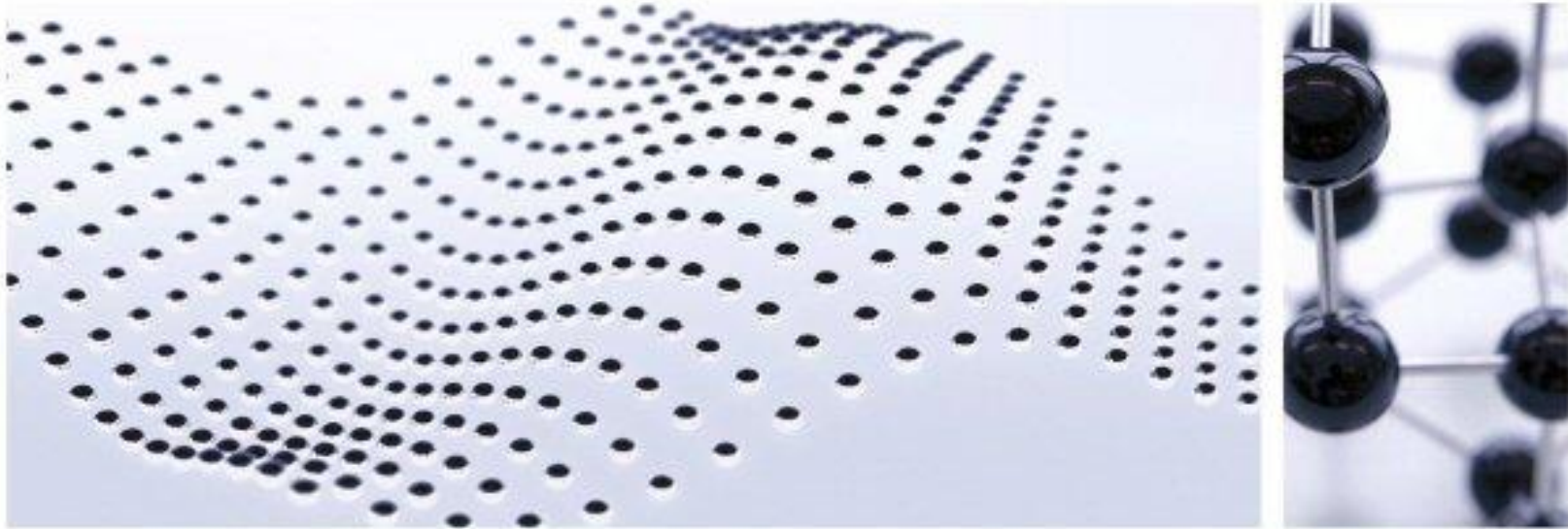


Customer relevant evaluation of cloudiness on painted surfaces. BYK user meeting 16./17.11.2010



BMW Group Labortechnik. Solutions for the Network.

BMW Group



Customer relevant evaluation of cloudiness.

Agenda.

- Introduction.
- Motivation.
- Step 1: Qualification of a measurement device for the evaluation of cloudiness.
- Step 2: Field study to develop customer relevant limits for cloudiness.
- Conclusion and perspective.



Customer relevant evaluation of cloudiness.

Introduction.

What is cloudiness?

- Cloudiness: Visually noticeable differences of lightness on metallic colours
- The impression of cloudiness varies from „slight mottling“ to „camouflage painting“.
- The visual sensibility declines from light to dark colours.
- Cloudiness may be caused by different effects:
 - Uneven distribution of the basecoat filmbuild .
 - Uneven orientation of the aluminium flakes in the basecoat layer.



Customer relevant evaluation of cloudiness.

Motivation – where do we come from?.

- The evaluation of cloudiness is carried out solely visually .
- In the basecoat release process, cloudiness is evaluated visually against a reference basecoat with known performance.
- The evaluation of cloudiness is based on experience and subjective sensibility of the examinant.
- No limit values ok/nok exist from a customer relevant perspective.



Customer relevant evaluation of cloudiness.

Motivation – targets.

