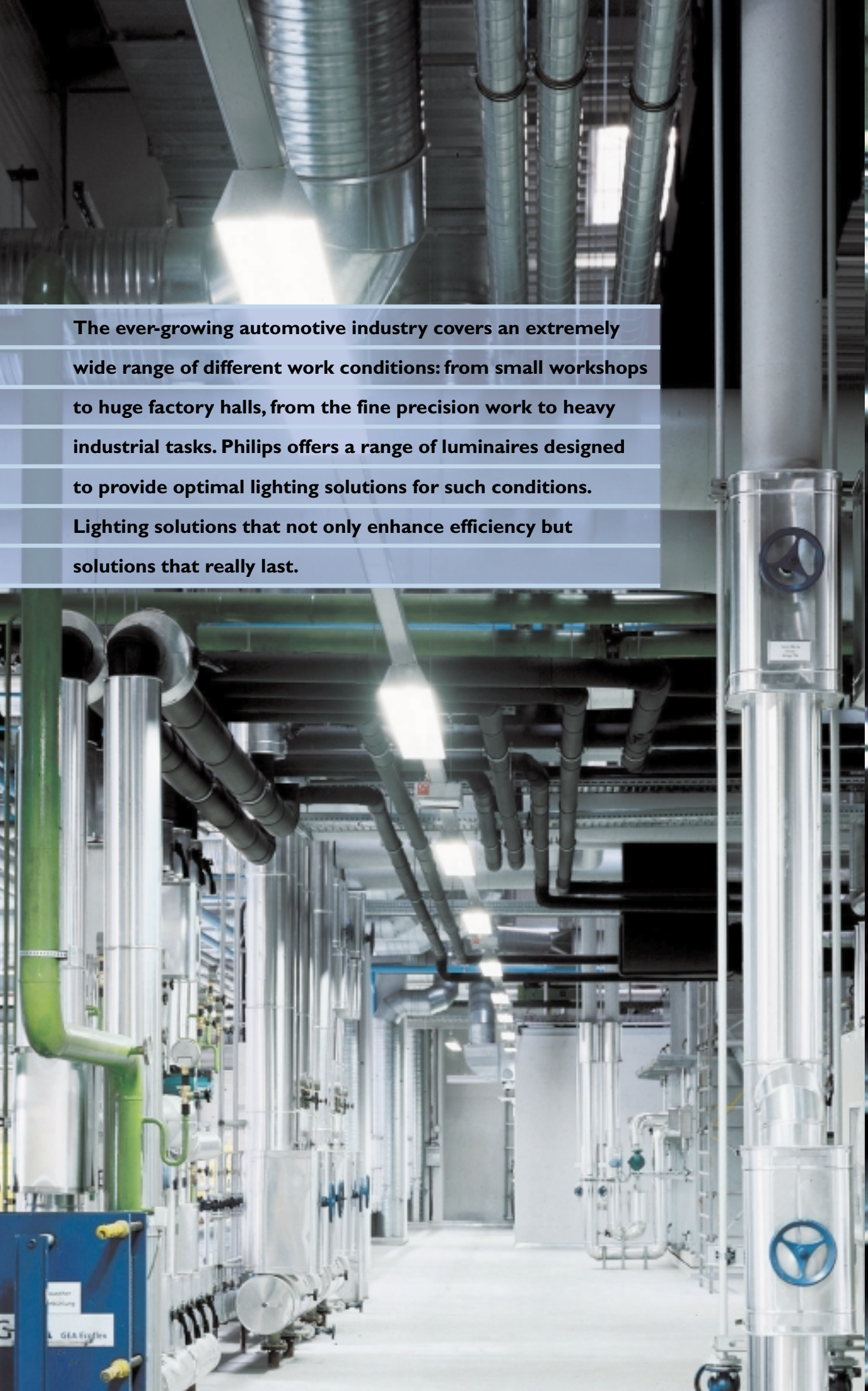
PHILIPS

Automotive Industry Lighting

by Philips Lighting

lighting solutions that really last



The ever-growing automotive industry covers an extremely wide range of different work conditions: from small workshops to huge factory halls, from the fine precision work to heavy industrial tasks. Philips offers a range of luminaires designed to provide optimal lighting solutions for such conditions. Lighting solutions that not only enhance efficiency but solutions that really last.

