

# PMMA in the mirror of Automotive Megatrends

Automotive Applications and Trends

Lenorplastics Technologietag | Oberriet, CH  
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# PLEXIGLAS® Experienced



## PLEXIGLAS® – Younger today than yesterday:

- Invented by Dr. Otto Röhm in Darmstadt in 1933 as a sheet product
- 1935 market launch of PLEXIGLAS® molding compounds
- PLEXIGLAS® is one of the world's best-known brands of plastic.
- PLEXIGLAS® is a very familiar brand, e.g.:
  - known by over 97% of people in Western Europe
  - known by almost two thirds of people in China.



# PLEXIGLAS® Experienced





# PLEXIGLAS® – Experienced

PLEXIGLAS® – inspired from the very first

**Automotive**



DKW / mid-1950s / small rear lights

**Consumer goods**



Braun Phonosuper / SK4 / „Schneewittchensarg“ / 1956

**Architecture**



Olympic Stadium / Munich / 1972

**Lighting**



LED headlights



TFT-LCD TV



Kunsthaus / Graz



LED Lighting

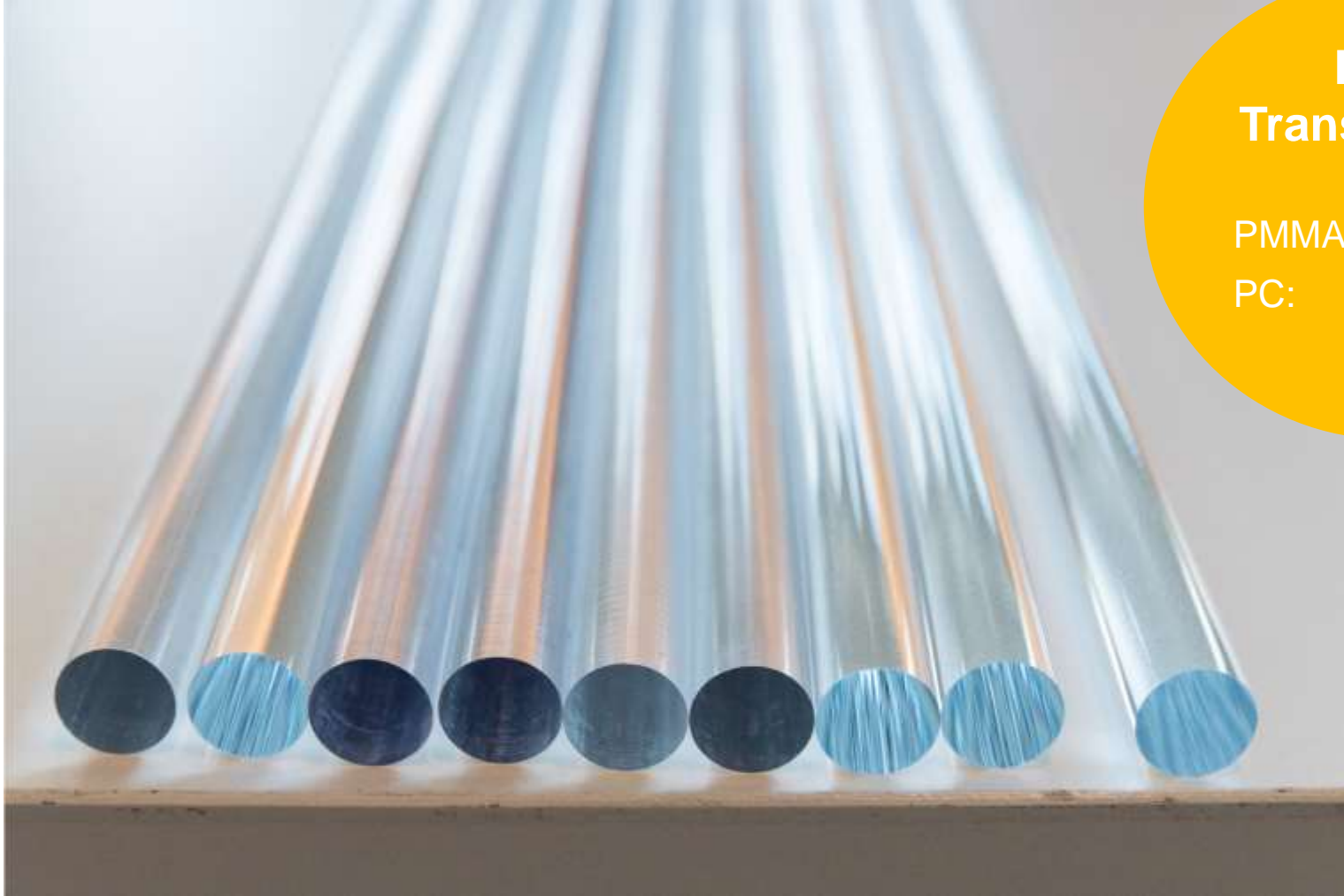
# PLEXIGLAS® Performing



## PLEXIGLAS® has unique properties

- **Optical properties**
  - Highest possible transparency and more than 92% light transmittance
  - Low birefringence
  - Excellent UV and weather resistance (shows no yellowing)
- **Mechanical properties**
  - Highest surface hardness of all thermoplastics
  - Good resistance to many chemicals
- **Appearance**
  - High brilliance
  - Colorable at will
  - Noble appearance (high gloss surfaces with depth effect)
- Light weight (compared to glass or metal)
- 100% recyclable