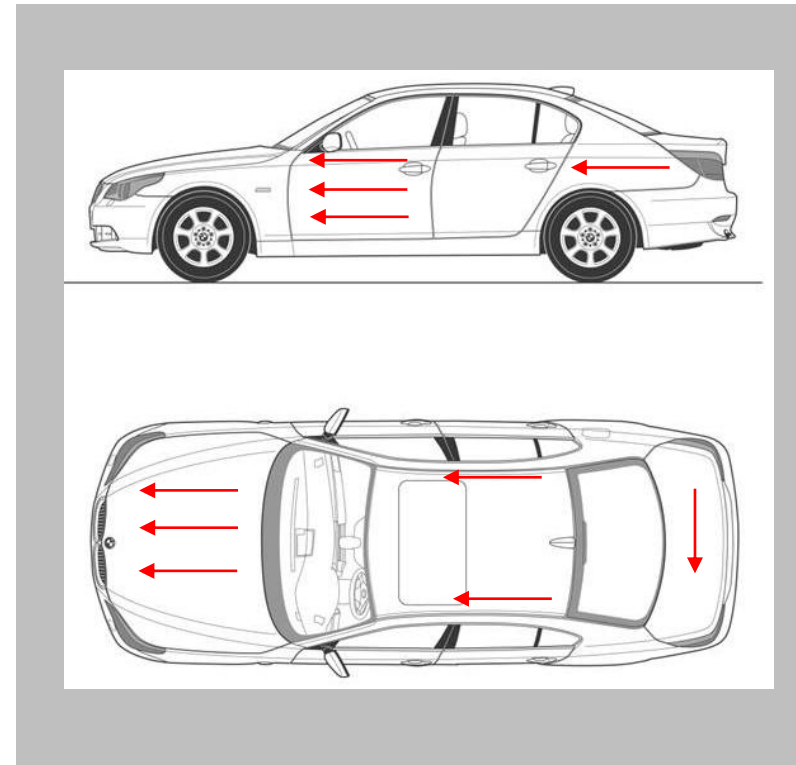
- In the assessment of painted surfaces, the characteristic optical properties colour and appearance are evaluated visually and by measurement.
- With measurement values, a consistent global basis for the description of customer relevant quality and for the objective evaluation of the relevant parameters are given.
- Essential enablers for the customer relevant evaluation of cloudiness and the assessment and steering of cloudiness in the manufacturing processes are:
 - Qualification of a measurement device.
 - Develop customer relevant limit values for cloudiness.



Customer relevant evaluation of cloudiness.

Basics – Resolution of the cloud-runner.

- Measurement of BMW customer cars before delivery (for example BMW-World):
 - 5 single measurements per zone.
 - Number of measured cars: 129.
 - Models:
series 1, 3, 5, 6, 7,
X3, X5, X6, Mini.
23 different colours.

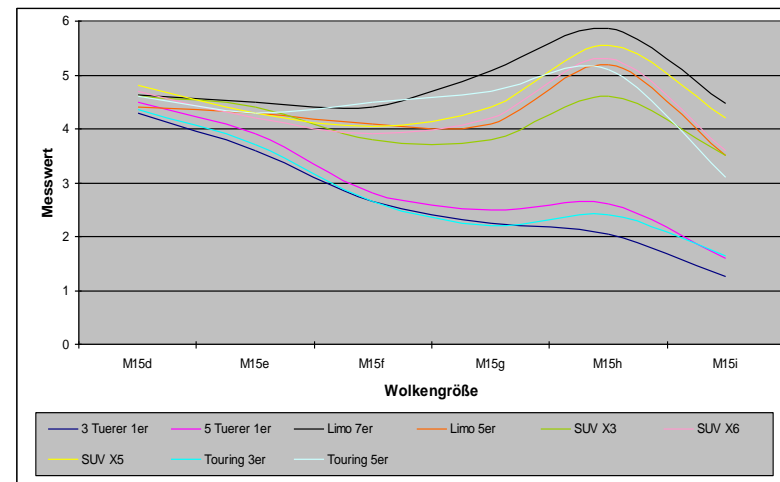
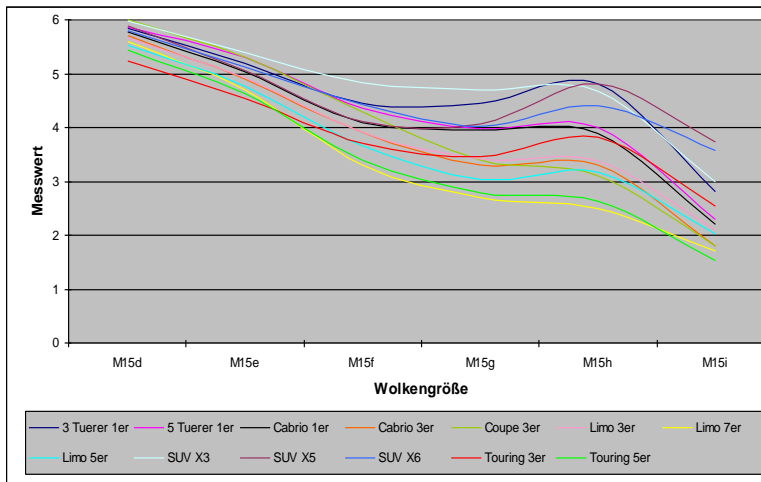