Proper construction of a vehicle often requires careful inspection at every step of the production process, with each step demanding very specific lighting conditions.

production basics

There are six main phases in the production of a vehicle: stamping, body-in-white (BIW) assembly, paintwork, engine assembly, final assembly and car testing and delivery.

Stamping
This is the process by which parts (bodies, doors, bonnets, floor pans) are cut out of sheet metal. Completely automated-machines known as transfer presses perform all the work of cutting and shaping the metal.

Body-in-white assembly
This is the assembly-line operation during which all the various parts are put together and then welded to make the "shell" either by semi- or fully-automated machinery.

Paintwork
Here too, the lines are automated to reduce waste and pollution. The body shell is cleaned, dipped in an anti-corrosion bath and dried thoroughly. This process is known as cataphoresis. Paint spray guns have been replaced by a sophisticated procedure based on the principle of aerostatics (the mechanics of elastic fluids), thanks to which paint particles are spread in a perfectly even layer. Water-based paint is used to reduce the release of solvents into the air.

Engine, axle and transmission assembly
When all components are completed, the engine, axles and transmissions are assembled and tested together.

Final assembly
During final assembly, all the remaining parts of the car are put together: seats, wheels, engine, dashboard and so on. Parts are delivered directly to the assembly lines by other production sites (or power train plants) and by suppliers on a just-in-time basis.

Car testing and delivery
At this stage, final exterior and interior inspection are performed, cars are fully tested and repairs are made as necessary.

The first essential for an automotive production center is good general lighting, which is important for creating a pleasant working environment with good conditions of visibility and comfort.

stamping

Stamping is operated by large, heavy and sophisticated machinery in a press shop, often producing high levels of noise, heat, dirt and even oil. Typical heights in a press shop are 15 to 18 meters, allowing overhead gantry cranes to move above the presses to transport the heavy press moulds.

Each press shop has a large workshop of equal height. In the workshop, a relatively high illuminance is needed to allow tool repairs to be performed properly.

Lighting recommendations

Illuminance	200-300 lux, in between machines
Uniformity	$E_{min}/ E_{ave} > 0.5$
Luminance	Insignificant
Colour temperature	Insignificant
Colour rendering	$R_a \geq 60$

Luminaires installed in press shops must be vibration-proof and made of oil-resistant material to guarantee worker safety. Tall machinery (12 to 15m) causes shadows if luminaires are not installed according to the layout. Deep light penetration is needed to obtain the required illuminance in between and under the metal presses. To check the press process and to improve safety, localized lighting must be installed onto the machines. By arranging the luminaires properly and by applying narrow beam reflectors, reasonable uniformity and illuminance levels can be obtained.

Typical lighting installation

The great height in press shops makes the utilization of high-bay luminaires ideal. If a fluorescent lighting solution is preferred, extremely narrow-beam continuous light lines can be utilized. Industrial high-bay luminaires should be spaced closely to prevent poor uniformity due to large obstructions. Although twin mounting of industrial high-bay luminaires is significantly cheaper than individual mounting, the latter is preferred to ensure good light uniformity. Where localized lighting is needed inside the machinery, the color of the lamps should be matched to that of the general lighting.

body-in-white assembly

The body shop is a large metal processing industrial hall with a height of 6 to 9 meters. The pressed components from the press shop are welded together here. This process is partly fully automated by robots, and partly semi-automated. Fully automated welding lines are often illuminated at higher levels than manual spot-welding locations. Process control can only occur successfully if high lighting levels are available. During the production process, complete subassemblies (doors, side panels, bonnets) are checked and inspected. Finally, the complete body is carefully checked for small press errors and welding drips.

Due to the dark appearance of the material (grey and galvanized metal) and the dirty environment (caused by welding), the body shop gives a very dark impression.

