

BRING YOUR IDEAS TO LIFE.



“

The ability to identify a need, and then create a solution that redefines the norm of an entire industry – that is what great engineering is all about”

- CHRISTIAN WADELL, HEAD OF R&D AT TYRI -

DESIGN MATTERS

In the automotive industry, design has always been of greatest importance. The lights on a car are one of the most important design elements and brand signals. Today, this is becoming as important for heavy vehicles.

When designing new lights for a vehicle there is much more to consider besides the look and feel of the light. High quality vehicles need high quality lights, in more ways than one. Quality means high quality products with a long lifetime, but it also means a high quality light output, optimal and flexible lighting to enable the driver to build a good working environment. Environmental issues in and sustainability will also become more important in the near future.

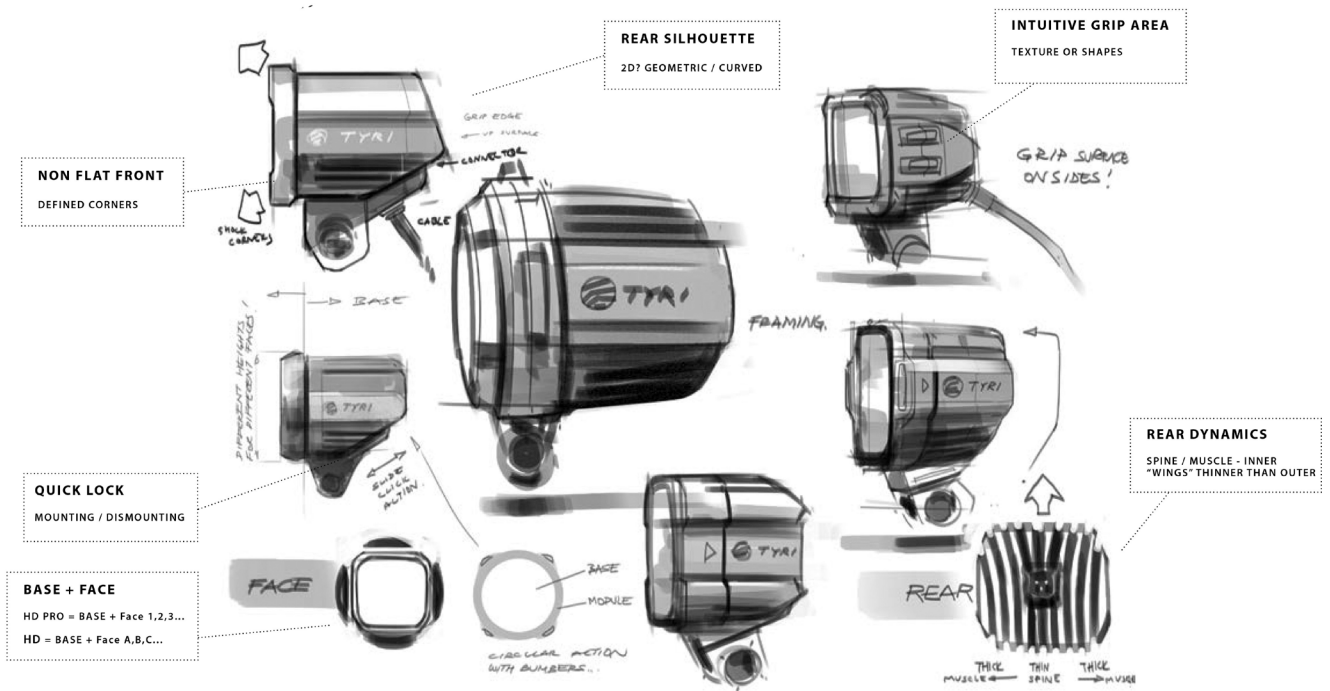
TYRI has been in the forefront of work light technology for over 40 years, and we continually strive to develop new technologies, to control lighting in completely new ways and to design industry leading concepts tailored to our customers needs.

We can take the role as a strategic design partner working with you, and acting as your lighting specialist, integrating into your design team. We also work with tactical design by adaptation. Where we can customise TYRI products with special features.