Customer relevant evaluation of cloudiness.

Basics – Resolution of the cloud-runner.

- BMW cars, colour „space grey“, hood, angle 15

- BMW cars, colour „titan silver“, hood, angle 15



Customer relevant evaluation of cloudiness.

Basics – Resolution of the cloud-runner.

- The evaluation of the measurement results of BMW series cars confirms:
 - The cloud-runner can differentiate the different levels of cloudiness of different colours.
 - The cloud-runner can differentiate the different levels of cloudiness on different body types painted in the same colour.



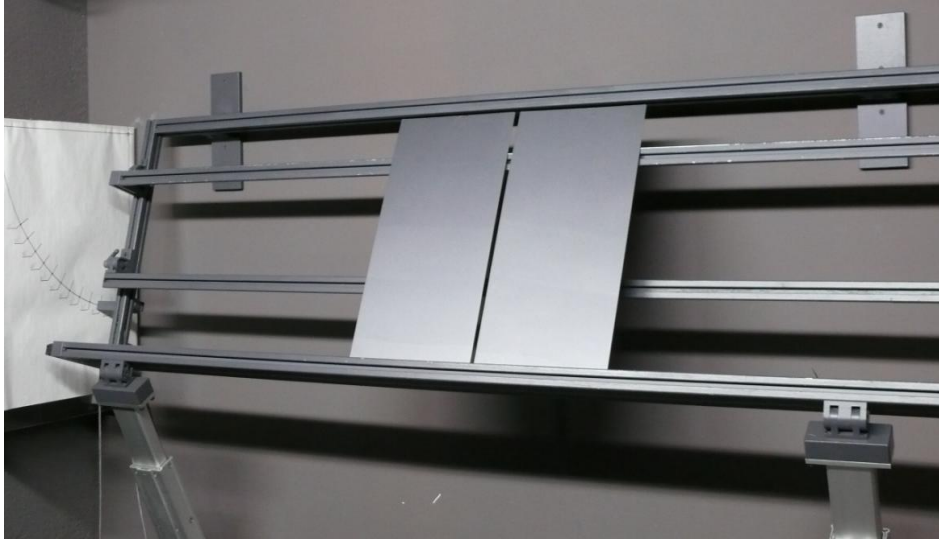
Customer relevant evaluation of cloudiness.

Correlation study - panels.

- Preparation of a test panel matrix with defined levels of cloudiness:
 - Colour „space grey“.
 - Colour „pure silver“.
- Selection of a test series „cloudiness“ with adequate grading.
- Visual correlation with the method „paired comparison“:
 - complete paired comparison.
 - evaluation of experts and laypersons.
 - constant external conditions as distance, light conditions, etc.



Customer relevant evaluation of cloudiness. Correlation study - panels.



Customer relevant evaluation of cloudiness.

Correlation study - panels.