Lighting recommendations

Illuminance	General: 500 lux
	Inspection: 1,500 lux
Uniformity	$E_{min}/ E_{ave} > 0.7$
Luminance	Limited
Color temperature	General: insignificant
	Inspection: warm white
Color rendering	$R_a \geq 80$

Illuminance should be relatively high due to poor luminance contrasts. Uniformity is heavily influenced by ceiling-mounted obstructions, and should be reasonably good. For inspection of the body and its parts, direct glare should be avoided, high illuminances are necessary and the most comfortable light color (warm white) should be installed.

Plastics applied in luminaires should be oil-resistant. Self-cleaning luminaires should preferably be used. At locations where welding smog is continuously generated, luminaires should be closed or screened off with an easy-to-clean opal or prismatic cover. Where luminaires are applied at ceiling heights of below 2 meters (during inspection of vertical surfaces), impact-resistant luminaires should be specified. A separate, fully closed room is sometimes available for detailed and random test checks. Good results are obtained with warm white or green fluorescent lamps, as these offer the best viewing conditions.

Typical lighting installation

Either wide-beam high-bay industrial luminaires or white fluorescent reflectors can be employed. An even light distribution offers the greatest flexibility for future expansion of the factory. For localized lighting required during inspection, direct discomfort caused by glare from bare lamps and lamps in white reflectors should be prevented by the use of louvers.

paintwork

The paint process generally consists of a cleaning and pre-coating line, a primer coating line, the sealing line where the body is made watertight by flexible seals, a wet or dry sanding preparation line, the first color coating line, the second and final coating line, and lastly the repair line. The process is continuous, partly automated and cars of various colors are produced in random order.

Apart from the process control task, manual activities consist of the application of a sealer, spraying in paint cabins, sanding and minor body repair work, paint inspection and final paint repair. Most visual tasks can be classified as difficult: glossy large and non-uniform surfaces have to be checked for small faults. The contrast between highly reflective surfaces and the surroundings is small. By definition, brightness ratios should not be optimized especially for black, white and metallic-colored cars.

Lighting recommendations

Illuminance	Outside paint cabin: 150 lux
	Transport corridors: 300 lux
	Working zones: 500 lux
	Inspection: > 1,000 lux
Uniformity	$E_{min}/ E_{ave} > 0.5$
	$E_{min}/ E_{ave} > 0.8$ (inspection)
Luminance	Limited
Color temperature	Neutral / cool white
Color rendering	$R_a \geq 80$
	$R_a \geq 90$ (color comparison)

The lighting designer should ensure high surface illuminance with good uniformity in the horizontal, vertical and relevant sloping planes. For optimal viewing conditions, glare should be limited as much as possible by screening off the light sources with optics or white louvers. Color rendering is also important, as workers must be able to detect production errors at an early stage.

Typical lighting installation

For general lighting in service areas of the paint shop, white-painted reflectors can be used, preferably aluminium-reflector wide beam ones. Closed, ingress-protected luminaires are needed near the production process. Protected luminaires with optics are required where special lighting effects can improve viewing conditions. The lighting installation needed to illuminate the paint cabins should be accessible from outside the paint cabin. Maintaining the luminaires from the outside ensures minimal interruption to work as well as reducing pollution. If luminaires are required inside the paint cabin, explosion-proof types should be specified. It is important to use easy-to-clean luminaires where a high level of soiling is present with smooth surfaces that can easily be wiped clean.

engine, axle and transmission assembly

From rough metal, advanced engine parts are manufactured. Aluminium parts are made in a die-casting process, and steel parts are forged in a typical heavy industrial environment. Small components are manufactured in series in precision machine shops. When all components are completed, the engine, axles and transmissions are assembled and tested together on hot test stands.

Lighting recommendations

Illuminance	Automatic machining: 300 lux
	Machine work: 500 lux
	Inspection: 750 lux
Uniformity	$E_{min}/ E_{ave} > 0.7$
	$E_{min}/ E_{ave} > 0.8$ (inspection)
Luminance	Limited
Color temperature	Neutral / cool white
Color rendering	$R_a \geq 60$

It is vital that the illuminance matches the task. As tasks can vary significantly from one location to another, care must be taken that each specific working area has a suitable lighting solution. On the assembly lines, limitation of glare is important, especially when recessed luminaires are used at heights of less than 2.5 meters to obtain the required high illuminance.

