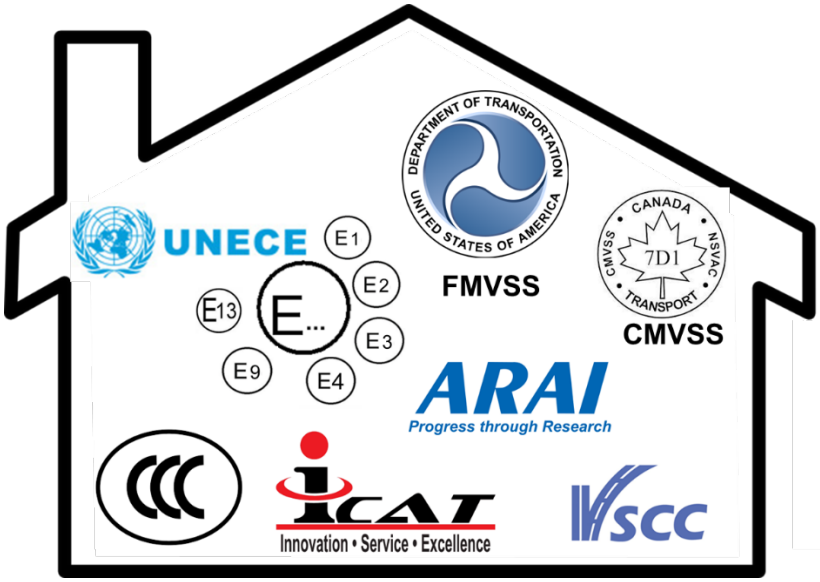

DVN Report on DEKRA

Published 22.April.2025

DrivingVisionNews.com
Automotive lighting, driver assistance and smart interior
Published by
Driving Vision News, 116 rue Jules Guesde, 92300-Levallois-Perret France
Website: DrivingVisionNews.com

DEKRA

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Executive Summary

One of the puzzles in automotive lighting that is not really visible on prime stage, by marketing actions or by innovation award ceremonies is the job of photometry and testing. During the process of homologation, no OEM or suppliers can avoid to verify and document that the products meet the technical standards in the world.

Since we have many slightly varying regulation frameworks like ECE, CCC, FMVSS, CMVSS etc. any worldwide product application needs to be developed and verified according to the national rules. For ECE and CCC, type approval processes are established. Even though USA's FMVSS requires self certification without official approval, no setmaker and no OEM can avoid to have documents that show their products are following the legal specifications.

This is the field of testhouses where they are offering their competences and services. There is no vehicle on the road without a fixed process concerning lamps and retroreflective devices. And before a vehicle can be homologated by one of the ECE contracting parties, the certified test labs have to supply the testing and photometry reports that are the base of any homologation. Photometry is a high tech laboratory job and needs qualified testing equipment like precise goniophotometers and qualified people.

And by nature, the experts from the test houses are active members in the rulemaking process. They are in their national GTB delegations, support the national administrations in GRE and participate in many photometry working groups trying to harmonize the regulations and to adopt all regulations to the ongoing technical innovation process. See the analysis for coming activities from DEKRA's Wilfried van Laarhoven in the report.

Modern applications like ADB are unfortunately not similar. The ECE/China world and U.S. are different, even when the final experience for the driver looks quite similar. So new outdoor measurements have to be designed and the infrastructure has to be installed. And - because outdoor means more potential measurement errors, error-minimizing actions have to be addressed.

So – let's have a look to some of the hidden champions.

The presented report shows some activities of DEKRA, one of the world's biggest players in safety and testing for a multitude of applications in the technical world, automotive world and lighting world. In the first section this report covers the lab section with the photometry team in DEKRA Certification Arnheim/NL. The second section covers the new activities in DEKRA Automobil Klettwitz/ D.

Enjoy the reports, pictures and interviews.

About the Author

Michael Hamm earned his physics diploma in 1993, and his doctorate in electrotechnics in 1997 from the University of Darmstadt, Germany. He joined Bosch's lighting division in 1996. After becoming section manager, he worked twelve years as department manager at Bosch and their successor company Automotive Lighting, with the main task to develop front lighting technologies in headlamp projects for customers worldwide. In this period, he pushed optical development and simulation as well as lighting innovations. Examples were the development of single-beam, two-beam, and adaptive HID systems (e.g., curve light; adverse weather light, motorway light…) as well as automotive infrared applications.

He contributed to the development of LED systems, including the world's first full-LED headlamp; LED modules; camera-controlled adaptive partial high beam functions, and light guide and DRL developments. Hamm took charge of headlamp development at Audi in 2012. For ten years, his focus was to constantly introduce new technology in Audi lamps for market readiness with his team and the suppliers. Examples from this period include the introduction of generations of matrix-beam headlamps; dynamic turn indicators and DRLs; laser high beams, and lighting Digitalization with digital projectors.
He has contributed to 76 technical papers and applied for 85 invention patents.
Since 2022 he has returned, as a lecturer for vehicle lighting and lighting technology, to the Laboratory of Adaptive Lighting Systems and Visual Processing at Technical University Darmstadt. This enables students to come in contact with lighting functions, physiology, photometry and regulation issues all around vehicle lighting.
Besides this, one of his main pleasures is to advise and support DVN in their groundbreaking activities as an industry standardisation and research community.

About Driving Vision News

DVN is the vehicle lighting and ADAS industry's journal of record, dedicated to keeping the community informed and communicating about the latest progress and developments. DVN's three pillars are:

• **Technological watch** on new emerging technologies, with weekly electronic newsletters bringing news, analysis, and crucial information on innovation in lighting, ADAS, and smart car interiors; there are also monthly technical reports with sharp focus on cutting edge technologies, company profiles, regulatory matters, and other relevant content available only from DVN

• **Networking** of high-level decisionmakers, researchers, innovators, practitioners, academics, and regulators to make new business connections with two workshops per year in rotating locations throughout America, Europe, China, Japan, India, and Korea. DVN Workshops gather over 300 participants.

• **Promotion of innovations** from DVN's 150 member companies—we facilitate the promulgation of knowledge of innovation, which in turn paves the way for commercialisation, enabling to build new relationships through DVN Community to forge new business worldwide. The DVN Gold membership roster includes 180 companies including automakers; lighting and ADAS tier-1 and -2 suppliers, and a wide variety of universities; research outfits, and consultants. DVN Gold members receive all publications and attendance privileges at all DVN Workshops.