Don't hesitate to contact us when planning for the next generation of your vehicles. Our team of specialists are at your service.

CHRISTIAN WADELL





CUSTOM DESIGNED WORK LIGHTS

- more cost-effective than you think

For many years, we have seen how the automotive industry uses lighting as a brand-strengthening asset. Few design details are as distinctive and character-creating, for the brand and vehicle, as well-designed lights. But how do you produce lighting that is tailored to a vehicle? Additionally, how do you design lights to not only look distinctive but also give effective lighting where it is needed? TYRI has over 40 years of experience in the design and production of lighting. We have worked with some of the most recognisable brands in agriculture, material handling, mining, and construction. TYRI's Christian Wadell, responsible for product and design development, explains how we can help you to develop your custom lights.



In recent years, TYRI has made many different design collaborations with some of the largest manufacturers in the world. For example, together with Toyota Material Handling, TYRI worked to design a rear lighting bar for the Toyota Traigo80. A truck that in 2019 won a German Design Award. TYRI has also received awards as the best supplier from many of its well-known customers. The secret, says Christian, is the proximity to the customer and TYRI's clear focus on having everything in house.

- There are few assignments that are impossible for us. Our customers are very creative and have high expectations that we always aim to exceed. This means that we aim to create an organization that will always go above and beyond for our customers, and we invest in having all the expertise in house. Bringing a bespoke lighting solution to a customer is always fun and challenging. When we have clear expectations of what the lighting will achieve and we are involved in the design work from the start, we can involve our experts at an early stage saving time and money in long run. The design team produces the exterior design, the technicians manage the conditions so that the light meets the desired requirements.

Our team of 3D designers make simulations that show how the vehicle looks with the proposed lights and what light image you can expect. Then comes testing and production where we build prototypes in our production facility and test them in our own test environments. Just like when we develop new lights that will be mass-produced in hundreds of thousands of units, Christian says.

The difference in cost for designing your own lighting compared to buying mass-produced ones decreases with the number of units. TYRI says that usually, a volume of 5000 units is required for it to be possible to compare prices. Then it is a lot about what the design looks like and what conditions and requirements there are.

- The cost does not have to exceed our mass-produced lights. Many times, we can use a lot of what is already available so when the requirement is for small volumes, the production looks the same, no matter what kind of light it is. The additional costs that exist are for the design, development and test work and it usually does not make much difference per unit in the end, says Christian.

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There are few assignments that are impossible for us. Our customers are very creative and have high expectations that we always aim to exceed.”

- CHRISTIAN WADELL, HEAD OF R&D AT TYRI.

The benefits of designing lights specifically for the vehicle and purpose are many. The opportunity for your own design and what it creates in value for the brand is of course a great advantage. However, it is about so much more than that. The design inside the lamp is also as important. Here, the customer can specify how strong the light should be, the

light colour, whether it is a warm or cold light you are striving for, and other specifications that can be met when the light is built from the ground up for a specific vehicle.

- With all the advantages that exist in designing customised lights, I would say that they are superior to the lights we have in series production. Here we use 40 years of experience and the company's full potential to produce a specific light at a cost that is often close to our catalogue lights, says Christian.



LEVELS OF CUSTOM DESIGN

Lighting can be one of the most recognisable vehicle design features available. Utilised by premium brands to stand out from the pack, it can be tailored in look and performance to uniquely emphasise the style of a machine.

A common misconception is that this level of design is out of reach for most machine manufacturers, however this is not always the case. There are different options available when working with lighting experts, such as TYRI.

- Level One – entry level
- Level Two – mid entry point
- Level Three – top entry point

From adapting colours and logotypes to a completely new product, in many cases, we are able to utilise existing proven technology to reduce cost and time frame. Here we discuss these levels of design.



Re-design

The most basic and lowest entry point for custom lights is to take an existing product and modify this to meet your needs. This can include changing the colour, logo, or trim details. This level is an effective solution which offers time saving as well as cost saving benefits as it has low to no entry cost. It uses an existing tried and tested product, so additional testing is not needed in most cases. A potential disadvantage to this level is that it does have limited design options. This level of design was utilised by Jeep when they approached TYRI Americas to initially supply a more powerful, durable off road light package for Jeep's new JL Wrangler launched in 2018. Read their story on page 8.