Metal forming takes place in areas where oil and cooling liquid are used. Luminaires must be oil-resistant and, if soiled, they must be easy to clean.

Where strong vibrations are present in heavy industry, luminaires must withstand this mechanical stress.

Typical lighting installation

Because these plants are part of the metal industry, not all possibilities are shown. Normally, mainly general lighting is applied in the manufacturing halls, which are common in this type of industry.

final assembly

The assembly shop houses several sub-assembly lines and the final assembly line. Sub-assembly lines handle the assembly of doors, dashboard, locks etc. On the assembly line, all components, parts and sub-assemblies are fitted to the body, both inside and outside. Two systems of assembly shops are in use: a conveyor-based production process and a platform-based production process. As well as the assembly tasks, logistics and transport are the main activities. Most assembly is performed manually.

Lighting recommendations

Illuminance	Corridors: 200 lux Normal assembly: 500 lux Fine assembly: 750 – 1,500 lux
Uniformity	Corridors: $E_{min}/ E_{ave} > 0.5$ Line horizontal: $E_{min}/ E_{ave} > 0.8$ Line vertical: $E_{min}/ E_{ave} > 0.4$
Luminance	Limited, no bare lamps visible
Color temperature	Neutral
Color rendering	$R_a \geq 80$

Workers on assembly lines perform repetitive work. High lighting levels and freedom from glare are essential for optimizing productivity. For this reason, asymmetrical luminaires suspended at a height of 2.5 meters, in addition to a general lighting installation, are required. If the car bodies are moving on a conveyor line and workers are moving during the task either along or inside the car, continuous light lines are preferred over intermittent lines.

Task lighting luminaires are mounted at rather low heights to allow light to penetrate deeply inside the car. Impact-resistant luminaires will have a significantly longer lifetime than those of a delicate construction. Open luminaires allow the desired lighting effects to be created more easily. For assembly work, the vertical illuminance is often more important than the horizontal light level. Attention should therefore be given to the use of luminaires with wide-beam light distributions, or with batwing light distributions. For each specific location, an optimal lighting solution can be created. However, plant engineering requires universal solutions so that activities can be shifted along the assembly line without costly adaptation of the luminaire layout.

For moving-platform systems, the lighting installation should either be part of the platform system, or a high-level general lighting installation should be used. If the platforms move during the task, care must be given to avoid flicker from non-continuous light lines.

Typical lighting installation

The most common combination is the use of advanced asymmetrical (closed) luminaires with task lighting optics, simple industrial aluminium reflectors or white-painted reflectors for general lighting.

car testing and delivery – quality and audit checks

This section of a car factory often appears like a large maintenance and repair garage. Final exterior and interior inspection are performed, cars are fully tested (water tightness, wipers, lights, engine, gearbox, final paint inspection etc.), and repairs are made as necessary. Optionally, the cars are coated with wax or surface-tempered plastic for protection during transportation to the dealer.

Lighting recommendations

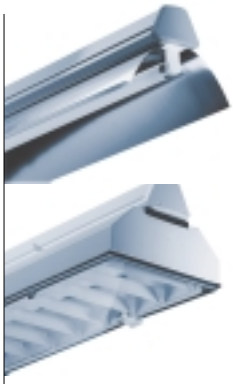
Illuminance	General area: 500 lux
	Specific inspection:
	750 – 1,500 lux
Uniformity	$E_{min}/ E_{ave} > 0.7$
Luminance	Limited, no bare lamps visible
	High: simulating a showroom
Color temperature	Neutral
Color rendering	$R_a \geq 80$

General lighting provides a basic uniform illuminance on the total floor, while additional task lighting facilitates car inspection.

Typical lighting installation

A typical arrangement is the use of waterproof luminaires for wet areas and aluminium- or glass / plastic- covered industrial reflectors for general lighting.