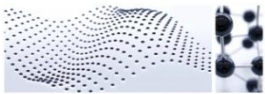
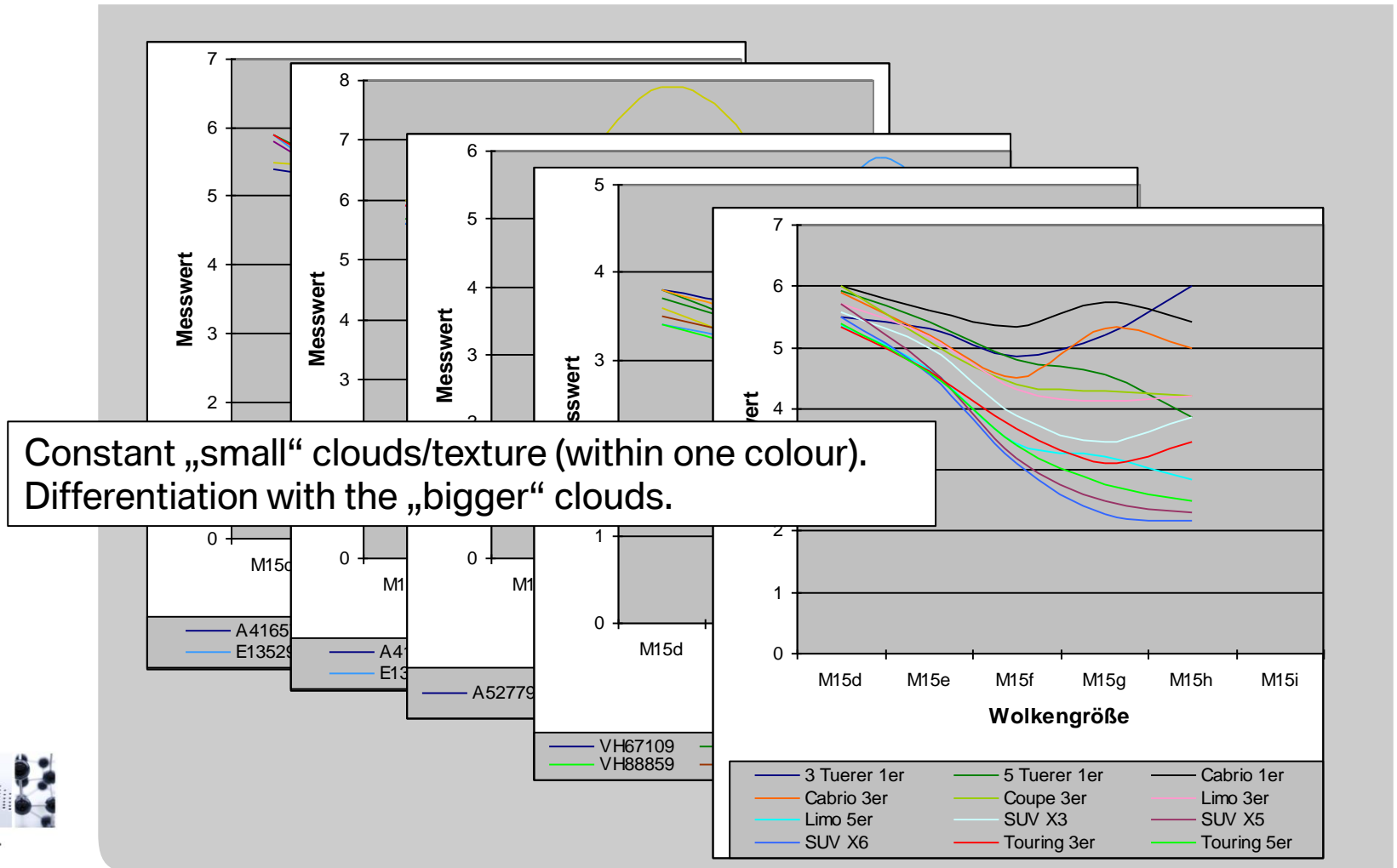
- Correlation 15 angle: Good differentiability.
Correlation with M15g (33 – 72mm).
- Correlation 60 angle: Differentiability ok, but low significance due to low spread of the test series.
Correlation with M60g (33 – 72mm).



Customer relevant evaluation of cloudiness.