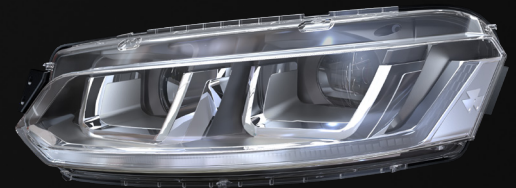
Module based

A mid entry custom design product or modular based design uses existing PCBA or electronics as well as optical systems to create a new product. This option gives more flexible design freedom as the outer shell of the light can be designed to your specifications using our expert knowledge. This design has a low to mid entry cost point and was used when TYRI UK worked alongside Terberg Benschop, based in the Netherlands. Read their full story on page 9.

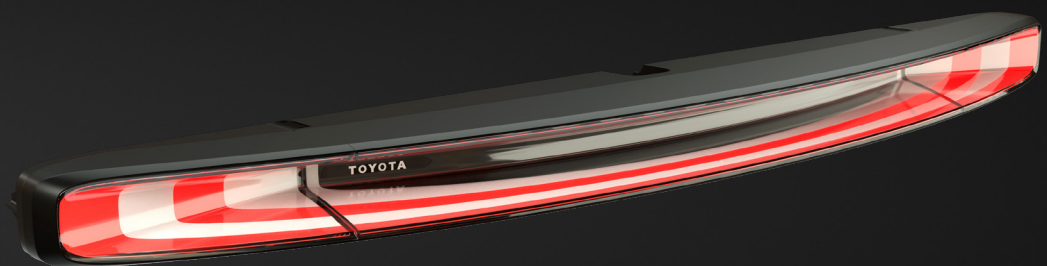


New Design

Using our lighting expert's knowledge, TYRI works with your design team to design and build a completely new lighting product to perform to your exact requirements. This option is a mid to high entry cost and for the most effective results, requires TYRI to work alongside your design team to ensure complete synergy in design and expectation throughout the project. This process was followed by Massey Ferguson working with TYRI Sweden and resulted in brand new Halogen and LED headlights and work lights being created. All developed products are subjected to TYRI and industry testing standards to ensure longevity and performance. Read Massey Ferguson's story on page 13.



TYRI also worked alongside Toyota to create a bespoke rear light bar to incorporate full functionality of brake warning, turn and reverse signals in one stylish unit for their Traigo 80 forklift (page 10). During this project, TYRI worked alongside Toyota's design team from the beginning to deliver on style and performance. Using TYRI lighting experts, Toyota Material Handling was able to extend the knowledge of their design team to produce a Forklift truck which went on to win a German design award in 2019.





OFF ROADING WITH JEEP



TYRI Lights was approached to initially supply a more powerful, durable off road light package for Jeep's new JL Wrangler launched in 2018.

Working with Jeep, TYRI Lights designed a custom lighting package which included a 1010 work light with a 4600 elumen output which includes the Jeep logo in the lens and light covers. These lights are now available in kit form for the A pillars of the Jeep and are supplied through Jeep Performance Parts and Mopar.

TYRI also designed a custom 1313, 8000 eLumen kit with the same Jeep specs and logo as the 1010 kit. These lights are to be mounted to the grill guard or bumper. Both Light Kits include wires, ties and installation instructions.

Building on the success of these kits, TYRI began work on a similar project for the Dodge truck launched in 2019. This is a 1010 kit with Mopar logo on both the lens and cover.

TYRI Lights has a strong working relationship with Jeep and Mopar and will continue to develop more lighting possibilities in the future!

David Halvorson, TYRI Business Development Manager said, "It's been a pleasure working with Jeep to upgrade their lighting packages, and we look forward to continuing our partnership through new and exciting launches. TYRI lights have proven to be very popular with Jeep enthusiasts and we are excited to develop further products to serve the Jeep community."

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TYRI lights have proven to be very popular with Jeep enthusiasts and we are excited to develop further products to serve the Jeep community.