DEKRA

DEKRA is the world's largest independent, non-listed expert organization in the field of testing, inspection and certification. As a global provider of services and solutions, DEKRA helps their customers improve safety, security, and sustainable outcomes. Whether western industrial nations or upcoming emerging countries – safety is a basic need worldwide.

DEKRA's international expansion began with entry into the marketplace in France in 1988. Since then, the company has further expanded its global position through strategic acquisitions with locations in countries such as China, the USA, South Africa and New Zealand. Therefore, DEKRA is involved in more than 50 countries on five continents.

1.1 History

DEKRA's history begins in 1925 – the year the "Deutscher Kraftfahrzeug-Überwachungs-Verein" was founded. The company, which started out in the automotive sector, now covers a whole range of safety-related services. Whether on the road, at work or at home – DEKRA's skilled experts improve safety across all the key areas of life.
At first, attention was focused on technical safety – primarily in the automotive sector. Now, as the largest unlisted expert organization, DEKRA has expanded its activities into many diverse aspects of daily life "on the road, at work, and at home". In addition to analog functional safety, DEKRA is also fully committed to digital security in a networked world – on five continents. This is because there is no limit to safety.

1.2 Organisation, Business Figures

At the moment DEKRA has around 49.000 employees and Locations in over 60 countries. A revenue of 4.1 billion in 2023. More than 31 million vehicle inspections in 2023.

DEKRA Business sectors

Revenue DEKRA Group and business areas		2021	2022	2023
Revenue DEKRA Group	in € million	3,534.8	3,796.5	4,101.4
of which Vehicle Inspection	in € million	1,217.7	1,308.3	1,453.6
of which Industrial Inspection	in € million	555.0	555.9	587.2
of which Claims & Expertise	in € million	483.4	514.6	555.7
of which Temp Work	in € million	438.5	539.3	528.3
of which Advisory & Training Services	in € million	403.2	410.7	446.3
of which Digital & Product Solutions	in € million	296.3	317.8	363.0
of which Audit	in € million	99.9	108.8	125.2
of which Other	in € million	40.8	41.1	42.1

DEKRA Business figures 2021..2023

1.3 Interview: Bram T.M. Holtus, CEO and Managing Director DEKRA Certification B.V.

Bram T.M. Holtus is the current CEO and Managing Director of DEKRA Certification B.V. Located on the IJsseloord industrial estate in Arnhem (Netherlands) are the test laboratories of DEKRA Certification. In these test labs, a wide range of electrical products are tested for safety, from automotive lighting and industrial components to charging stations and batteries for electric vehicles

DVN: Let's talk about DEKRA's business figures. The largest part of DEKRA's operations seems to cover the automotive sector and Periodic Technical Inspection (PTI). How did that come to be?

B.H.: That's correct. If you delve into DEKRA's history, you'll see that our global development has always been rooted in the automotive sector. It's the backbone of our organization. Over the years, especially since the early 2000s, we've aimed to diversify our offerings. For instance, in 2009, DEKRA acquired a site that was formerly part of KEMA's product testing division, starting with a revenue of approximately 45 million euros. We've since grown that figure to 220 million euros globally. However, when you compare these steps to our efforts in diversification, it's still small compared to our core automotive business.

DVN: How have new developments, particularly in lighting, influenced your business?

B.H.: Consider the advancements in EV chargers. Many consumers might view them as just high-powered socket outlets. However, they involve complex systems, combining high power with low voltage, which presents challenges. We conduct protocol testing to ensure communication between chargers and energy providers, along with battery management and cybersecurity.
Let’s zoom in on cybersecurity as another example. The interconnectedness of products poses new challenges, making cybersecurity increasingly important. Imagine if someone hacked 50% of a country's charging stations and disabled them—that's a scenario we must guard against. Technological developments today pose risks we hadn't considered a decade ago. This is similar to the advancements in lighting, where sensor technology plays a crucial role. We're deeply involved in high-tech developments to stay ahead for our customers. This means going beyond standard testing to engage in what we call "debugging testing." We collaborate with manufacturers to ensure they aren't delayed by testing within critical market lead times.

DVN: So, debugging testing involves intelligent planning and time-saving measures?

B.H.: Exactly. Over the years, we've identified risks that weren't initially apparent. While you can anticipate many risks through design rules, in areas like EMC, predicting total radiated emissions from a combination of components is challenging. Testing, particularly debugging testing, becomes crucial here. The sooner we identify issues like excessive radiation, the faster manufacturers can make necessary adjustments on-site. This approach speeds up the R&D process, ensuring the quickest time to market.

DVN: DEKRA operates behind the scenes, away from media events and marketing hype. You're not widely known outside specialist circles.

B.H.: True, for a long time, we were considered the industry's best-kept secret. Through acquisitions in various countries, we've had to enhance our visibility as leaders in safety. It's a gradual process. Our primary focus is ensuring recognition within our customer groups. We actively participate in standardization and technical committees and contribute to respected publications like the annual DEKRA Road Safety Report, which is highly valued in politics and beyond. For safety topics, we create white papers and publications, including those related to medical innovations.

DVN: Are you satisfied with your headlights?

B.H.: I am quite pleased with my Matrix headlights. They represent active safety at its best.