# PMMA – superstar in light transmission!



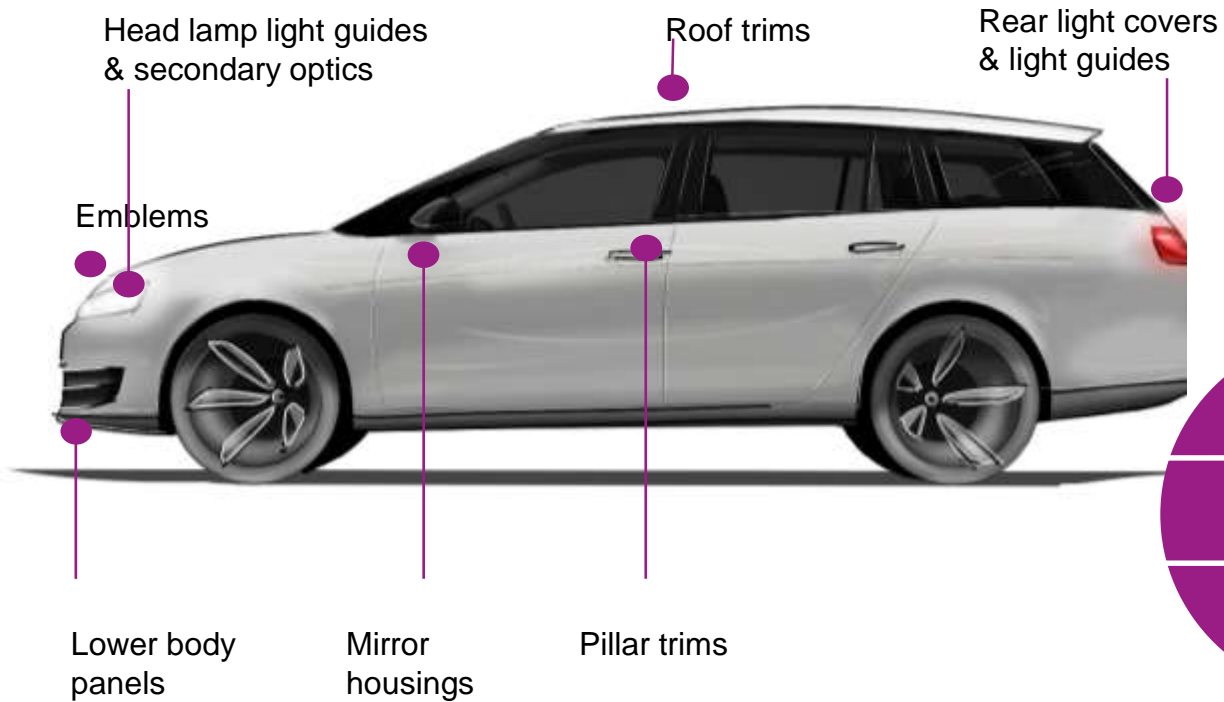
## Light Transmission

PMMA: 92%

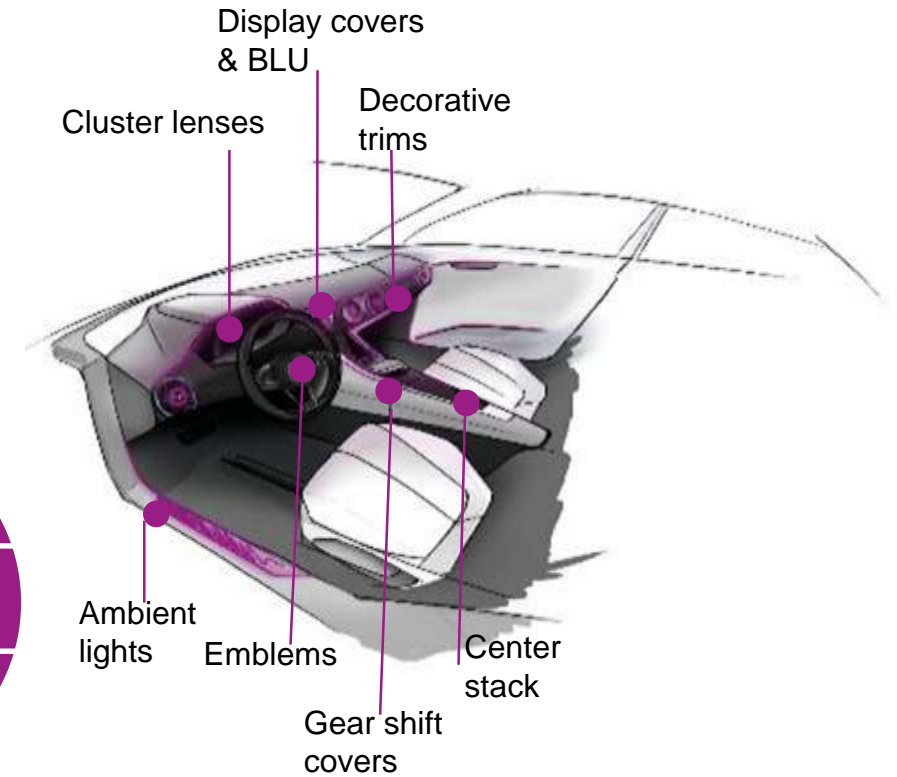
PC: 89%

# Average usage of PMMA per car

## Exterior



## Interior



1.5 kg Exterior

~1.6 kg per vehicle

0.13 kg Interior



# PLEXIGLAS® - New challenges through automotive megatrends

e-mobility



connectivity



autonomous  
driving



shared  
mobility





# Megatrend 1

## e-mobility

Impact on exterior design



## Long light guides at front and rear end



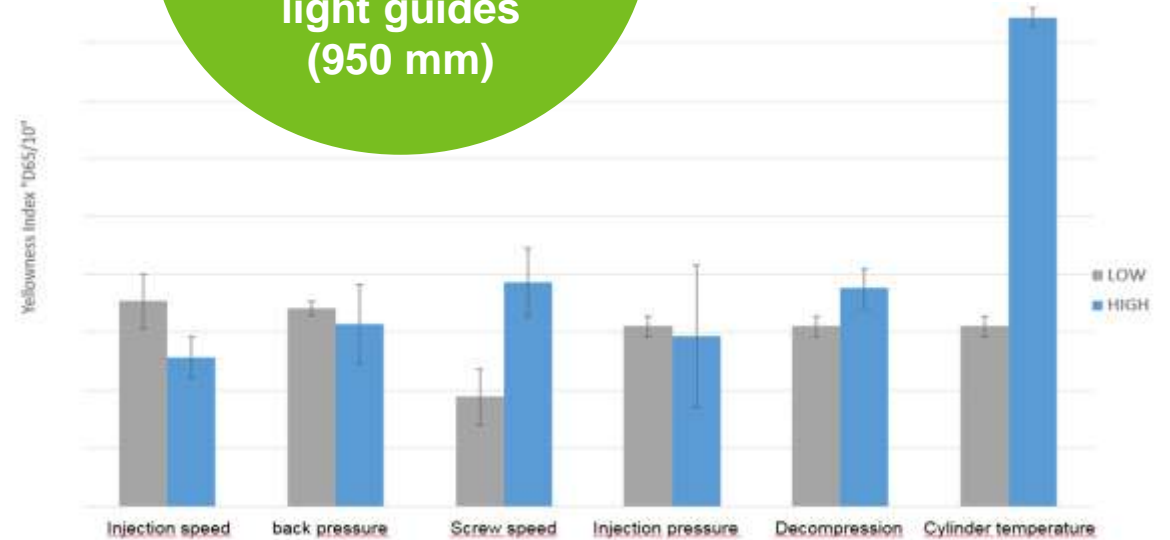
Latest  
trends from  
IAA 2017



# Long light guides - Testing of new specimens



Impact of  
process  
parameters on  
long distance  
light guides  
(950 mm)