Maxos



Material and finish
Trunking: Hot-dipped galvanised steel; in silver or white color
Reflector: White- or silver-colated steel with high quality aluminium mirror
Optics and Louvres: Various types of high-quality aluminium optics and louvers are available
Classification
IP20 / IP40 / IP54 / IP64 / Class I
Product range
Please refer to Maxos catalogue or contact any Philips Lighting sales office in your country.
Gear
HF / Coventional / Low-loss
Application area in automotive industry
Body-in-white assembly, paintwork, engine, axle, transmission plant / assembly, final assembly, car testing and delivery.

Light-line System: **Maxos**
An advanced high-performance indoor light-line system for TL'D and TL'5 fluorescent lamps. Maxos provides you with more flexibility, higher performance in a professional style. The durable and sturdy construction of the system makes it span up to 5 meters, contributing to shorter installation time yet better task performance. The system is delivered from the factory with 1 or 2 flat ribbon cables (5- or 7- pole) and can hold up to 14 (2 x 7 pole) cables. The cable is suitable for three-phase power that is interconnected via a 3- or 5- pole block to the electrical unit. Lighting control such as a dimming feature can be integrated into Maxos system.

TTX150 (Tetrix)

Material and finish
Trunking: Hot-dipped galvanised steel; white color
Reflector: White- or silver-colated steel with high quality aluminium mirror
Louvers: White-painted louver available as an option
Classification
IP20 / Class I
Product range

Length	Lamps	Length	Lamps
1.5 m	1xTL'D 58W	1.5 m	2xTL'D 58W
3.0 m	1xTL'D 58W	3.0 m	2xTL'D 58W

Double switching and emergency lighting are available as options
Gear
HF / Coventional
Application area in automotive industry
Body-in-white assembly, paintwork, engine, axle, transmission plant / assembly, final assembly, car testing and delivery.

Light-line System: **TTX150 (Tetrix)**
A basic pre-wired lightline system for single and twin TL'D fluorescent lamps. With everything you need assembled in one box, Tetrix significantly reduces pre-assembly work needed, allowing you to get straight on with installation, connection and completion. The pre-assembled trunking is equipped with 5 x 2.5mm^2 through-wiring.

TTX080 (Scala)

Material and finish
Trunking: Extruded aluminium painted in white
Reflector: High-quality aluminium
Classification
IP20 / Class I
Product range

Length	Lamps	Length	Lamps
1.23 m	2xTL'D 36W	1.23 m	3xTL'D 36W
3.68 m	2xTL'D 36W	3.68 m	3xTL'D 36W

Gear
HF (conventional available upon request)
Application area in automotive industry
Body-in-white assembly, paintwork, engine, axle, transmission plant / assembly, final assembly, car testing and delivery.

Light-line System: **TTX080 (Scala)**
An economical lightline system for twin and triple TL'D fluorescent lamps in a continuous row. The system allows you to create a straight light-line in your production area with wide light distribution for general lighting. Trunking is pre-wired with an electronic ballast to the lamp holders. Electrical contractor has the flexibility to connect the mains as required.

TCW097 (Pacific II)

Material and finish
Housing: Poly-carbonate; Cover: Poly-carbornate
Toggles: Stainless steel; Mounting bracket: Stainless steel
Classification
IP66 / Class I
Product range

TCW097	1xTL'D 18W	TCW097	2xTL'D 18W
TCW097	1xTL'D 36W	TCW097	2xTL'D 36W
TCW097	1xTL'D 58W	TCW097	2xTL'D 58W
TCW097	1xTL'5 14W	TCW097	2xTL'5 14W
TCW097	1xTL'5 28W	TCW097	2xTL'5 28W
TCW097	1xTL'5 35W	TCW097	2xTL'5 35W

Gear
HF / Coventional / Low-loss
Application area in automotive industry
Stamping (press shop), body-in-white assembly, paintwork, final assembly, car testing and delivery, moisture and dusty area, storages, loading / unloading area with installation height of less than 4 meters.