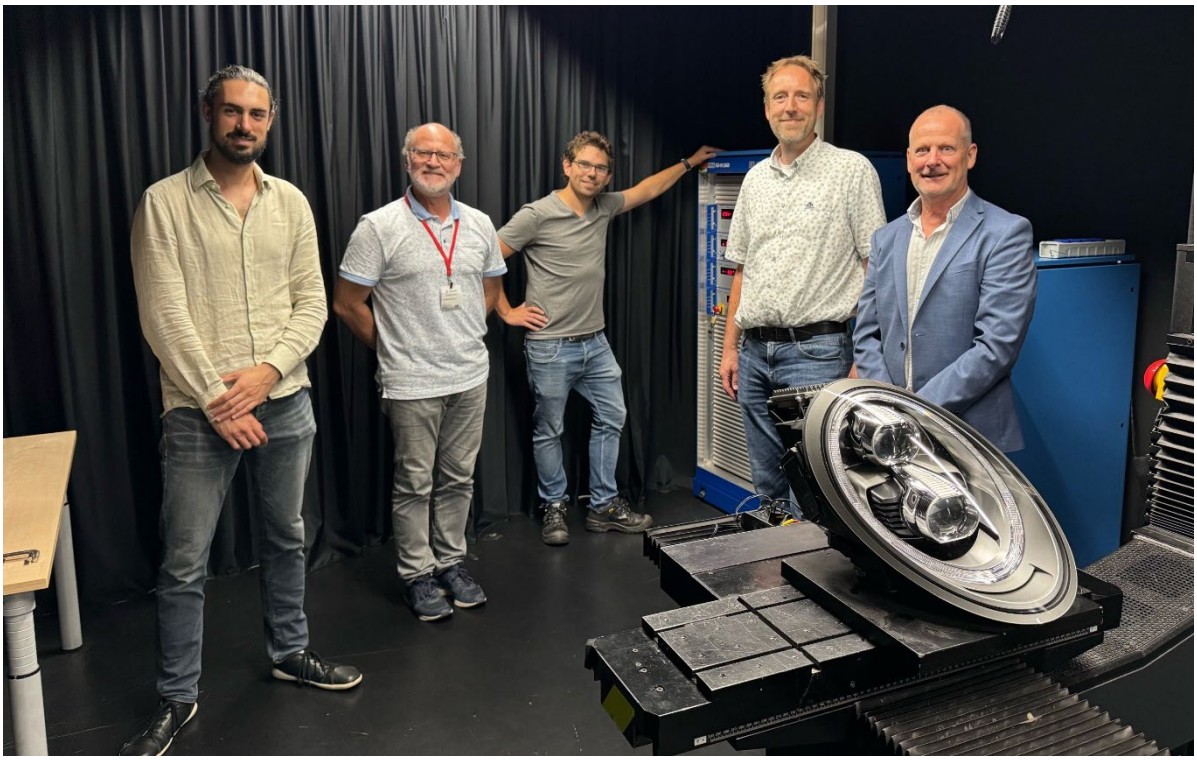
DVN: Thank you very much for sharing these insights.

1.4 DEKRA Arnhem, Netherlands

DEKRA facilities in Arnhem, NL *(DEKRA)*

Anyone familiar with the history of Arnhem probably knows the name KEMA. In 1927, the Foundation for the Testing of Electrical Materials (KEMA) was established. In 1931, the company introduced its own mark, KEMA-KEUR, which would appear on many household appliances for decades.

KEMA Quality B.V. was founded in 1995 as a subsidiary of KEMA. This separate entity focused specifically on certifications and quality assurance in various sectors, with certifications for systems (including ISO), individuals (certificates), and electrical products (including KEMA-KEUR). In 2009, DEKRA SE (Societas Europaea) took over the subsidiary KEMA Quality B.V.
As part of the global DEKRA organization, the new 'DEKRA Certification' is committed to expanding its expertise in high tech, as well as in the field of sustainability.



DEKRA Homologation team in laboratory: (l2r) Jozef Gleizer, Michael Hamm; DVN Advisor, Toon Buurman, Gertjan Muda and Wilfried van Laarhoven. *(DEKRA)*

In Arnhem, Netherlands, several test laboratories of DEKRA are located. In these test labs, a wide variety of products are tested for safety, ranging from robotic vacuum cleaners and tumble dryers to car lighting, batteries for electric vehicles, charging stations and industrial components.
One of the main test activities at DEKRA Netherlands is automotive lighting homologation. Over the last few years, innovations in headlamps, signaling and light sources in combination with advanced styling and complexity have added tremendous value to automotive lighting. Ensuring quality, performance and safety while obtaining access to global markets is no easy task.

DEKRA testing laboratories. *(DEKRA)*

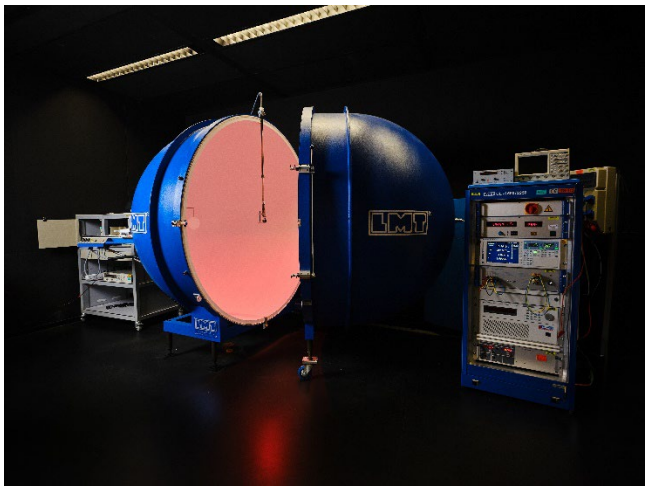
The DEKRA experts test the newly developed lighting and light signaling devices. They use the actual standards to test several aspects including photometry according to latest legal standards. The reports are used to get the certification by several authorities. In the case of the North-American market the DEKRA and resulting Calcoast-ITL reports are used to support the self-certification. This is possible because of their proven expertise, the state of the art laboratories and test equipment, their quality management systems and the accreditations and designations from authorities, the Dutch Counsel of Accreditation and regular audits.

1.5 DEKRA Testing and Accreditations

DEKRA runs full test programs to issue reports and certificates for their customers automotive lighting products so they can make sure these products are globally accepted in most legislated countries. Depending on the target market, distinct requirements may be applicable. DEKRA performs homologation testing for:

- Europe and Japan: according to UN (ECE) Regulations, and certification through the Dutch and some other authorities.
- Signaling lamps, headlamps and retroreflective devices according to UN (ECE) Regulations No. 148, 149 and 150 respectively.
- Replaceable light sources according to UN (ECE) Regulations No. 37, 99 or 128 depending on its technology and category.
- Rear view systems, i.e. camera-monitor systems according to UN (ECE) Regulation No. 46.
- Emergency vehicle flashing lighting or rotating beacons emitting yellow, red or blue flashes according to UN (ECE) Regulation No. 65.
- Taiwan: with the UNECE test report issued by DEKRA, companies are able to certify their product to obtain access to the Taiwanese market. DEKRA also guides through the certification process from the Taiwanese authority (VSCC).
- India: using the same test samples used for ECE approval, the testing according to Automotive Indian Standards (AIS) tests will take place in the DEKRA laboratories witnessed by a representative of the Indian approval authority (e.g. ARAI or ICAT) which will issue the test report and the certification.
- North America: DEKRA tests automotive lighting according to the FMVSS108 (Federal Motor Vehicle Safety Standard No. 108) and corresponding Canadian Motor Vehicle Safety Standard (CMVSS108). Non-federally regulated lighting can be tested according to the SAE standards, which can be applicable in the individual American states. Based on DEKRA's test results, their partner Calcoast-ITL in California will issue the test reports for the North American market.