# Impact of LED light source on material aging

## Light guides and lenses



**PLEXIGLAS® 8N** (lenses for indicator lights)

- Vicat 108° C

**PLEXIMID® TT50** (light guide)

- Vicat 150° C

**PLEXIGLAS® Heatresist FT15** (main lens)

- Vicat 115° C

## Factors of aging



Radiation



Temperature



Humidity

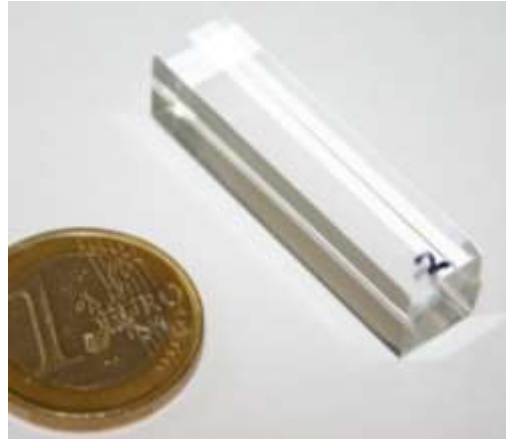
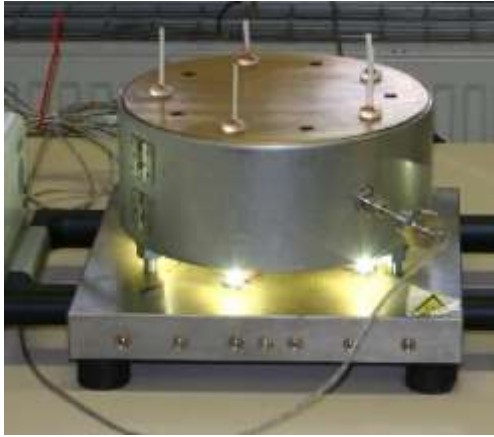


Time

### Expectation:

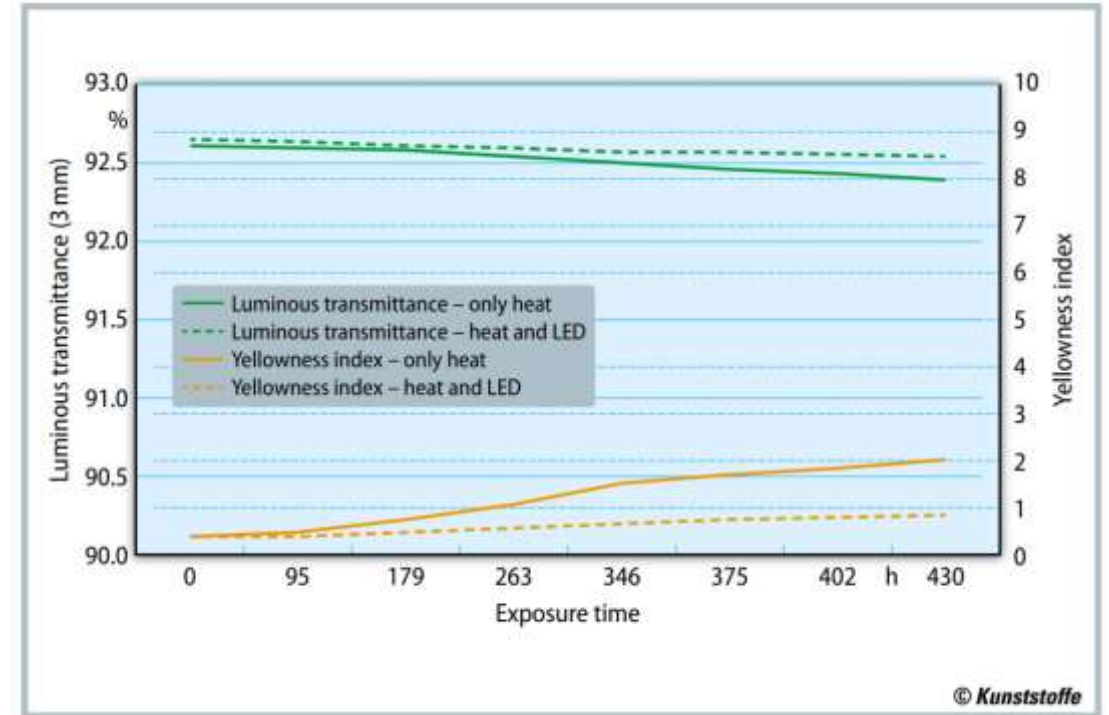
Radiation + Temperature will have a stronger impact than temperature alone!

# Impact of LED light source on material aging



## LED radiation and temperature

- PMMA specimens 10x10 mm<sup>2</sup>, 40-100 mm
- Homogeneous temperature profile for all samples, 100 °C
- Dark control samples
- High power white LED:
  - 62 W/m<sup>2</sup> (400-480 nm)
  - 149 W/m<sup>2</sup> (480-750 nm)



Article for free download at KUNSTSTOFFE - Issue March 2018:

<https://www.kunststoffe.de/en/journal/archive/article/with-illuminated-decorative-elements-and-functional-properties-pmma-is-shaping-new-automotive-ideas-5270639.html>

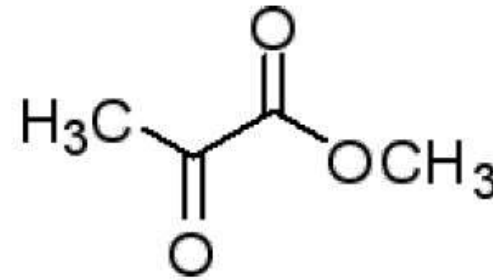
# Chromophores are formed and depleted in PMMA

## 1. What happens at 100 °C without LED light?

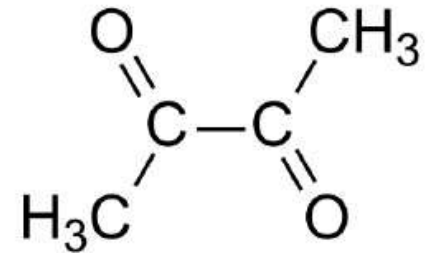
- Reactions of residual monomers / oligomers and additives with each other and with oxygen

## 2. What happens at 100 °C & LED light?

- Depletion of chromophores which have been formed through temperature, likely diketones (400-480nm)



Methyl pyruvate



Diacetyl (2,3-butanedione)



# Megatrend 2

## connectivity

Impact on interior design



# Connectivity will influence interior

Today



Tomorrow



**PLEXIGLAS® Heatresist FT 15**

is also available in a wide range of dark grey colors for dark panel effect!