DAVID HALVORSON, TYRI BUSINESS DEVELOPMENT MANAGER



SUPERIOR LIGHTING WITH TERBERG BENSCHOP



When Terberg Benschop, based in the Netherlands, wanted to offer an LED alternative headlight to meet customer demands, they began to look at possible suppliers.

The new headlight needed to have the same look and feel of their current applications to allow retro fitting into the existing mounting points and be offered as an upgrade from Halogen to LED. They also required a LED turn signal to match the LED headlight. This also had to be designed in the current format; a yellow lens turn signal to fit on the current mounting points and be separate from the headlight.

As these demands were very specific, several other OEM lighting companies were not able to design or supply a new product within the parameters of size, fit and technology. However, TYRI began to work with Terberg Benschop to fully explore their needs and assess whether it was possible. TYRI gave a ground up project feasibility report and developed relationships with key Terberg Benschop personnel to help develop this new lighting product to meet their exact specifications.

TYRI's Research and Development department began work on this challenging project to develop a new headlight

from concept, through design, to production. With lighting experts at each stage liaising with Terberg Benschop to inform them of progress and achieve sign off.

The results delivered the HL Compact, a space efficient LED headlight specifically designed to provide more light to the sides than standard headlights and allowing for higher installation.

HL Compact met Terberg Benschop's need for an attractive drop in replacement option for halogen headlights and complies with ECE R112, R87, R7 and R10 standards. The external turn signal also conforms to ECE R6, categories 1 and 6. Additionally, it features daytime running lights as well as multiple configurations to adapt to vehicle requirements.

TYRI Business Development Manager, Christopher Parke reflects on the project, "This development journey was challenging and had many issues to overcome. However, with TYRI lighting experts and resources in house, we were able to deliver a quality product, specifically designed to meet the needs of Terberg Benschop's existing and future applications. The HL Compact offers industry first, superior lighting and delivers on the specifications set by Terberg Benschop. We look forward to working with Terberg Benschop on future projects."



AWARD WINNING WITH TOYOTA



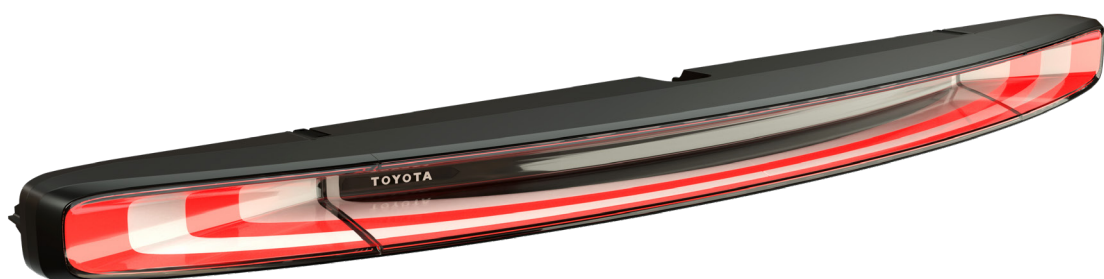
TYRI proud to be part of the Toyota Material Handling German Design Award winning team.

TYRI are proud to have worked alongside Toyota Material Handling to create exclusive and custom rear lighting bar for their Traigo80, a top-of-the-range, heavy-duty electric forklift and the official winner in The German Design Awards. The Traigo80 was chosen as the winner in the category 'Excellent Product Design' awarded by an esteemed international jury of experts. The German Design Awards are international prizes awarded by the German Design Council to honour unique design trends.

TYRI worked closely with the Toyota Material Handling design team to create a completely lighting system which brings together full rear lighting functionality of brake

warning, turn and reverse signals in one stylish unit which fits the clean look of the Toyota Traigo80. This unit is exclusive to Toyota Material Handling and showcases what can be achieved in lighting design by TYRI working alongside OE manufacturers.

TYRI founder, Martin Karlberg stated, "Our sincere congratulations to Toyota Material Handling on being awarded the prestigious German Design Award 2019 for the Toyota Material Handling Traigo 80. It's really fantastic news and highlights the efforts and hard work of everyone working on this project leading towards this great accomplishment. We as the TYRI team are really thankful and humble Toyota Material Handling's confidence and trust in us to deliver a part of this amazing machine."