Some of the DEKRA accreditations, designations and recognitions
- Dutch Approval Authority RDW for E4 certification
- ISO 17025 for automotive lighting testing
- Recognition by the Taiwanese MOT and VSCC
- Indian Approval Authorities ARAI and ICAT
- Calcoast-ITL (USA)
- Automotive Manufacturers Equipment Compliance Agency (AMECA)



DEKRA Photometric equipment


Colour Evaluation Software

DEKRA Worldwide Activities as Technical Service for Type Approval

As a designated Technical Service, DEKRA offers the entire range of approval tests: from tests and appraisals for EC whole and EC part type approval certificates to technical reports for ECE approvals and tests conducted in accordance with national regulations.
At DEKRA's wide range of facilities, they offer customers the entire range of approval tests: from tests for EU directives, UN ECE whole and UN ECE (United Nations Economic Commission for Europe) part type approval certificates to technical reports for UN ECE approvals and tests conducted in accordance with national regulations.

DEKRA's range of Automotive Services as a TIC (Testing. Inspection, Certification) company includes:

- Tests in accordance with the relevant EU/ECE regulations, DIN and ISO standards, interest groups (e.g. wireless or connectivity equipment manufacturer) or vehicle manufacturer requirements
- DEKRA offers all requisite assessments and tests for the issue of EC or ECE type approvals for components and separate technical units
- Support to determine technical and legal requirements for our customers' target markets and to identify all required approvals
- Training on safety issues and certification
- DEKRA offers homologation/type approval and driving dynamics testing of motorcycles, cars, trucks, trailers, agricultural and forestry machines, self-driving work machines and trailer work machines, and system and parts suppliers. The experts ensure that all our customers' vehicles, chassis, driver assistant systems and other components meet the applicable and common regulations.

As DEKRA is an official Technical Service, all certificates and official approvals are issued through Approval Authorities like RDW (in The Netherlands for E4 marking) or the German KBA (E1) as well as Conformity of Production (CoP) checks.

1.6 Inverview: Wilfried van Laarhoven, Account & Business Dev. Manager DEKRA Arnhem/NL

DVN: What role does your team play in vehicle development?

WvL: Our team is responsible for the final stage of the device homologation process, right before the installation phase. From a product perspective, headlamp and rearlamp approval testing and certification represent the culmination of our clients' hard work. Our testing methods and equipment are highly precise, allowing clients to accurately predict our results. We don't confine our efforts to just one market; we test for multiple markets at once. This is beneficial because our testing covers UN ECE standards, including Japan and Korea. Additionally, for left-hand traffic lamps, we conduct tests for India with Indian authorities like ARAI or ICAT witnessing them. The same tests for right-hand traffic lamps are valid for Taiwan, which has its own approval system.

DVN: You've been in the business for 35 years. How has it changed over time?

WvL: The industry has evolved significantly. Initially, we dealt with simple metal and glass headlamps, either round or rectangular. Over time, complex shapes and projector technology emerged, and the value of lamps increased dramatically. Now, we have basic, mid, and luxury versions with enhanced functionality and value. This has introduced more testing and unique challenges, especially for different markets like India and Taiwan. Although lamps for the U.S. may look similar, their optics differ greatly.

DVN: You're involved in standardization. What challenges do you foresee?

WvL: One major challenge is harmonization, as more countries, termed as contracting parties, are joining the 1958 agreement, forming the basis of the UN ECE Regulations. This doesn't affect testing directly but boosts the value of certification. Manufacturers' innovations push us to develop new testing methods. For instance, mounting a large illuminated grill on the goniophotometer or testing new lighting source technology requires advanced near-field goniometer photometry. We need to measure aspects like light center length, luminous area dimensions, and luminance distribution. Aspects like symbol projections in headlighting also need testing and approval.

DVN: How do you view your position relative to the competition?

WvL: We are at the forefront of testing with exceptional equipment and profound photometric knowledge, allowing us to make precise measurements that all authorities trust. We are audited and understand the processes and procedures required by ECE, India, and Taiwan. We cover U.S. standards through our partnership with Calcoast-ITL, a recognized NHTSA laboratory. Calcoast-ITL reports, combined with DEKRA's test results, are equivalent to any Calcoast-ITL report. This unique selling proposition benefits our customers. The proximity aids European clients, especially when help is needed for operating today's complex headlighting. Our staff is our core value, embodying about 140 years of combined experience.

DVN: Your latest improvement aims to replicate FMVSS requirements for ADB in Klettwitz, similar to NHTSA's work in Ohio. Do you think ADB will achieve the same success in the U.S. as it has in ECE and China?

WvL: Certainly, though ADB isn't on the U.S. market yet. The requirements were published on February 22, 2022. There's always a transition period for new standards. While the delay is surprising and somewhat disappointing, there might be additional risks and developmental challenges that I'm unaware of. In Europe, type approval means shared responsibility with authorities, while in the U.S., self-certification places full responsibility on manufacturers.

DVN: Should U.S. ADB switch to type approval?

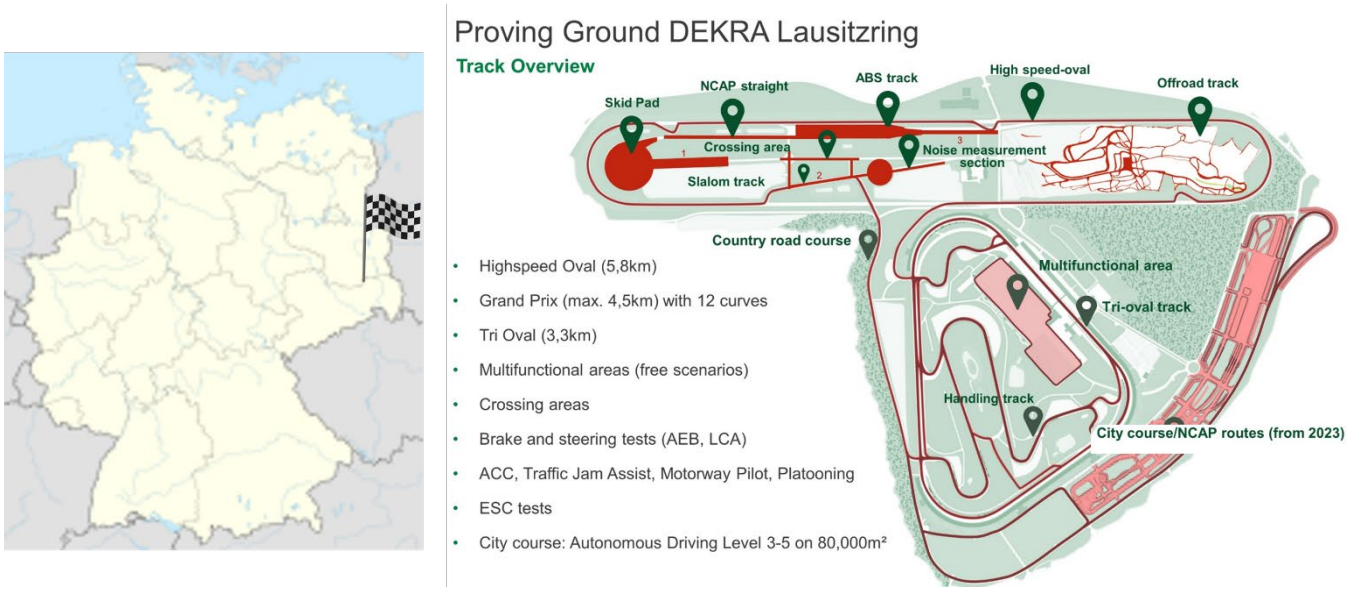
WvL: Not necessarily. Whether it's type approval or self-certification, clear requirements are crucial. In the U.S., NHTSA developed ADB requirements without industry or standardization group involvement. Universities and scientists should contribute to developing safety levels and limits, while testing experts should define the standards for tests using these limits. There's a wealth of knowledge within the industry and testing institutes like DEKRA. It's essential to create reliable, accurate, and repeatable results.

