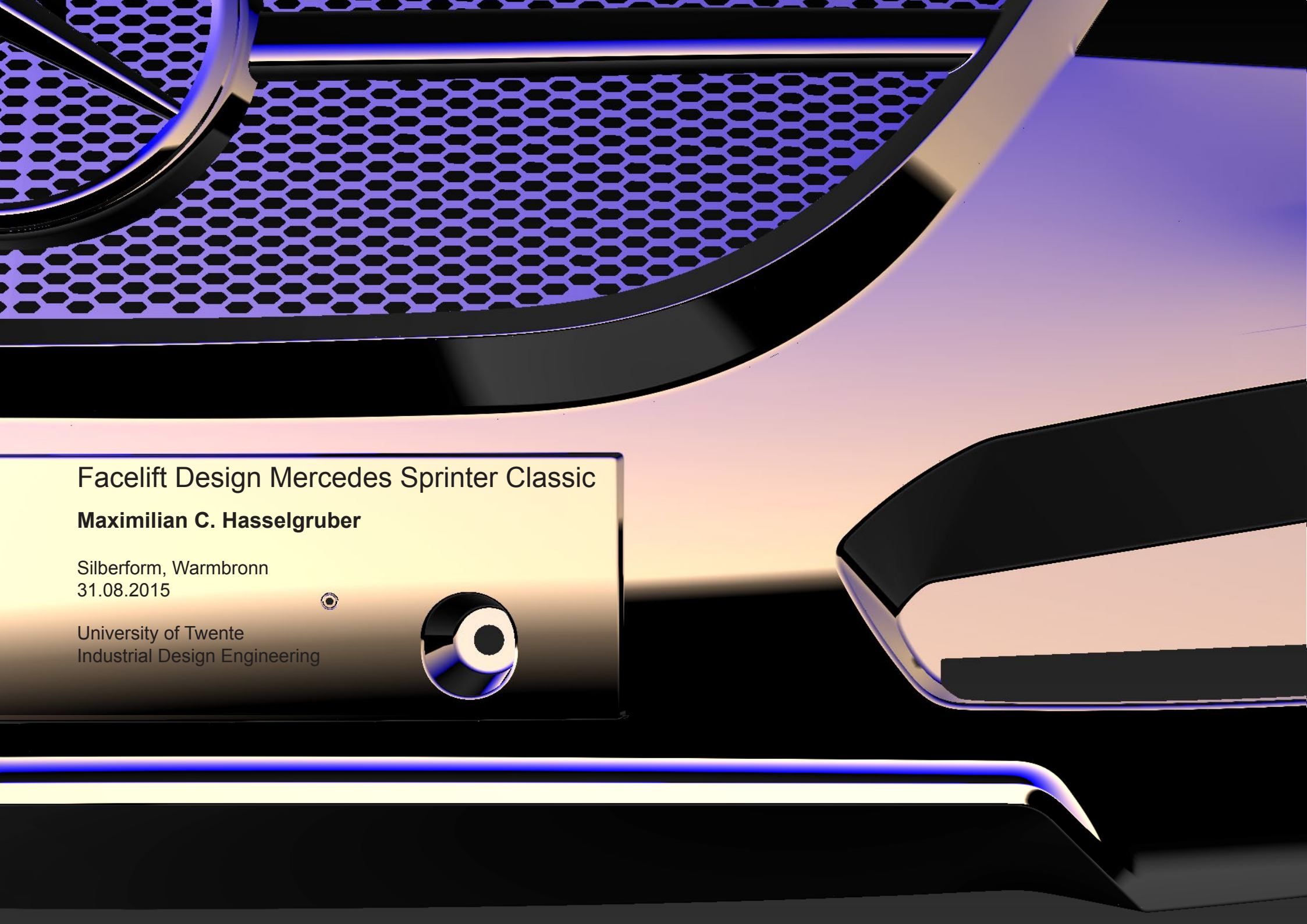

Facelift Design Mercedes Sprinter Classic

Maximilian C. Hasselgruber

Silberform, Warmbronn
31.08.2015

University of Twente
Industrial Design Engineering

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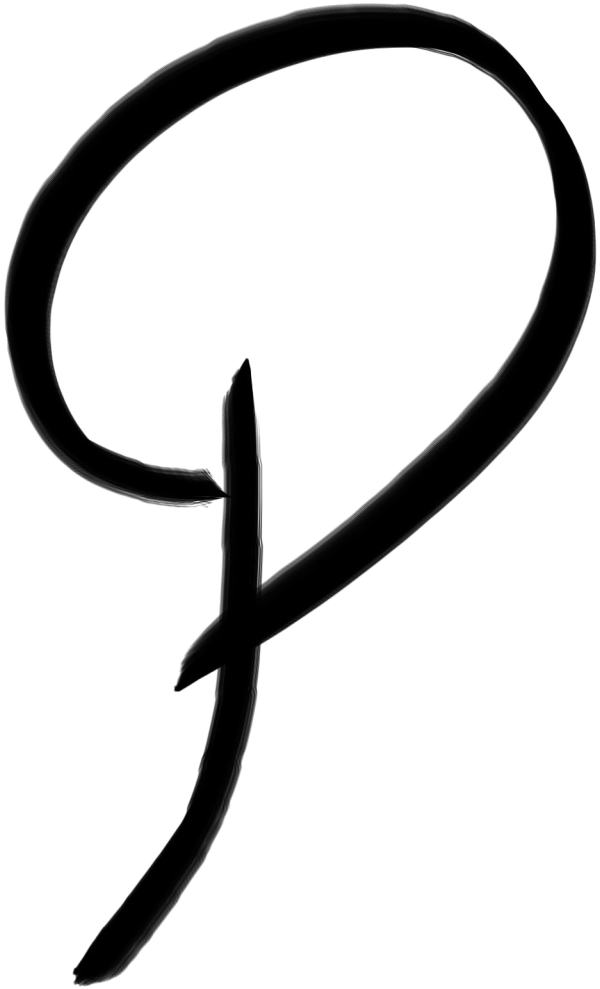


Preface

Writing a bachelor thesis is the final phase of the bachelor study Industrial Design Engineering at the University of Twente. This thesis can be carried out either for an external company or for the university itself and should last minimal 3 months to maximal 6 months

My interest in cars led me to a bachelor work about car design; to be more specific about the bumper redesign of a Mercedes Sprinter vehicle.

For that I have chosen for an external company near Stuttgart. The south of Germany gathers most of the German car brands; Mercedes, Porsche, Audi, VW. Except for the fact that the company side is near to my hometown, I really like working in this area.