Source: <http://www.bbc.com/autos/story/20150916-mercedes-benz-concept-iaa-is-the-shape-shifting-clc-of-tomorrow>

# Connectivity will also influence exterior

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Today



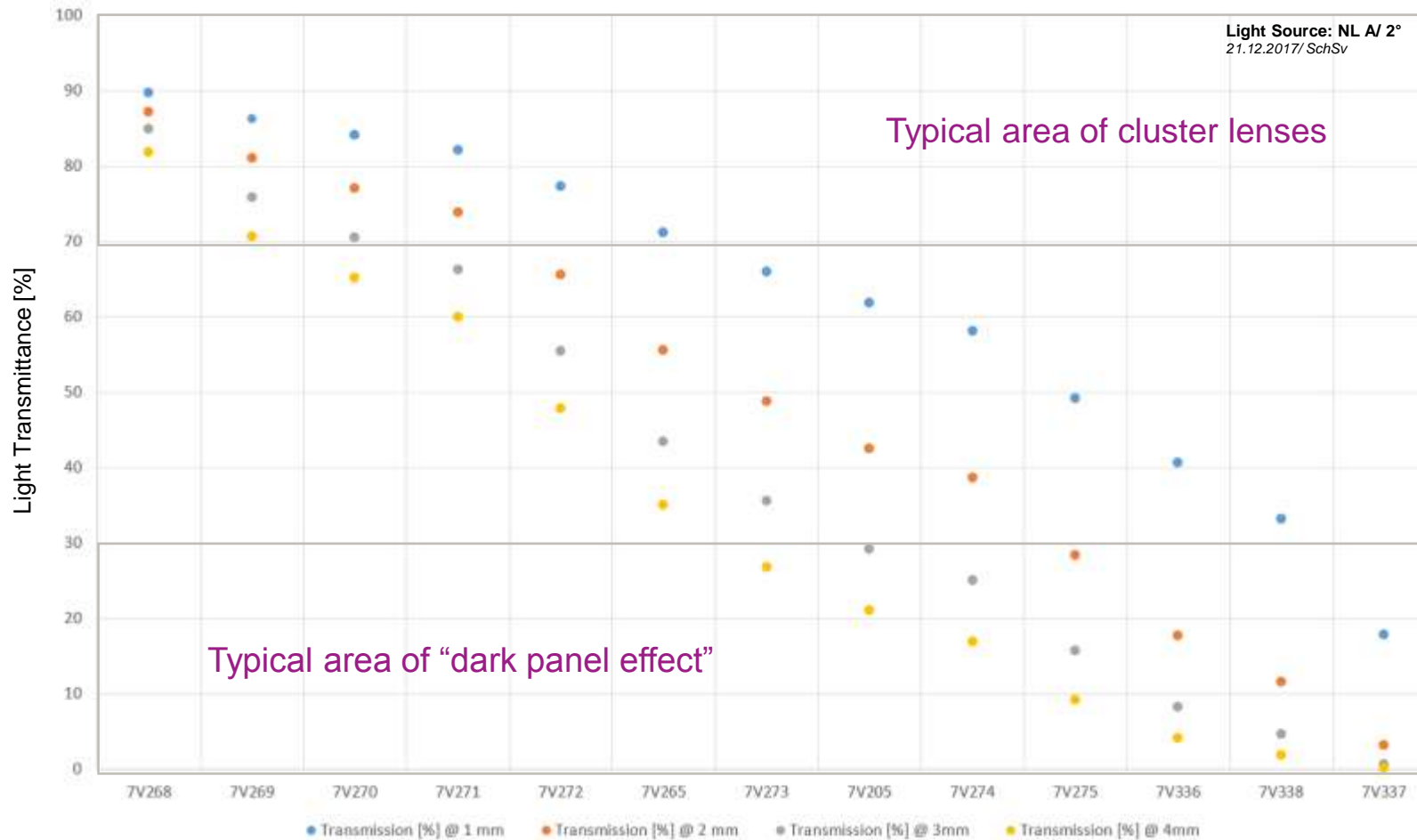
Tomorrow



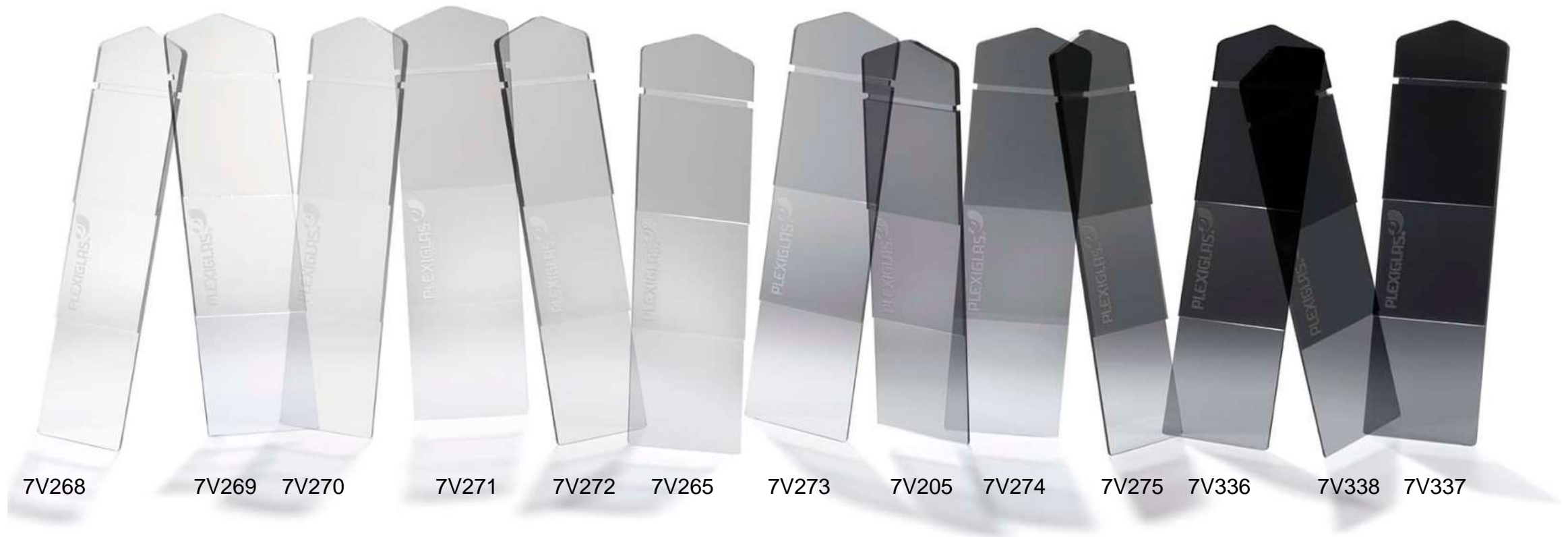


# PLEXIGLAS® neutral grey

## Light transmittance - dependency from wall thickness



## PLEXIGLAS® - range of neutral grey color grades



# Black Panel Effect also for front ends

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**Today**



**Tomorrow**




Source: <https://www.daimler.com/innovation/case/electric/concept-eq.html>



# PLEXIGLAS® LED LD grades for light curtains

## Light curtain



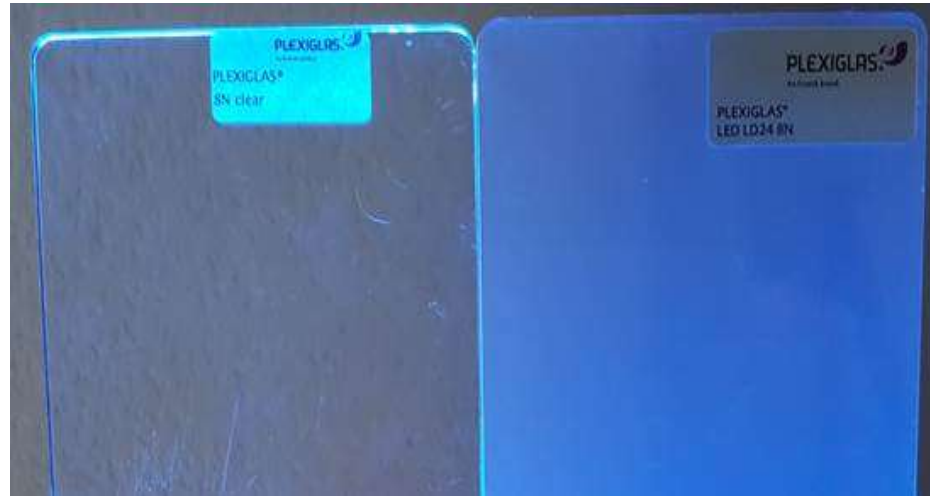
LED, zweiseitig	LED, einseitig	Materialempfehlung
 bis 12 cm	 bis 6 cm	PLEXIGLAS® 8N LD12
 12 bis 24 cm	 6 to 12 cm	PLEXIGLAS® 8N LD24
 24 to 48 cm	 12 to 24 cm	PLEXIGLAS® 8N LD48
 48 to 96 cm	 24 to 48 cm	PLEXIGLAS® 8N LD96

The grade to be selected from the **PLEXIGLAS® LED LD** product range for **edge lighting** depends on the light guide configuration.

- Light is fed in on one side; light is to be guided over a distance of up to 48 cm
- Light is fed in on both sides; light is to be guided over a distance of up to 96 cm

# PLEXIGLAS® LED LD grades for light curtains

## Light curtain



The grade to be selected from the **PLEXIGLAS® LED LD** product range for **edge lighting** depends on the light guide configuration.

- Light is fed in on one side; light is to be guided over a distance of up to 48 cm
- Light is fed in on both sides; light is to be guided over a distance of up to 96 cm