TYRI LIGHT ACADEMY



Education, insights, tips, updates and industry trends for work lighting in off highway vehicle manufacture and aftermarket.

TYRI are lighting experts and we believe in sharing our knowledge to help you make better informed decision on what work lighting solution will deliver the best results for your application. We work alongside your team to develop unique and effective lighting that delivers on performance, design and longevity.

Visit us at:
tyrilights.com/tyri-light-academy/



SOME OF OUR AWARDS



2015, 2016, 2017, 2018,
2019 & 2020
*John Deere Construction
& Forestry*



2014 & 2019
Unicarriers



2022
Red Dot Award



2015 & 2016
Hyster Yale Group



2018
Hyster Yale Group



2018
Hyster Yale Group

SPECIAL HEADLIGHT DESIGN CAPABILITIES

TYRI's expertise is not limited to work lights. Applying our knowledge of optics and lighting we are able to design and manufacture unique headlights in both LED and halogen technologies. These lights are tested and approved to industry standards for on road use as well as TYRI's own robust testing standards. Contact TYRI to discuss your headlight needs.

DESIGN CO-OPERATION



Allowing TYRI to be part of your design team early means you receive expert advice from the beginning meaning designs can be more integrated into the machine's design.

REGULATIONS



With extensive knowledge and experience of onroad regulations, TYRI can ensure your headlights are road legal and effective.



Tractor of the Year 2021
Red Dot Product Design 2021
AE50 Award 2021
Farm Machine 2022



SUCCESSFUL DESIGN WITH MASSEY FERGUSON



With over 160 years history, Massey Ferguson is one of the leading and most recognisable tractor brands in the world. Their design and brand language are clear, and their manufacturing process is of the highest quality. When Massey Ferguson began to develop a new tractor series, they turned to TYRI to help design the unique lighting required.

- This project was a prestigious assignment for TYRI. Massey Ferguson is one of the world's best manufacturers of tractors and we know that they place very high demands on their suppliers. TYRI was given the chance to be involved from the start of the project, developing the lighting for a new tractor series, ensuring it added value and increased the overall user experience of the tractor. A very exciting assignment, says Sibylle Naumann-Edgren, Area Sales Manager at TYRI.

The requirement was to produce quality headlights and work lights both in halogen and LED with an "automotive style" look. The lighting would be part of the brand-based communication in the tractor series' design. As standard practice in the automotive industry for many years – lighting is used to develop the character-generating features that create brand recognition in the details of the design. To make this possible, TYRI was consulted early in the process at a start-up meeting in Beauvais, France, where Massey Ferguson's headquarters and design centres are located. During the process, frequent reconciliation meetings were

held both on site in France, but also in Sweden and via virtual meetings.

- The close dialogue with industrial and CAD designers at Massey Ferguson was crucial to achieving the goals set out in this project. The desired design in combination with the technical conditions must be compatible for a successful project and then there must be a close dialogue between the various sub-projects. A simple example is that physically a certain amount of space is required for the lamp to produce a certain amount of light, says Per-Arne Torstensson, Senior Optical Engineer at TYRI.

Massey Ferguson is known for its brand promise to the end customer, to always deliver the highest possible quality and

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The close dialogue with industrial and CAD designers at Massey Ferguson was crucial to achieving the goals set out in this project.”

- PER-ARNE TORSTENSSON, SENIOR OPTICAL ENGINEER AT TYRI.

user experience. This includes function as well as safety and comfort. Lighting is an important part of all these factors. In addition, creating a design that strengthens the brand and recognition is a challenge. The optical solutions must meet the specification parameters that are set and adapted to the desired design preferences.

- A tractor usually has many lights, which often have different properties and different light distribution patterns. Despite different characteristics, the lamps must still work together to achieve optimal light distribution around the vehicle. It is a complex task to make this work, and it is this knowledge that TYRI offered Massey Ferguson. Effective lighting on a heavy vehicle is crucial for both safety and productivity.

This collaboration was very stimulating, and we were able to show TYRI's entire spectrum of knowledge in both optics and design, says Per-Arne Torstensson at TYRI.