DVN: Wilfried, thank you for your insights

Dekra Testing Facility in Klettwitz / Germany

1.7 Area and History

The original idea of a racetrack in the far south east was created as a replacement for the Berlin AVUS city race track in a former brown coal open-cast mine. The original plannings already came up during the era before the German reunification and were originally included in the GDR “five-year plan” in 1986.
The opening of the Berlin Wall in 1989 initially delayed construction, but the subsequent increase in traffic in Berlin's city center reinitiated the search for an alternative racetrack in the expanded metropolitan area. And Klettwitz is just at the state border between the are Berlin-Brandenburg and Saxony.
The “Lausitzring” was built on the site of a former opencast mine. The large conveyor bridge and some coal mining machines near the facility are still a reminder of this time today.



DEKRA Klettwitz and their different testing applications (DEKRA/ *Wikipedia*)

After a serious racing accident, racing operations at the AVUS were stopped prematurely in 1998, but a year later the Lausitzring opened in 1999 after a closing ceremony for the AVUS.

EuroSpeedway Lausitz
“Lausitzring” in action (*Wikipedia*)

Some technical parameters of the track:
There is a main tribune/stand 368m long and with a capacity of low and high area of about 25.000 visitors.

23 VIP lounges in the main stand are located with their own terrace and 28 business seats each with a fascinating view over the entire racetrack. 17 lounges for 40 to 45 guests each directly above the pits and with a direct view of the pit lane. 39 commentary booths are located below the raised grandstand roof.
Other facilities are a Welcome Center, Speedway Inn, 16 shop outlets, First aid area, a big Media Center, with 400 fully equipped workstations, catering kitchen, meeting and seminar rooms, briefing room for racing drivers…

1.8 DEKRA Facility

In November 2017 DEKRA took over the famous Lausitzring racetrack and facilities in Klettwitz, Germany. The area covers 540 hectares. That is equivalent to 770 soccer fields or 1333 acres.
DEKRA brings together a great deal of automotive expertise in the Technology Center in Klettwitz. Over 200 employees ensure safe and sustainable mobility of today and tomorrow. On one of Europe's most modern test tracks, own test benches and in the laboratories the focus is many kinds of safety. Among other things, this covers automated and autonomous driving, emissions and drive, passive safety and, from 2025, high-voltage battery tests - both in development-related testing and as part of homologation, Type testing and market surveillance.

DEKRA Team right inside the ADB Test track: R2L: DVN's Michael Hamm, Wilfried van Laarhoven, Daniel Kapitany and Peter Röder. (DEKRA)

For automated driving functions DEKRA targets to offer all parts of testing including facilities and routes independent if inner-city, out-of-town or motorway journeys. The coming infrastructure will also include all the necessary components to include Vehicle-to-vehicle or vehicle-to-infrastructure communication (V2V or V2X). The metrological equipment includes state-of-the-art Systems such as driving robots, self-propelled platforms, various soft targets as well mobile traffic infrastructure facilities.
Additionally, DEKRA has a training center offering seminars for technical qualifications and in outdoor driver safety qualifications. Their facilities can welcome more than 500 participants.

And – such a big area with covered and uncovered grandstands like in a stadium, they are attractive for racing events (DTM, Red Bull Championships…) as well as pop concerts….

1.9 Lighting and vehicle issues

At DEKRA Automobile Test Center, the focus is on the vehicle as a complete system. With the homologation/type approval and the driving dynamics testing of:

- motorcycles,
- cars,
- trucks,
- trailers,
- agricultural and forestry machines,
- self-driving work machines and trailer work machines,
- and system and parts suppliers

DEKRA ensures for manufacturers and importers that their vehicles, chassis, and driver assistant systems and other component meet the applicable and common regulations.

In this way, quality standards can already be involved in the development of new vehicles and accessories. In the process, the following is possible:

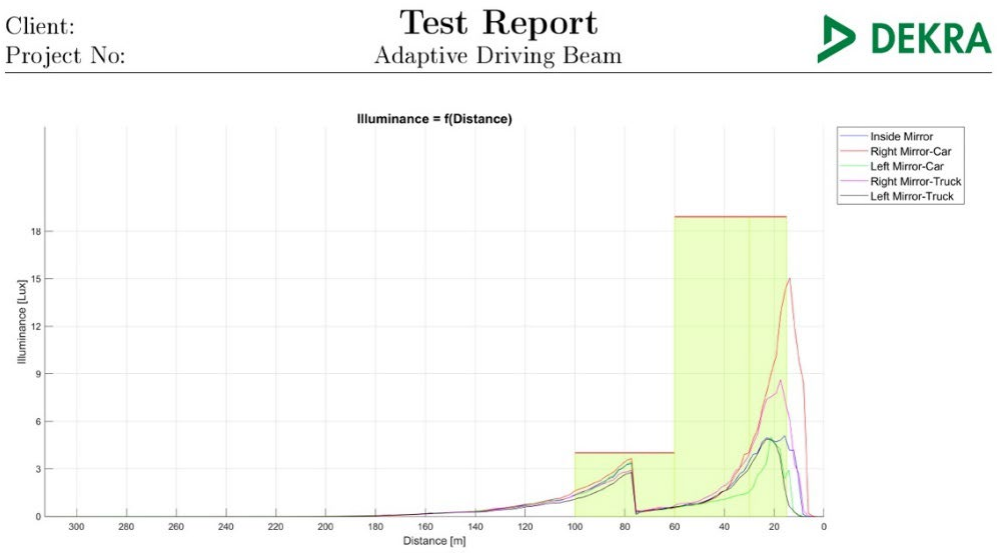
- Technical reports for ECE approvals
- Type approvals of vehicles and vehicle parts
- ADB Testing according to NHTSA FMVSS Standard from 2022