## PLEXIGLAS® 7V376 - for Day and Night Design (black panel effect)

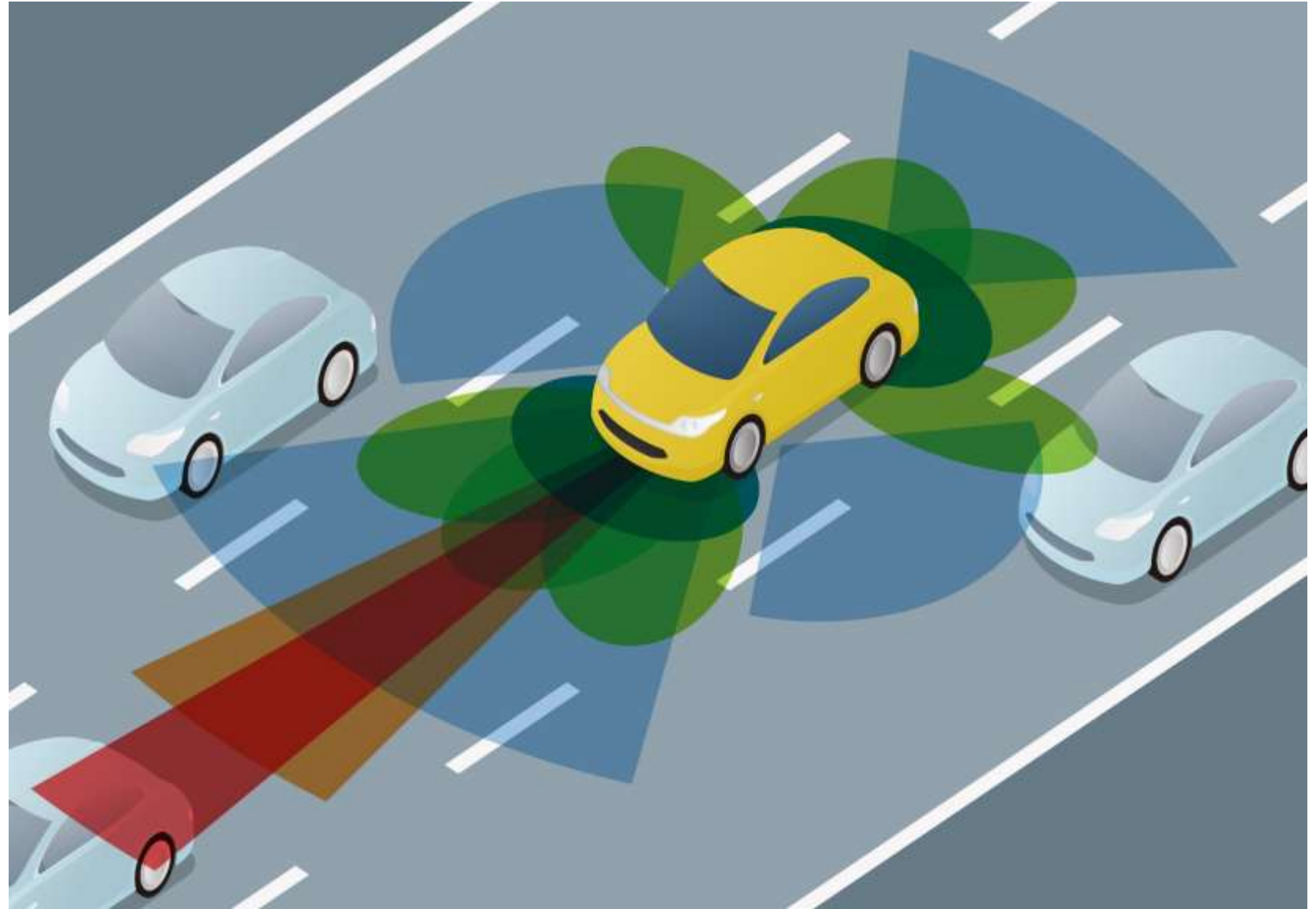




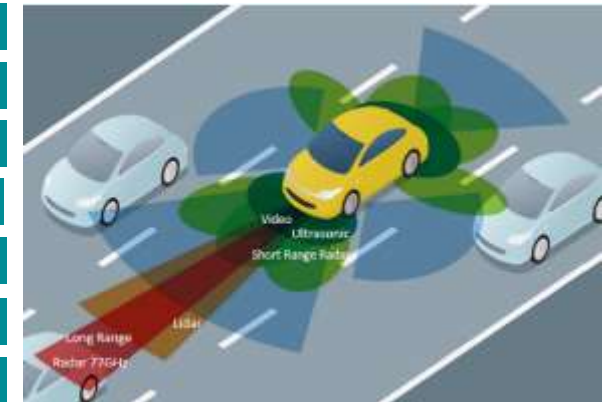
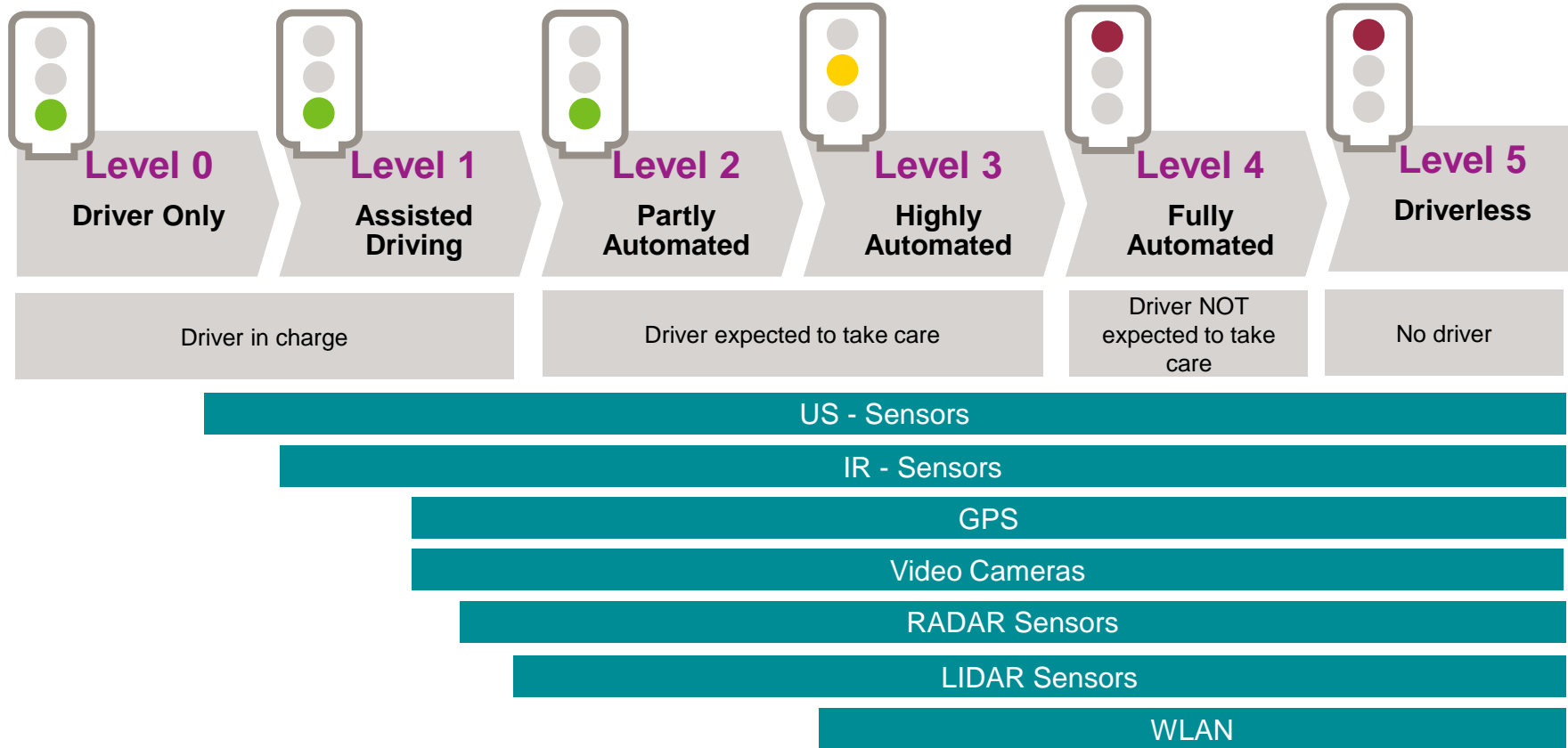
# Megatrend 3