The result of the collaboration speaks for itself - a clear and distinctive design with the light specification desired by Massey Ferguson.

The expert team from TYRI included the following professionals:

- Physicist - Senior Optical Designer
- Global R&D Director
- Project manager
- 3D Visualization Artist
- Mechanical design engineers
- Senior design engineer electronics
- Test engineers
- Area Sales Manager



Massey Ferguson Work Light



Massey Ferguson Headlight

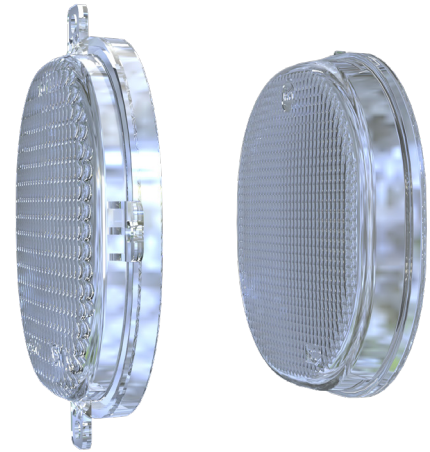


SPECIAL DESIGN ACCESSORIES

One way of adjusting the products is by using different kinds of accessories, like lenses, brackets and ramps.

Lenses

Damage to lights can be expensive to repair so a replaceable lens can make this task much more cost effective. Similarly, if a different light pattern is needed, a replacement lens is a practical solution and is available on a variety of lenses. Please speak with your local TYRI office for further information.



Swivel Bracket

The swivel bracket enables a work light to be easily adjusted into various positions for individual illumination of the work area. This bracket is available for several work lights on the TYRI range and provides maximum mounting flexibility.

Custom Light Ramps

Custom light ramps offer an efficient solution for mounting work lights to machines. Due to the customisable nature, they can be bespoke designed for the intended machine and fitted for lights and wiring in assembly. This means the solution becomes a simple plug and play system, making installing the light ramp much easier. Here is an example of a light ramp designed for a hydraulic excavator.



THE GAME CHANGER

At TYRI, we've always been keen to understand our clients' working environments. That's how we continue to create innovative solutions that improve the operators' working conditions. INTELLi*light* is our new and revolutionary way to connect light sources in a wireless network mesh. Allowing the operator to adjust colour temperature, actively dim and group/regroup all connected lamps. Designed and engineered for a better working environment.

A dream for operators.



ADJUST COLOUR TEMPERATURE

Operating in snow, fog or dust greatly reduces your line of sight. INTELLi*light* enables the operator to seamlessly adjust colour temperature from 2 700 K to 6 500 K creating a clearer line of sight.



ACTIVELY DIM

Dealing with reflections off the bucket, other vehicles or even snow can create glare, this however can easily be adjusted by simply dimming your lights via the TYRI app or the remote control.



GROUP. REGROUP

Use the app or remote control to group and regroup an indefinite number of light sources in a wireless mesh network for perfect lighting in every unique working situation.

More facts about INTELLi*light*.



INDIVIDUALISED PROFILE

Create your own personal configuration and control the system through the app, easily accessible through any smartphone, anywhere.



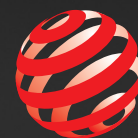
SCALABLE

With the INTELLi*light* system you can add as many new light sources as you wish. Group and regroup them, and then name the settings as you desire.



IMPROVES SAFETY

The light sensor actively detects light from reflections or approaching vehicles, automatically dimming the lights so as not to blind the operators.



red*dot* winner 2022
interface design

INTELLi*light*[®]

For more information visit tyrilights.com



TYRI PARTNER WITH TECHNO CREATIVES

INTELLi*light* - an intelligent lighting system that opens new possibilities for both users and installers, utilizes a digital platform that enables the system to function. This platform is very complex and relatively new, and so requires the very best experts in the world to ensure its continued success. That is why TYRI have partnered with The Techno Creatives, a global leader in digital innovation to ensure the digital system provides advanced functionality in a stable platform.