1.10 ADB Outdoor

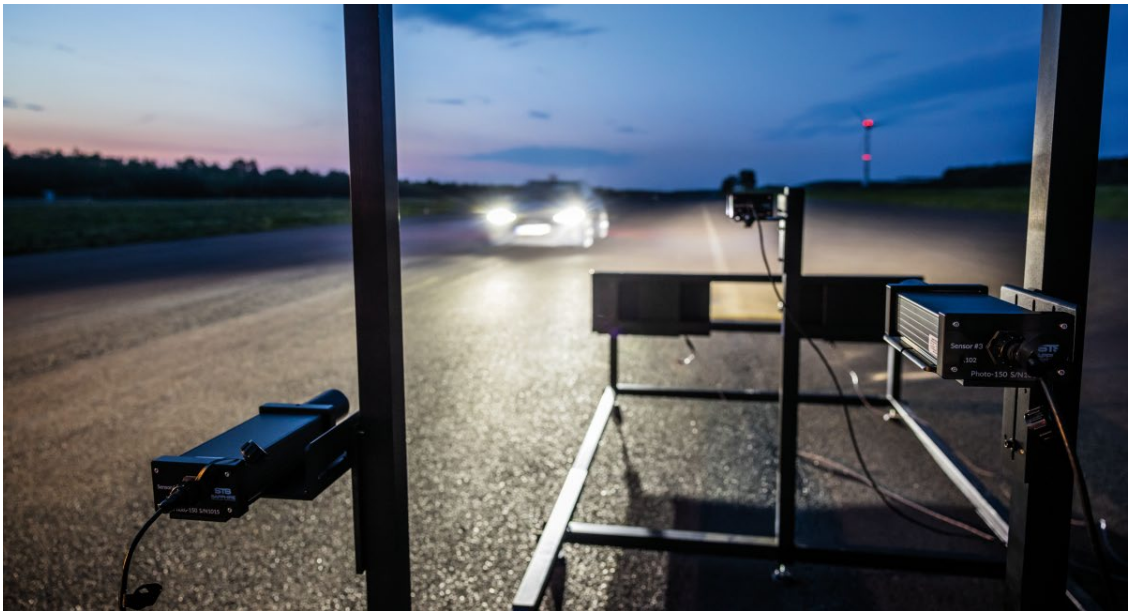
Relevant for lighting is that the open area offers the possibility of Outdoor testings like they are required for SAE J3069 ADB lighting or the new NHTSA ADB testing requirements

Driving plan for NHTSA ADB Outdoor testing. (DEKRA)

DEKRA Klettwitz has installed a measurement and evaluation system to record, evaluate and document for their customers. So ADB Outdoor measurements can be used to support the manufacturer self-certification in the U.S. FMVSS framework.
Together with the indoor laboratory capabilities in DEKRA Arnhem, they can offer a broad portfolio in lighting measurements.

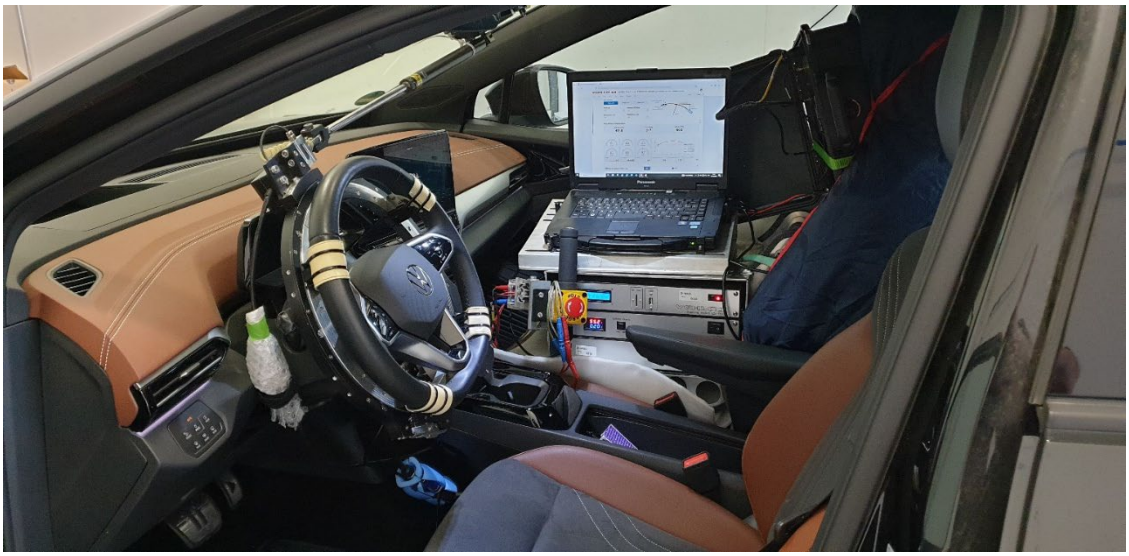


Test Report from an ADB NHTSA Outdoor test.



Testtrack at night NHTSA ADB Outdoor testing. (DEKRA)

One of the specialties for outdoor lighting test is that the DEKRA team could participate from the Test Center competence in automated drive testing. They have been able to implement a steering robot in order to eliminate the car position tolerances while testing the glare and deglare functions.



Steering robot application at the steering wheel for NHTSA ADB Outdoor testing. (DEKRA)

As a positive side effect, the automated driving ability at the Klettwitz testing site enables the lighting team to offer a drive with a steering robot. The automatic steering and gas throttle control is implemented via non-destructive testing in the test cars. According to the DEKRA Klettwitz team, only a few days are needed to prepare the tests. And – if the weather is fine – they could perform a test in one or two nights. The preciseness is higher than any driver could do and repeatability at least for the track position is guaranteed. Deviations are less than 10cm. Due to the test track size there is sufficient acceleration and deceleration space. Even those elements are automated. The author was able to participate in a testing round and can confirm it works.

1.11 Inverview: Peter Röder, Head of an Automotive Test Dept., DEKRA Automobil GmbH Klettwitz

DVN: How did you come to ADB testing in Klettwitz for U.S. regulations?