Cloudiness – development of a “grading system”.

- Evaluation of BMW series cars:



Customer relevant evaluation of cloudiness.

Cloudiness – development of a “grading system”.

- Grading system:
 - **Mottling** = „Makro-Mottling“, describes the process relevant cloudiness/mottling.
 - **Texture** = „small clouds“, describes the structure of a colour, constant parameter (colour specific), not process relevant.
- Mottling and Texture are deducted from the cloudiness spectra.



Customer relevant evaluation of cloudiness.

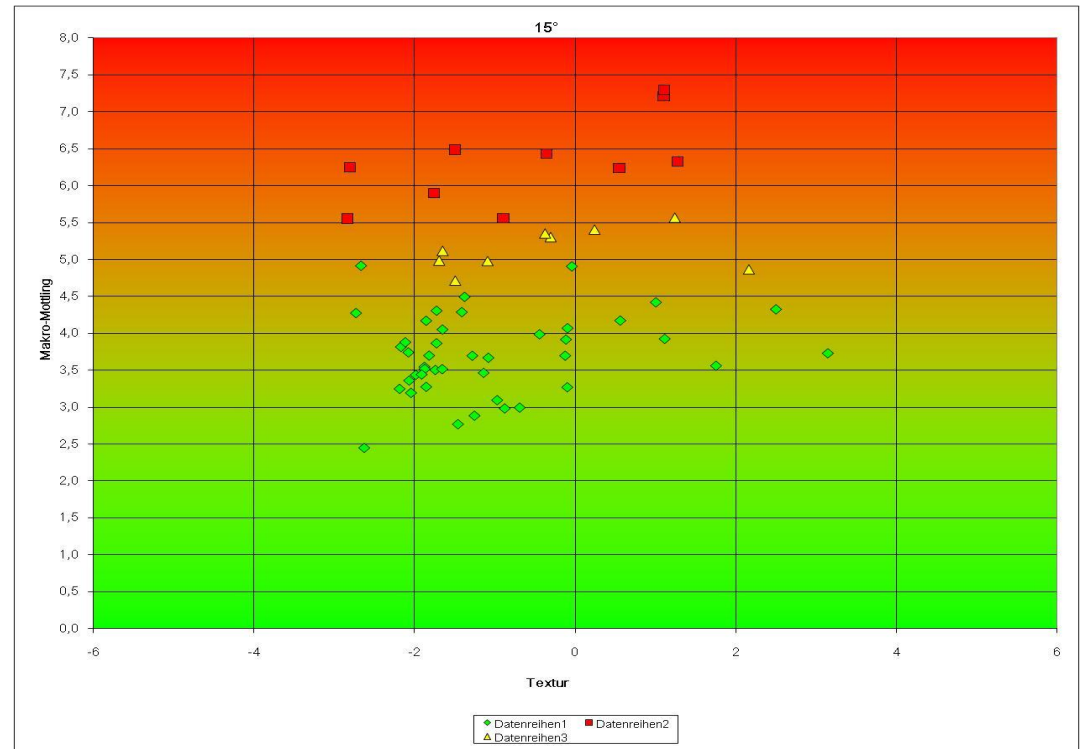
Cloudiness – development of a “grading system”.

- Optic panels with different colours: Mottling/Texture (15°) and visual evaluation of cloudiness:

Red: nok.





Yellow: critical.

Green: ok.



Customer relevant evaluation of cloudiness.

Field study – Customer relevance.

- A team of 5 people (BMW and BYK) planned and carried out the field study for customer relevant evaluation of cloudiness. 
- Evaluation of a variety of cars of different manufacturers in a variety of colours. 
 - Evaluation by measurement with the cloud-runner.
 - Visual evaluation under standardized conditions by probands. 
- 70 questionnaires were analysed. 



Customer relevant evaluation of cloudiness.

Field study – Customer relevance.

Results:

- Mottling15 angle:
 - Suitable parameter to describe cloudiness on painted cars.
 - Significant correlation, limit values from a customer perspective could be defined:

	15M	> 6,0	→ not ok.
6,0 >	15M	> 4,5	→ critical.
4,5 >	15M		→ ok.