INTELLi*light* has been received by the market with open arms. No switches in the cab, no cables, no predefined groups of lighting. For the user, the possibility of dimming the lights and changing the light temperature will offer clear advantages. The lighting system, which is based on the lighting being connected in a closed Mesh system via Bluetooth, must be able to be controlled by an app, among other things. A solution that turned out to be more complex and more difficult than TYRI initially thought.

- We are experts in lighting and lighting systems. When we decided to bring the Internet of Things into INTELLi*light* and control the system via an app, we first thought we could do it ourselves. However, we realized quite early on that it is an extremely complex and difficult process to develop an app that does what we want, to be able to control all lighting and at the same time be very easy to use and understand. In our

frustration we encountered The Techno Creatives and after conversations with them, we understood that it would be impossible for us to solve this ourselves. This resulted in a joint venture where we will together develop the world's most user-friendly solution for lighting systems, says Christian Wadell, globally responsible for research and development at TYRI.

The Techno Creatives are a consulting firm with expertise in the development of digital services, products and even companies. Part of the business model is to enter various joint ventures. This business model requires a much greater commitment to all components of the system, and a constant focus on balancing customer value with the commercial. INTELLi*light* was such an assignment that fit well into that model. A very complex and difficult task that triggered Techno to take on the challenge of doing better than everyone else has done before.

INTELLi*light* is developed to create a flexible lighting solution that adapts to the driver's needs and external circumstances (such as dust and snow). The system can easily change brightness and colour temperature for optimal lighting. In addition, without a single extra cable, you can group and regroup your lights. A completely flexible lighting solution that can be controlled with the help of sensors in combination with a remote control or an app.

TYRI TEST LAB

Unique, practical & efficient

TYRI's lights must withstand harsh stresses in the toughest environments. To guarantee that the lights perform in environments where they are subjected to impacts, high salt content, moisture, water, dust, and extreme cold or heat, all products are tested in TYRI's own test lab. Anders Johansson, Head of Quality Testing, takes us on a tour of the lab.

Many lighting manufacturers send their products away for testing, but TYRI has an in-house laboratory. This enables us to quickly and easily examine new products and make modifications to existing products. When we develop new innovations, it is highly practical to have access to our own lab. It allows us to perform tests at an early stage and determine whether we are investing in the right technology, instead of being surprised by faults and shortcomings far into development. Furthermore, it goes much faster when we produce customised lights with clear requirement specifications for what the lights must be able to cope with," says Anders.

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Many lighting manufacturers send their products away for testing, but TYRI has an in-house laboratory. This enables us to quickly and easily examine new products and make modifications to existing products.”

ANDERS JOHANSSON, TYRI HEAD OF QUALITY TESTING





VIBRATION TESTING

To ensure that the lighting is able to withstand the impacts and vibrations to which it is subjected in heavy equipment, the lights are tested in a shaker. It shakes the light with different accelerations at different frequencies in order to check that nothing breaks. Vibrations in the light's various materials are also analysed in the shaker to identify any resonance frequencies.

"If we discover that a material in the light starts to oscillate, we will have to address the design in order to eliminate this," says Anders.

SALT SPRAY CHAMBER

In the salt spray chamber, the lights or their components are sprayed with a mist of distilled water mixed with salt. This is done to test how TYRI's materials withstand corrosion.

"White rust normally appears in this type of test, and is completely harmless. What we watch out for is the emergence of iron oxide rust, which can affect the quality of the light. We have recently started using a new kind of coating on our light housings, which has shown significantly better corrosion resistance than the coating previously used. We could confirm this after hard testing in the salt spray chamber," says Anders.

DUST TESTING

In mines, on farmlands, and in essentially all environments where heavy vehicles are used, there is dust. To ensure that TYRI's lighting can cope with all extreme environments, it must be able to withstand fine-grained dust. In dust testing – which is carried out to determine how well the lights are sealed – the lights are exposed to vacuum and dust is dispersed.

"We work from international guidelines for dust testing. The guidelines describe, among other things, the required size of the dust grains and the degree of vacuum. This test is

incredibly efficient to conduct in-house instead of engaging with external testing institutes, which often have relatively long waiting times," says Anders.