PR: Well, there was history before. Initially, an OEM asked because of some Chinese Regulations on Driving Paths on DEKRA Proving Ground Klettwitz. This was a time before SAE J3069 and ADB. But since that inquiry we were aware that driving paths could be covered. Some time later NHTSA ADB came into focus. Especially for the dynamic test requirements we discovered we are one of only a few test tracks that can provide the needed surface requirements. And we are neutral and open for all.

DVN: What makes your Klettwitz area better than others ?

PR: We are using a steering wheel operating robot, at the beginning we just thought it could be a nice option. Meanwhile we see from the driving results that especially due to preciseness in driving path tolerances this should be mandatory, even though the NHTSA ADB regulation does not request that. Doing this, we can offer a system with increased efficiency, no track painting, no extra markings etc.

We just put a digital grid on the surface, that was a one-time effort, and we can use that without any change again and again. This saves time and makes our service much more attractive. And we are precise, with only 5 to 10 centimeters of deviation in any test scenario.

DVN: Now ADB is available in hundreds of car models following ECE requirements. What is your experience in interest for U.S. ADB ?

PR: Sure, we expected a higher increase in the requests for our services. But we are in contact with OEM and suppliers. Maybe a cause could be delay in development.
Second, there might be seen some risk at some OEM of being one of the first. Because even when we can deliver correct and positive test results, the next outdoor verification test could deliver slightly deviating results. And third, in the prevision of vehicle market's ups and down it might be that the customer's priority is not US ADB.

DVN: What workload do you expect from this special segment in ADB testing ?

PR: Looking to the activities with customers we contracted this could lead to about 12 or 13 measurement rounds per year, 2 to 3 measuring nights per go. The wintertime is better for us than the summer, given that we need more darkness time.

DVN: What are your ideas for future interaction in lighting ?

PR: Automated driving and lighting systems will be an interesting field. We have a team totally dedicated to autonomous driving and it might be a valuable contribution to investigate the interaction, e.g. visibility of moving participants at night and the system reaction. There are customers starting to contact us for designing test setups. We can also give assistance for a precheck in IIHS tests.

DVN: You have a huge testing site, please explain some of the other testing possibilities ?

PR: We have many services, many tests accompanying vehicle development, especially for autonomous driving. Homologation type approval for full vehicle and components, lamps and devices we cover Reg. 48. Many activities are for braking, steering, cyber security, ESP, all things covering dynamic testing. Another field is for electromobility range-, consumption- and cw-data investigation in every sector, truck, passenger vehicle, motorbikes. We offer powertrain testing, emission investigations and more.

DVN: Thank you for these insights in your work.

New Developments and fields of activity

seen by Wilfried van Laarhoven, DEKRA

One of the focus areas of activity will be harmonization (besides progress in technology, updating, safety investigations and many more). Here are some thoughts:

Harmonizations

Several markets have created their own standards and approval schemes:

- **UNECE** is a big part of the world including Europe (and EU), Japan and many countries: more than 60 which are called contracting parties (CP). Each CP can issue approvals that have to be accepted by the other CPs. The idea is to create an economic level playing field based on safety requirements.

- **India** is not CP of UNECE. It has published its own Automotive Indian Standards (AIS). Fortunately for the industry the AIS requirements correspond with those of UNECE Regulations. Therefore, the devices developed according to UNECE can also be approved in India. So, except the efforts to be taken to get the approvals for India, there is no technical burden for the industry.

- **Taiwan** is not a CP of UNECE but also has copied the requirements from the UNECE Regulations. In case of updates of UNECE Regulations there is a delay before Taiwan has copied these into their requirements, which can temporarily result in a mismatch what can be approved.

- **China** is not a CP and created the GB Standards. The technical requirements correspond with those of UNECE but there are a few mismatches. Generally, the same products can be approved for UNECE and China as well. Different formalities apply.

- **North-America.** In the USA the products have to meet the requirements of the Federal Motor Vehicle Safety Standards (FMVSS). The requirements however are different from UNECE and therefore the automotive lighting devices also differ from UNECE. At a first glance they look the same but often the internal optical elements are different to meet the FMVSS requirements. So generally the headlamps and rear combination lamps in USA and the rest of the world have a different performance. Canada is generally following the FMVSS requirement of the USA but for some lamps and functions Canada accepts the UNECE requirements as an alternative.

- **Other markets**. Most countries in the world not part of the above schemes have their own national automotive requirements. Sometimes they have one or more free-trade agreement one or more other markets indirectly accepting products from those markets without further approval testing or certification.

Outlook & Author's Summary

Testhouses are real hidden champions. DEKRA and the teams inside are big players in the world of test houses. Their homologation testing and reports open the door for having the required official approval markings at the lamp's housing, E-marks, CCC or many more. The lighting world is relying on their expertise and preciseness of their reports.

What the report shows is that regulation needs to follow the innovation speed by considering the technical impact and thus to report in GTB and GRE about recommendations on adopting the rules. The super idea of worldwide harmonization seems still to be a target far away, so the synchronization of the national specialities is a key feature the test houses are looking at.

We see from the interviews and lists that there are many different elements that must be considered when any car manufacturer wants to bring a vehicle to a worldwide market. No homologation – no car. And this report covers just lighting. The vehicle world seems to be even more complex.

An outlook shows that there are many new elements in lighting that have to be covered and it must be checked how and where new lighting elements can be addressed: e.g. ground projections, HD matrix systems, symbol projections, animations, autonomous driving requirements etc..

It seems test houses are not running out of challenges.

So thank you for your interest and endurance when you arrived on that page.