During my time at the company I used my learned knowledge from the university. Fastly I noticed, this was not enough. I had to improve my skills in CAD modelling very fast. With Silberform AG I got the possibility to learn much about the everydays world of automotive design and earned many tips and tricks to improve my own skill set.

I wanted to thank Mr. Müller for giving me the possibility to work out my thesis at his company and Mr. Cerkez for supporting me during my thesis with useful help that improved my whole result.

Nussdorf, 30.08.2015

Definitions and Additional information:

1. **CAD, CAS**
   Computer Aided Design, Computer Aided Surfacing. Description for the construction and development using computer software.

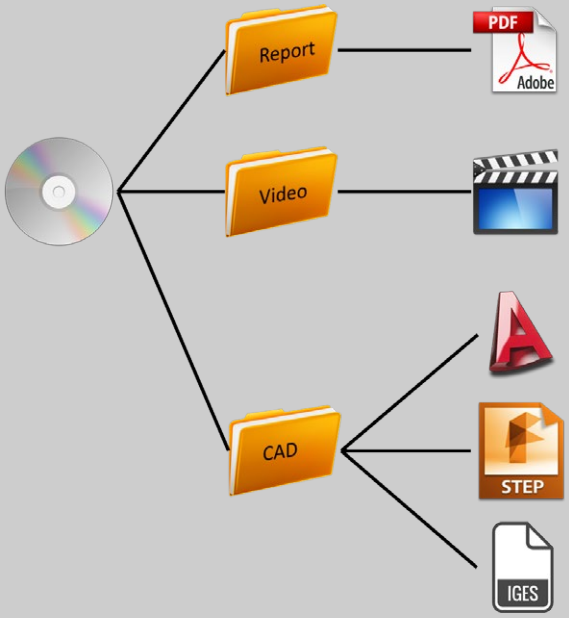
2. **Strak (-en)**
   Straken is the activity of bringing the surfaces of vehicles into the tolerance range. Using CAS software a professional checks and improves the built surfaces.