- Comparing the evaluation of the auditors against the rest of the probands (after being sensitised) show good correlation.



Customer relevant evaluation of cloudiness.

Field study – Customer relevance.

Results:

- Mottling 60 angle:
 - No customer relevance could be detected in the field study under the ruling conditions of chosen colours and installed lighting conditions.
 - A visual evaluation of the optic panels in the lab could only be correlated with the cloud-runner under strong daylight spots.
 - The numeric value of 60M is the „same“ as 15M (a corrective factor is implemented in the formula).
 - Up to now, if there is cloudiness under 60 , the cloudiness under 15 dominates the overall impression.



Customer relevant evaluation of cloudiness.

Conclusion and perspective.

- A customer relevant evaluation of the optical property cloudiness is possible:
 - Cloudiness can be measured with the cloud-runner.
 - Customer relevant limit values for cloudiness could be derived in the field study. Thereby, 15M, the Mottling under 15° angle is sufficient.
- The evaluation of cloudiness by measurement with the cloud-runner will be implemented in the basecoat release process within the BMW Group. The Mottling values 15M and 60M will be measured and monitored.
- The limit values, adapted to the BMW auditing levels will be implemented in the relevant quality specification.



Thank you for your attention.

T. Schäckeler

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Customer relevant evaluation of cloudiness.

Field study – Customer relevance.

Working steps:

1. Measuring all cars with the cloud-runner (Mottling 15 , 45 , 60 and texture 15 , 45 , 60).
2. Basic visual evaluation of hoods and left side doors in the light cabinet.
3. Sensitising the probands for cloudiness with a prepared car body.
4. Visual evaluation of hoods and left side doors in the light cabinet.



Customer relevant evaluation of cloudiness.

Field study – Customer relevance.

Evaluated „subjects“:

- Number of cars: 25.
- Car mix consisted of a wide range of car manufacturers.
- Preferably colours with sensitivity to cloudiness, for example silver, grey, champaign.

Montag		Dienstag		Mittwoch		Donnerstag		Freitag	
BMW X1	kaschmirsilber	BMW X1	kaschmirsilber	Nissan Qasqai	diamant silver	Nissan Qasqai	diamant silver	Mini	pure silver
BMW 3er lim	spacegrau	BMW 3er lim	spacegrau	BMW 3er limo	platin bronze	BMW 1er	blue water	BMW 1er	blue water
Renault Laguna	602 gris	Renault Laguna	602 gris	Lancia Y	Grigiopatizia	Lancia Y	Grigiopatizia	Lancia Y	Grigiopatizia
Audi A4 Avant	lavagrau	Audi A4 Avant	lavagrau	Mazda 2	icy blau	Mazda 2	icy blau	Mazda 2	icy blau
Lexus IS	premium silber	Lexus IS	premium silber	Toyota Avensis	schiefer met	Toyota Avensis	schiefer met	Toyota Avensis	schiefer met
Nissan Qashqai	diamantsilber	Jaguar XF	Vapour grey	BMW 3er limo	space grau	BMW 3er limo	space grau	BMW 3er limo	space grau
Mini	dark silver	Mini	dark silver	Suzuki Swift	Lagoon turquoise	Suzuki Swift	Lagoon turquoise	Suzuki Swift	Lagoon turquoise
BMW 3er lim	titansilber	Jaguar XF	lunar grey	Jaguar XF	lunar grey	Jaguar XF	lunar grey	Jaguar XF	lunar grey
Audi A3 sportback	kondorgrau met	Audi A3 sportback	kondorgrau met	BMW X1	titansilber	BMW X1	titansilber	BMW X1	titansilber
Audi A4 Avant	eissilber met	Audi A4 Avant	eissilber met	Audi A4 Avant	eissilber	Audi A4 Avant	eissilber	Audi A4 Avant	lavagrau



Customer relevant evaluation of cloudiness.

Field study – Customer relevance.

- Standardised conditions for the visual evaluation.



Customer relevant evaluation of cloudiness.

Field study – Customer relevance.

Probands:

- Total number: 70.
- Men: 56.
- Women: 14.
- Qualification: layperson to expert/auditor.