Regards,
Michael Hamm
DVN Senior Advisor

List of main DVN Monthly reports

Main reports launched in 2008-2020

Koito company profile
China lighting market
The Wonderful World of Passenger Car lighting
Tier 2 and 3 contribution on automotive lighting
ZKW company profile
Simulations in automotive lighting
Mercedes-Benz profile
LED technologies in automotive lighting
LEDs Thermo-Electrics
Interior Lighting BMW
and lighting Lighting
and ADAS Materials in
lighting Laser Head
lighting
Automotive lighting Regulations
worldwide Israeli Startups
Jaguar Land Rover and lighting
Engineering companies involved in lighting
Japanese lighting market
Status of w/w Regulations
Korea Lighting Market
SL Corp profile
ADB/Matrix Beam
India Car Industry and Lighting Market
Vision of lighting 2025-2030
Automotive lighting Regulations worldwide
Vehicle Lighting in USA
New ADB technologies
Interior Lighting Camera
technologies Varroc profile
Volkswagen profile
US automotive lighting industry
Materials in Vehicle Lighting
The Future of Exterior Lighting
IAA Frankfort Autoshow
DVN Munich WS
GENEVA
Autoshow US
Lighting Marelli
AL Profile
50 years Light
Styling ADAS and
Lighting

Main reports launched in 2021

Evolution of LEDs
New Models July-October
2020 Audi Lighting & ADAS
Lighting in development countries
ADB Update
DVN Shanghai WS
Innovations in Rear Lighting
Global Landscape of Automotive LED Suppliers

Reports launched in 2022

Technologies presented in CES 2022
Laser light automotive lighting
ISAL report
DVN US workshop
Worldwide Demographic Development
Models launched May to August DVN
Shanghai report
VISION congress
Paris Autoshow + last Vehicle models
L.A. Autoshow

Reports launched in 2023

CES Report
TU Darmstadt Lighting Institute
DVN Paris Workshop
Universities and Lighting
MLA Technology
Models launched in H1-2023 DVN Tokyo
Workshop ISAL Report
DVN US Workshop Osram Company
Profile DVN Shanghai Workshop

Reports launched in 2024

CES
New cars of the semester
DVN Munich Workshop
OLED Technology Beijing Autoshow
Display Week
2024 DVN Detroit Workshop ALE, June
2024
Indian vehicle lighting market
DVN Pune Workshop summary
New cars 2024
Nichia company profile Test houses
Shanghai DVN event summary

Reports to be launched in 2025

CES and Bharat Mobility Global Expo
Regulation UNECE 155 &156
DVN Munich event summary
Dekra testhouse
Company Profile
ALE + shanghai motorshow report
Czech Republic automotive lighting
ecosystem
RGB leds status

DVN ecosystem and scientific community

DVN is a reference in the world of Lighting, Interior comfort and Lidar

Car Makers

Audi
Avatr Technology
Bentley
BMW
Ferrari
Ford
Ford Otosan
General Motors
Genesis
Hero MotoCorp
Honda
Hyundai
Jaguar-Land Rover
Kia
Lotus cars
Lucid Motors
Mazda
Mercedes-Benz
Mitsubishi Motors
Nio
Nissan
Renault
Rivian
Seat
Stellantis
Subaru
Toyota
TVS
SAIC Volkswagen
Volvo Cars
Zoox

System Suppliers and Tier 1s

Adient
Anrui
Appotronics
Aspöck Systems
Braslux
Cepton
Ceres Holographics
Chongqing Rebo
Continental
Creat
Diode Dynamics
Elba
F2J Industry
Feka
Fiem Industry
Flex-N-gate
FORVIA designLED
FORVIA HELLA
GHSP
Grupo Antolin
Hascovision
Hitachi
Ichikoh
J.W. Speaker
Keboda
Koito
Lightworks
Lumax
Luxit
Maier
Magna
Marelli
Marquardt
Mind
Mobileye
Mobis
Muth Mirror Systems
Nordic Lights
Odelo Farba
OPmobility
Panasonic
Polycontact
Prettl group
Rehau
SL Corporation
SMR Automotive
Stanley
The Lighting Consultants
Toyota Boshoku
Uno Minda
Valeo
Varroc
Weidplas CH
Xingyu
Zanini
ZKW
Zodiac

Light Source Suppliers

ams OSRAM
APT Electronics
Brightek
Dominant Opto Tech.
Everlight Electr.
HC Semitek
Kyocera SLD Laser
LG Innotek
Liteon Technology
Lumileds
Nichia
OLEDWorks
Refond
Samsung LED
Seoul Semiconductor

Tier 2s and service providers

A2Mac1
Ascorium
AML Systems
Ansys
ASAP
ASYST Technologies
Auer Lighting
BASF
Bluebinaries
Brightview Technologies
Capgemini
CLM Search
Coindu
Covestro
Dajac
DBM Reflex
Delo
Die haptiker GmbH
Docter Optics
Dow
Edag
Elmos
Endego
Ennostar
Euro Moulders
EV Group
Focuslight
Fusaware
Grewus
HJ Optics
Huawei
Idemitsu
Infineon
Inova Semiconductors
Instrument Systems
Integrity
Joysonquin
Leonhard Kurz
L.E.S.S.
LMT
Luminus
Mektec
Microvision
Maxell Frontier
MD Group
Melexis
Microchip
Microrelleus
Mitsui Chemicals
Mocom
Nalux
NBHX Trim
Oerlikon
ON Semiconductor
Polyrise
Preh
Ray Group
S&P Global Mobility
Sabic
Seaborough
Seoyoneh-Ewha
Shihu
SP3
Sunny Automotive Optech
Suzhou Senbo
Synopsys
TechnoTeam
Toshiba lighting
TQ Technology
Uni Tooling
Ventura
W.L. Gore & Associates
WLOPT
X2F
Xunchi

Universities, NGO and labs

Alliance for Automotive Innovation
ARAI
Automotive Research Association of India
BMDV
Bundesministerium für Digitales und Verkehr
CATARC
China Automotive Technology and Research Center
CEA Leti
Darmstadt university
DEKRA
Department for transport, UK
DTI
Danish Technological Institute
Estaca
École supérieure des techniques aéronautiques et de construction automobile
Fraunhofer (FEP, IAP, ILT, IMS)
Fudan university
GTB
Hannover Leibniz
Hochschule Aalen
Hochschule Magdeburg-Stendal
Icahn School of Medicine at Mount Sinai
Light and Health Research Center
ICAT
International Centre for Automotive Technology
Idiada
Institut d'Optique
JASIC
Japan Automobile Standards Internationalization Center
KBA
(Kraftfahrt-Bundesamt)
KATRI
Korea Apparel Testing & Research Institute
KIT
Karlsruhe Institute of Technology
Kotsa
Korea Transportation Safety Authority
LCOE
Laboratorio Central Oficial de Electrotecnia
L-LAB
MLIT
Ministry of Land, Infrastructure, Transport and Tourism
NHTSA
National Highway Traffic Safety Administration
OICA
International Organization of Motor Vehicle Manufacturers
Pacific Northwest National Laboratory
RDW
RISE Research Institutes of Sweden
Sapphire STS
SMMT
Society of Motor Manufacturers And Traders
SMVIC
Shanghai Motor Vehicle Inspection Certification
TNO
Traficom
Transport Canada
UMTRI
Université Gustave Eiffel
UTAC
VDA
Verband der Automobilindustrie
VEDECOM
Vrije Universiteit Brussel
YoungNam University

DVN
Lighting