GONIOPHOTOMETER & INTEGRATING SPHERE

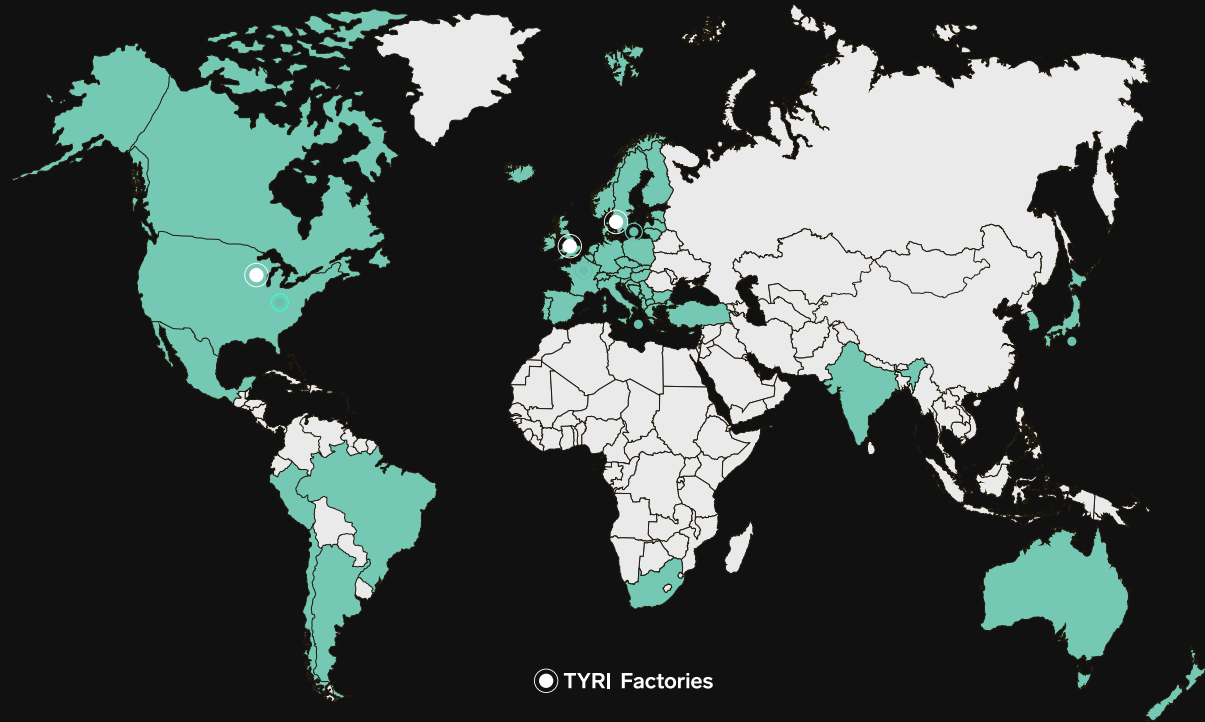
An important part of the testing process is when the distribution and character of light are tested.

"In our goniophotometer we can precisely measure the width and length of the light beam from different angles in order to obtain a representation of the light beam's propagation. From these measurements we also glean information about the luminous flux, luminous intensity and half-value angle. In the integrating sphere we measure the colour temperature of the light as well as the colour rendering index, and we can compare how closely we are able to emulate sunlight, since sunlight is usually considered optimal," explains Anders.

AN EVOLVING LABORATORY

"Today we subject our lights to extreme heat and cold in our environmental chamber to make sure that the products perform in all conditions and the toughest environments. And we measure luminous flux in another device. Our hope is that we will soon be able to test both temperature and luminous flux simultaneously, which will both streamline the testing process and enable us to study other results. That would allow us to see how illumination is affected when the light is extremely cold or overheated," says Anders.

Following TYRI's development of INTELLiLight – intelligent lighting controlled via an app – the need arose for new types of tests in the lab. "We don't yet know exactly which tests will be required from my side going forward, but we anticipate increased standard tests in the lab to ensure the sustainable development of the wireless INTELLiLight. Since we are now introducing new technology with which to work, we will start to regularly conduct software testing and be sure to maintain the app," says Anders.



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