3. **Ill. 12**
   Abbreviation for 'Illustration 12', which refers to written information

4. **… 7; … 12;**
   Superscript numbers are referential web links of images or websites. The web address can be found in the appendix chapter A).

5. **…***
   Superscript star signals the additional information at the lower page. Maximal one star per page is available so the additional information consequently belongs to this one.

The CD contains additional information about the design and can be found on page 99:



Bachelor report as PDF-Document	(10,3 mb)
Video of alternation of the bumper during the 4 months of development	(18,1 mb)
Original data set of the bumper kit (alias .wire format) (Encoded)	(23,0 mb)
Data set of the bumper kit (.stp Alias Step format) (Encoded)	(59,2 mb)
Data set of the bumper kit (.iges format) (Encoded)	(105,7 mb)

Table of Contents

Summary

This bachelor thesis aims at acquiring specific knowledge about the design and development process of vehicle parts of a specific car - the Mercedes Sprinter Classic (T1N).

During this Bachelor assignment one was focused on the front bumper what actually took 4 month of development. All started with the intention to evolve a pickup version of the Sprinter Classic.

Due to the sudden plan to relocate the bumper production the need of a new injection mold was present and the idea came up to use this possibility for a facelift of this vehicle. Soon this got subject of the following bachelor thesis. With Silberform AG giving me the change to work on this project at a professional working place.

After some time of research and form finding it all started to take shape in 3D using the CAD software Alias Surface. This actually entailed several problems considering my lack of knowledge of this tool.

With the help from colleagues and business partners it was possible to walk this path and to design a new makeover for this Mercedes vehicle with a plug-and-play solution that does not request any changes to the chassis.
In conclusion: a cheap facelift that even has the potential to lower the production costs.

Zusammenfassung

Diese Bachelor Arbeit zielt darauf Wissen über Design- und Entwicklungsprozesse zu erlangen, die erforderlich sind für das Entwickeln von Automobil Einzelteilen, bei dieser speziell von dem Mercedes Sprinter Classic (T1N)

Während dieser Bachelor Arbeit wurde sich lediglich auf die Vorderstoßstange konzentriert, was dennoch vier Monate in Anspruch nahm. An Anfang bestand die Intention einen Pickup zu entwickeln auf Basis von einem Sprinter Classic.

Wegen der überraschenden Neulokalisierung der Frontstoßstangenproduktion und der benötigten neuen Spritzgussformen entstand die Idee des Facelifts für das Fahrzeug. Bald wurde diese Idee zum Thema dieser Bachelor Thesis. Durch die Hilfe der Silberform AG bekam ich die Möglichkeit dieses Facelift an einem Professionellen Arbeitsplatz zu entwickeln.

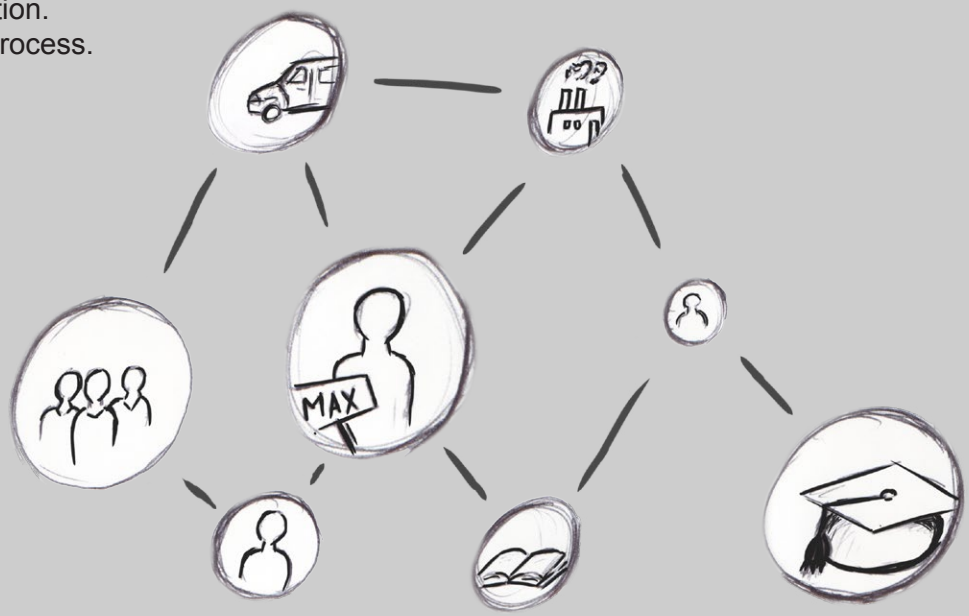
Nach einiger Zeit der Nachforschung und Formfindung begann alles Form anzunehmen mit der 3D CAD Software Alias Surface, was jedoch eine Probleme mit sich brachte, da Basiskenntnisse nicht vorhanden waren.

