulse and the test setup, and correlate with our computer simulations/FEA. No matter whether it starts on the analysis side or with a physical test, we're using the same set of parameters in the computer environment as in the real one. And that information is coming directly from the customer – we use the same vehicle coordinates, simulating their belts, all kinds of things.

"The connection with FEA is very important when you're attacking variation," he expands. "In the past our predictions didn't always align. When we investigated why, it often came down to differences in assumptions and how the analysis models were set up – in terms of the load inputs, for example – versus how the physical test was set up. So we've been attacking the problem from both ends to achieve the same goal. Of course, our world needs to move more into virtual analysis early on in order to become more efficient and rely less on physical parts." (See also sidebar, *Virtually comfortable*.)

Johnson Controls did consider upgrading the HYGE sled to a ServoSled, as others have done, but that 1.5MN option didn't meet the requirement to deliver the payload for a small vehicle – a heavy mass (up to 3,000kg) and high-energy pulses (up to 60g). Instead it chose a full-fat, 3.1MN specification that can handle full-vehicle body bucks and offers the test efficiency of running multiple rows of seats, ideal for unoccupied dynamic testing.

At the low end of the scale, the precise servo control over how the sled slows down enables Johnson Controls to run whiplash tests for Euro NCAP. Indeed, this was the focus for a similar sled installed at the Burscheid facility in 2012: "They always had a hydraulic sled for the high-end payloads," says Szerlag. "They needed something to supplement the low end, so they got a 2.0MN sled from Seattle Safety." Note that the company's common test procedures don't demand identical

Rigs for rent

Johnson Controls' Plymouth laboratories are A2LA (American Association for Laboratory Accreditation) accredited, which recognizes the consistency of their testing and permits them to do some commercial testing for outside customers such as OEMs, research institutes, or other test labs. The ServoSled attracted its first external users last year.

"It offers a unique capability in southeast Michigan so we've been approached by third parties who wanted to use it," says Rodney Szerlag (*pictured right*). "We do it to fill overcapacity that we have and apply the same accuracy and due diligence that we do to our own tests. It works out well for both parties."

equipment: "So long as we can hit the performance expectations, it's okay to go a little different."

Plymouth's new sled sits in a rebuilt former office area that was specially converted over 12 months. Illuminating the sled is instant on/off, high-intensity Seattle Safety lighting. Its specification, controls and power source are the same as for the HYGE sled, which has been in service at Johnson Controls for nearly 20 years and remains a "workhorse" for the company, according to Szerlag. Typically only about three-fifths of the available lights are used for a test; advances in camera technology – those in Plymouth are from IDT – mean that much higher-quality video is available with less light than in the past.

The company usually runs six onboard cameras and one offboard; 1,000fps gives sufficient resolution to slow events down for video analysis.

"We use FalCon eXtra video analysis software to track targets on the sled in real time and determine angle rotation, and to look at groupings for areas like pelvic displacement – typically things that are hard to instrument and see during a test," says Szerlag. "We have taken it further by calibrating lens-to-camera combinations that enable us to increase the accuracy of the video analysis. And as our test methods evolve, we're taking that to the regions."

The camera boom might yet be rolled out across the other labs, too. "The camera boom was designed and built at Johnson Controls and bolts right onto the sled. The standard ones didn't give us the flexibility of camera position that we wanted for video analysis. Within the boom, a gate opens up for access, and it does not obstruct the overhead crane that can bring in a test fixture. We have an overhead camera boom system too, that allows us to look straight down for displacement measurements, cargo retention testing, etc," says Szerlag.

Aside from the cameras, Johnson Controls typically keeps 64 data channels online during a test, of a total of 128 on the sled. The HYGE has 64 more and the two systems are compatible; cameras, sensors and the Kistler data acquisition system can be moved back and forth between the two sleds, as can the four-

TOP: Johnson Controls has around 12 adult ATDs at the Plymouth facility, mostly 95th and 5th percentile Hybrid-IIIs, and some children. Uninstrumented dummies are used for ballast to save sensor wear and tear when not required for the test

ABOVE: IDT camera ready for action on the ServoSled

strong team of technicians. For both sleds, an Aicon MoveInspect system speeds up turnaround time and gives repeatable dummy/test buck positions.

"Our goal is to get everything within 5mm," says Szerlag, "including anchor points, belts and H-point." Most of the dozen or so ATDs are also shared between the two sleds, although the two BioRIDs are confined to the ServoSled for low-speed, rear-impact, whiplash protection tests for Euro NCAP and FMVSS 202a. With only 12 shots before a BioRID goes out for recertification at Humanetics (which is also located in Plymouth), doubling up ensures that one is always available. The ballast dummies are checked in-house.

In a control room at one end of the lab, test results can be analyzed automatically. Video footage is downloaded for later use both internally and by customers, and can also be viewed immediately in the lab's observation room. All the data and post-test photos are put into a GLIMS (Global Laboratory Information Management System) system for engineers on-site to view, or for distribution to customers.

The creation of a single, worldwide information repository is another test integration task on Szerlag's radar. "We're down to two databases driving our whole validation system globally," he says. ELIMS (the Europe-based one) handles about 50% of the capacity and GLIMS the rest. "We think that gives us a competitive advantage in the global market. However, in line with our goal of continually exceeding our customers' expectations, we are developing a database that will take us down to one.

"That will give us a common specification library, common requirements, common methods and access to data across all regions, including test data and test reports," he furthers. "It'll be known as VMS (Validation Management System). It's challenging because the systems weren't built to talk to each other and it can be difficult to exchange information. But the way we run the business now is that we routinely need data that was generated in another of the centers."

Virtually comfortable

"There are as many as 1,600 different physical tests we could do on a complete seat," observes Nick Petouhoff, director of complete seat advanced development at Johnson Controls Automotive Seating. "It helps us to do as many of those virtually as we can. Design cycle times have shrunk because they're costly for OEMs and suppliers alike. But virtual tests don't just shorten the development time, they give us a better understanding of what we've designed. In the advanced development area, if I can test 10 or 15 different ideas quickly, that helps me get to the two or three that I should take to the next level and do physical testing on.

"The regulatory crash tests (short timeframe, high energy) and static anchorage tests (high load over a longer duration) are relatively easy to do in simulation. Comfort can be more challenging but we continue to develop tools in that area."

Other simulations can now predict H-point locations using models of foam, trim, suspension systems. Another development on the horizon is Woelfel's MEMOSIK vibration mannequin, a means of bridging the gap between the subjective and objective for comfort studies. This move to a more predictive model is being developed with CASIMIR, the human-body model.