Impact-proof / Dust and Waterproof Protected Luminaire: **TCW097 (Pacific II)**
An indoor dust- and jet- and impact-proof luminaire range for TL'D and TL'5 fluorescent lamps.
Suitable for surface-mounting and suspension for general lighting in the industrial environment as well as storage areas.

H/M/SDK900 (Phoenix)

Material and finish
Gear housing: High-grade die-cast aluminium
Reflector: High-quality spun aluminium
Classification
IP65 (Gear compartment) / IP54 (Lamp compartment with glass cover) / Class I
Product range

150W/250W/400W	High-pressure sodium lamp
250W/400W	High-pressure mercury lamp
250W/400W	High-pressure metal halide lamp

Reflector: Choice of narrow beam or wide beam
Glass cover available as an option (must be used with metal halide lamp)
Gear
Conventional type with capacitor
Application area in automotive industry
Body-in-white assembly, paintwork, engine, axle, transmission plant / assembly, final assembly, car testing and delivery.

High-bay: **H/M/SDK900 (Phoenix)**
A high performance high-bay luminaire for high intensity discharge (HID) lamps. The study and long-lasting quality of the product makes Phoenix high-bay suitable for various industrial environments even in the dusty and high moisture areas.

TMS012 MKII

Material and finish
Housing: White-painted sheet steel
Classification
IP20 / Class I
Product range

TMS012 MKII	1xTL'D 18W	TMS012 MKII	2xTL'D 18W
TMS012 MKII	1xTL'D 36W	TMS012 MKII	2xTL'D 36W
TMS012 MKII	1xTL'D 58W	TMS012 MKII	2xTL'D 58W

Gear
HF / Coventional / Low-loss
Application area in automotive industry
General lighting in non-production areas with less importance in light performance.

Batten: **TMS012 MKII**
An indoor batten with single or twin TL'D fluorescent lamps. It is suitable for surface-mounting and suspension for general lighting. Industrial reflector and prismatic covers are available as options.

Hologram

Surface inspection luminaire: **Hologram**
A high performance inspection luminaire for grinding imperfections.
The system comes with 4 x white high-pressure sodium SDW-T 100W lamps with rotationally symmetrical reflectors.
- optics rotate and tilt
- security glass to protect from heat and UV penetration
- cover can be opened (security lockers)
- electronic ignitor and stabilizer
- end axial fan with silicon free filter mat
- lamellae louvre can be inserted from either side

Application area in automotive industry
Paintwork – Paint inspection
- sanding / polishing
- clear varnish
- final control

Surface Control 1

Surface inspection luminaire: **Surface Control 1**
A high performance inspection luminaire for surface control with prismatic optics. The system is equipped with 3 x TL'D 36W or 3 x TL'D 58W fluorescent lamps.
- with electronic regulating ballasts
- longitudinal prismatic optic (2 piece)
- one-piece-safety glass
- throughwiring 7 x 2.5 mm^2
- quick installation safety catches

Application area in automotive industry
- body assembly
- phosphating section
- top painting layer
- grinding and polishing section
- clear painting layer
- final paint inspection

Surface Control 2

Surface inspection luminaire: **Surface Control 2**
A high performance inspection luminaire for surface control with prismatic optics. The system is equipped with 3 x TL'D 36W or 3 x TL'D 58W fluorescent lamps.
- with electronic regulating ballasts
- one-piece-safety glass
- throughwiring 7 x 2.5 mm^2
- quick installation safety catches

Application area in automotive industry
- body assembly
- phosphating section
- top painting layer
- grinding and polishing section
- clear painting layer
- final paint inspection

Floor luminaire

Surface inspection luminaire: **Floor luminaire**
A high performance inspection luminaire for floor-mounted application. The system comes with 1 x TL'D 58W fluorescent lamp and HFR electronics regulating ballast.
- dimmable from 3% to 100%
- symmetrical light distribution
- shock-proof safety glass
- magnetic locking device without screws
- active air ventilation
- twin-prism optic

Application area in automotive industry
Paint inspection areas
Assembly lines

Other types of luminaires are available.
Please contact the Philips agent in your area to get more information.
Information subject to modification without prior notice.

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