## autonomous driving

Impact on exterior and  
interior design



# Autonomous Driving



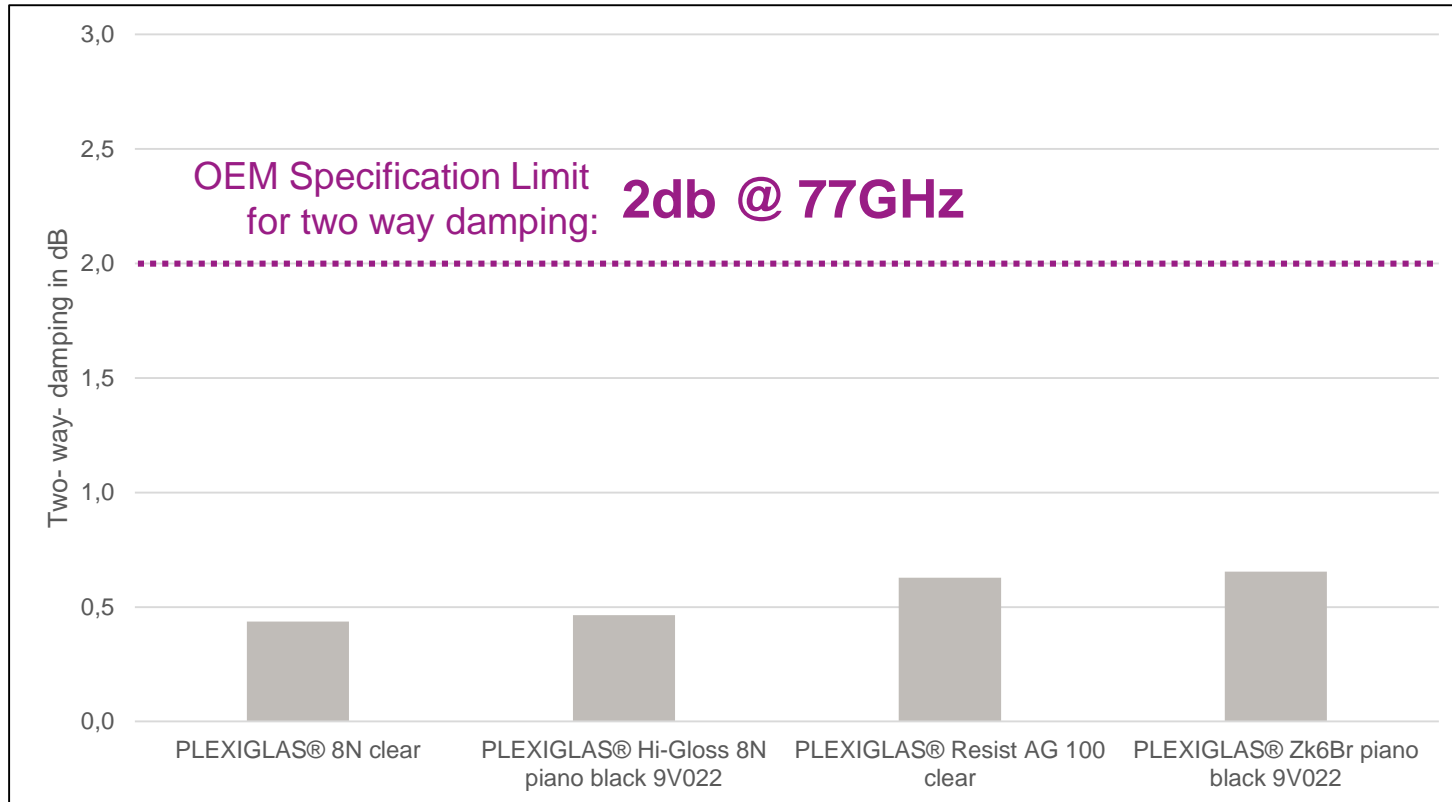
## Autonomous Driving – example visibility of sensors

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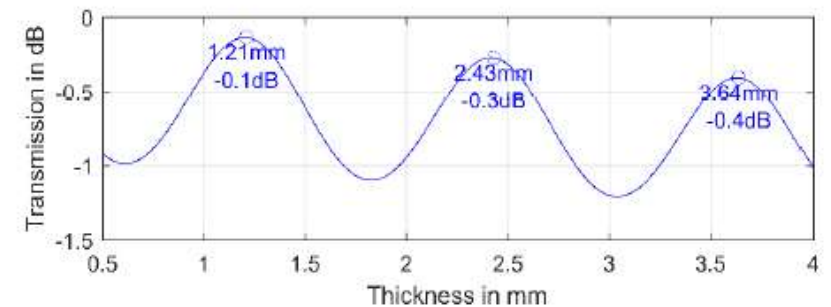




# PLEXIGLAS® fulfill OEM requirements for Radar damping below 2db



Optimum performance at resonant wall thickness of 1,2 mm and multiples!

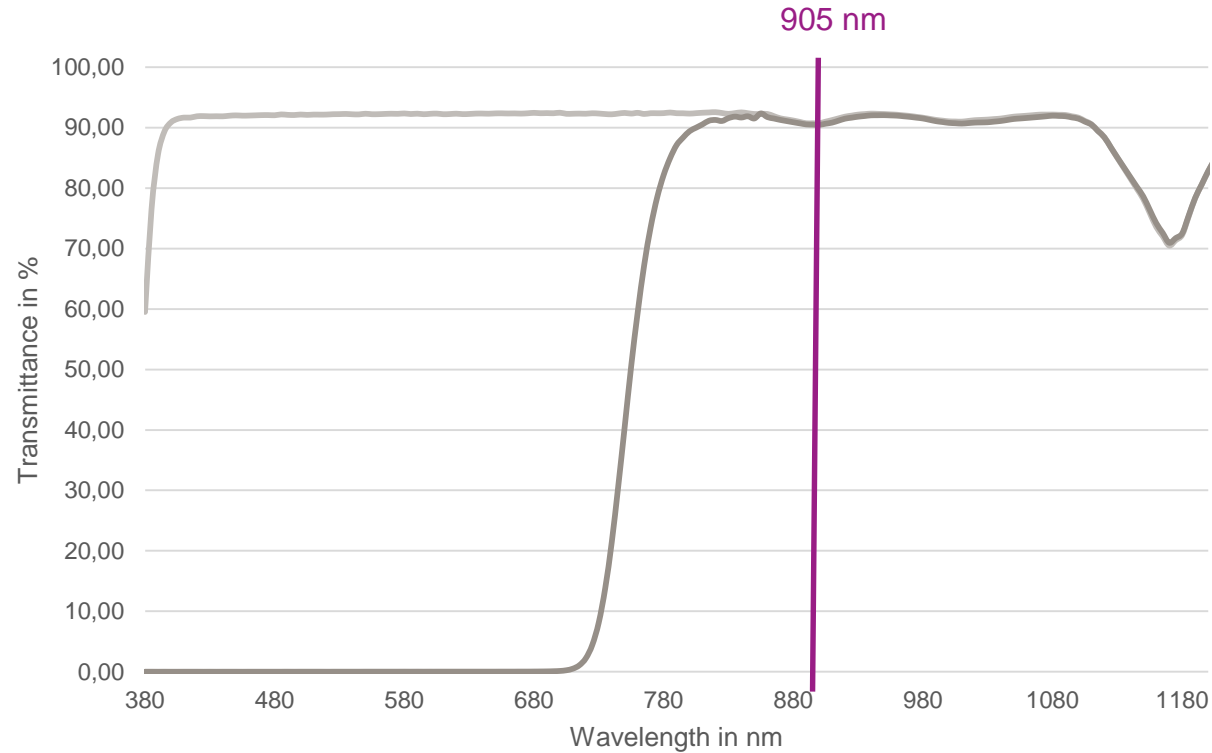


Valid for:

Wall thickness between 3.6 and 3.7 mm (Resonant design for PMMA at a thickness of a multiple of 1.2 mm)

Frequency of 77 GHz (Long Range Radar)

# PLEXIGLAS® Hi-Gloss 8N 90114



Infrared  
and LIDAR  
transparent  
PMMA  
grade

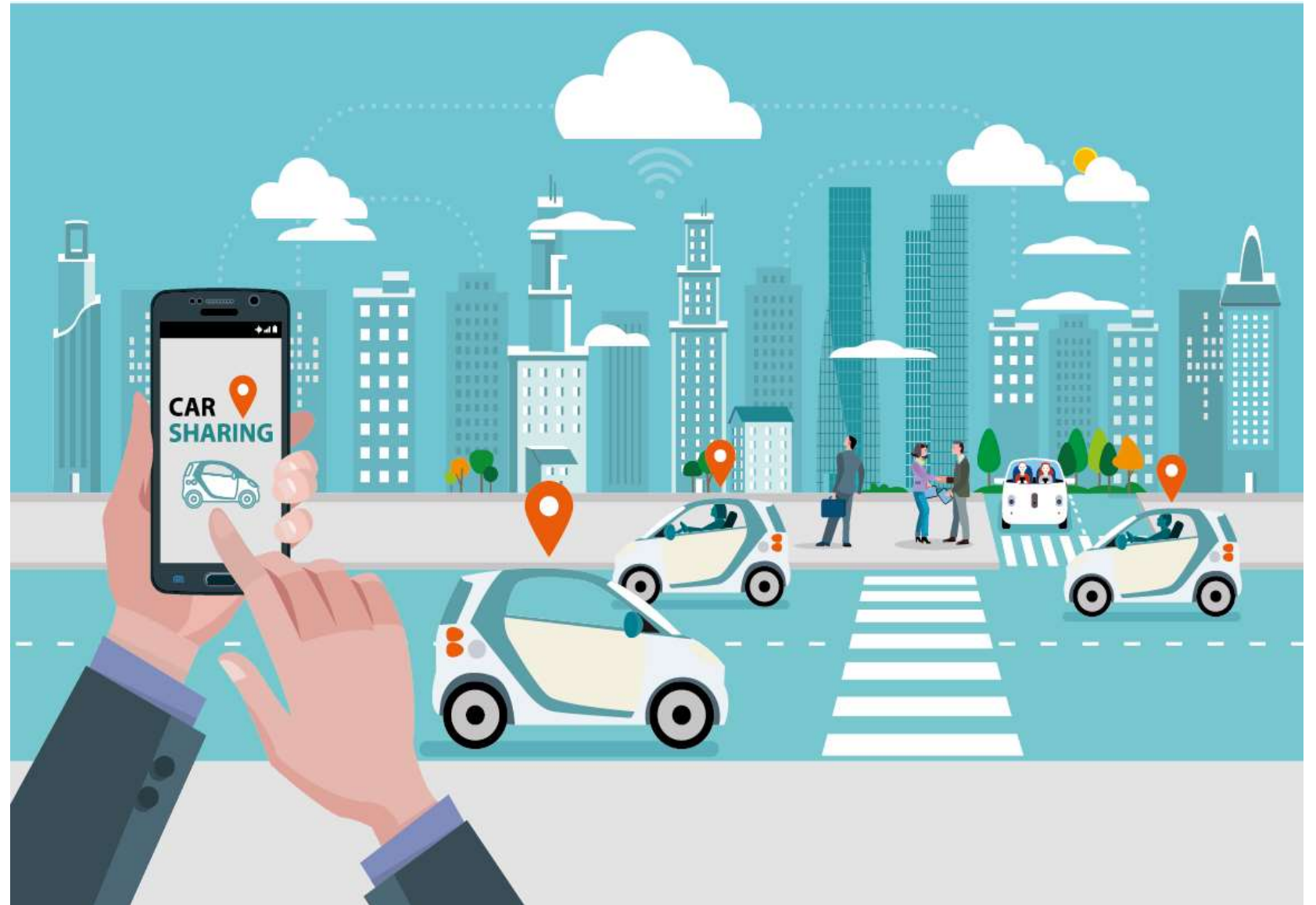
— PLEXIGLAS® 8N clear  
— PLEXIGLAS® 90114 black



# Megatrend 4

## shared mobility

Impact on exterior design





# Shared mobility demands impact and robust materials



## Material Requirements

- **Robust and durable**
  - Impact Resistant
  - Weather Resistant
- **Easy to clean**
  - Chemical Resistant
  - Scratch Resistant
- **Easy to replace**
  - Recyclability
  - Less complex part design
  - Low cost

## PLEXIGLAS® Resist (Impact Modified PMMA)

### zkBR-Series

With its special optical characteristics and balanced property spectrum, the zkBR series is the basis for impact-modified PLEXIGLAS® molding compounds.

PLEXIGLAS® Resist zk4BR

PLEXIGLAS® Resist zk5BR

PLEXIGLAS® Resist zk6BR

Increasing impact strength

### zkHC-Series

This series is characterized by even higher stress crack resistance than that of PLEXIGLAS® zkBR molding compounds.

PLEXIGLAS® Resist zk4HC

PLEXIGLAS® Resist zk5HC

PLEXIGLAS® Resist zk6HC

Increasing impact strength

### zkHF-Series

The special feature of this series of PLEXIGLAS® molding compounds as compared with other impact-modified grades is its excellent flow.

PLEXIGLAS® Resist zk5HF

PLEXIGLAS® Resist zk6HF

Increasing impact strength

### PLEXIGLAS® Resist AG 100

Very high impact strength combined with a high heat deflection temperature.

A typical feature of this product is the clear reduction in reversible haze at very high and low temperatures.

High impact strength

Very high impact strength

# Material for interior trims and displays

## PLEXIGLAS® Hi-Gloss NTX8 PLEXIGLAS® Hi-Gloss NTX15

- Improved wipe resistance against minor scratches



# PLEXIGLAS® Heatresist FT15



**Good flowability and  
chemical resistance**

## **PLEXIGLAS® Heatresist FT15**

- Good flowability (large trims, center stacks)
- Good chemical resistance (e.g. against sun cream...)
- Available in clear, black and other colors like dark semi-transparent grey
- Enables overmolding of wood



# PLEXIGLAS® - New challenges through automotive megatrends

e-mobility



connectivity



autonomous  
driving



shared  
mobility





If you have further questions ...

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... visit us on our booth!

# Contact

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