Mit der Hilfe von Kollegen und Geschäftspartnern war es möglich diesen Weg zu gehen und ein neues Gesicht für dieses Fahrzeug mit einer Plug-and-play Lösung zu entwickeln, welche keine Änderungen am Rest des Fahrgestells mit sich brachten.
Zusammengefasst ist es ein günstiges Facelift geworden welches selbst ein hohes Potential der Minimierung von Produktionskosten besitzt.

Chapter 01: Introduction

Content:

The following chapter is about the Silberform AG, the company that made this Bachelor thesis possible. Information will be given about the working situation, the design team and the CEO. Furthermore, the origin of this assignment will be described to give the reader an idea where the bachelor subject came from.
Over the course of this bachelor thesis “Alias surface” is a recurrent term.
However, what is Alias? Therefore the last subchapter is about this question.
The software and its functions are explained to make clear the working process.



1.1 Silberform AG

Ill. 1: Mr. Müller, CEO Silberform [2]

Silberform AG [1], a 150-people-strong design forge for especially cars. There, in the workshops, new prototypes and other creations of all leading car brands are created and worked out. The many departments of this company work together hand in hand with an uprising success. Silberform AG, former Messmotech AG, got restructured and renamed in 2011. Since then Mr. Müller (Illustration 1), CEO of Silberform, registered an increasing business from year to year. 2012 the company started to open new locations: Cracow, Poland; a new development location. This year, 2015, Ingolstadt became a new company's location and a next one is already in planning. The headquarter offices are located in Warmbronn and Renningen, both near to Leonberg, South Germany.

Ill. 2: Silberform Logo

Customers of Silberform are especially Daimler, Volkswagen, Audi, Porsche, Knaus, and many more. These references make Silberform very attractive for designers and developers of the automotive sector.

The bachelor working place was located in Warmbronn at the CAS department with many supportive young employees (Illustration 3).
Besides the permanent employees the company supports apprenticeship and gives foreign students internship positions. Everybody is highly motivated which generates a great working atmosphere.

Ill. 3: CAS Team, Warmbronn, 2015

1.2 Assignment Origin

The whole facelift idea came up at Mercedes almost a year earlier, September 2014; to gain sales it was thought of changing the old outfit of the T1N Sprinter to a new, good looking one. But, under one condition: it had to be cheap. The first intention was to rebuild the Sprinter as a pickup which includes parts of the Mercedes G63 AMG 6x6 (Illustration 4).
When suddenly the interest for this project gained, most of the attention was given to the front bumper and an easy changeable body kit (front, rear and side bumper as well as bigger fenders).

Ill. 4: First Sprinter Pickup visualization (2014)

A lot of different studies were made trying to change specific parts to make it look more aggressive and fitting to the today's production line. After many feedback sessions with several employees of Mercedes, a rough design structure came up as wel as the intention to realize it during this bachelor work.

Silberform gave the possibility to work on this facelift to get it ready as soon as possible. The condition was to develope the model with the until-that-day for me unknown program Alias Surface.
The first week consisted of getting everything to know and learning the program. Parallel, the final version of the front bumper was made in Photoshop with assistance of Silberform and Mercedes (Illustration 30).

During the second week all needed data was collected from Mercedes: original meshes* from the original T1N bumper, trims and retainers. In the beginning of the CAD modelling fittings and connections were rebuilding, which are needed to make the facelift change directly fit to the car chassis.

Ill. 5: Sprinter Classic todays' design

Ill. 6: Sprinter Classic redesign

* A polygon mesh is an arrangement of vertices, edges and faces that defines the shape of an object in third dimensional modelling. The surfaces usually consist of triangles, quadrilaterals, or other simple shapes. This method simplifies rendering.

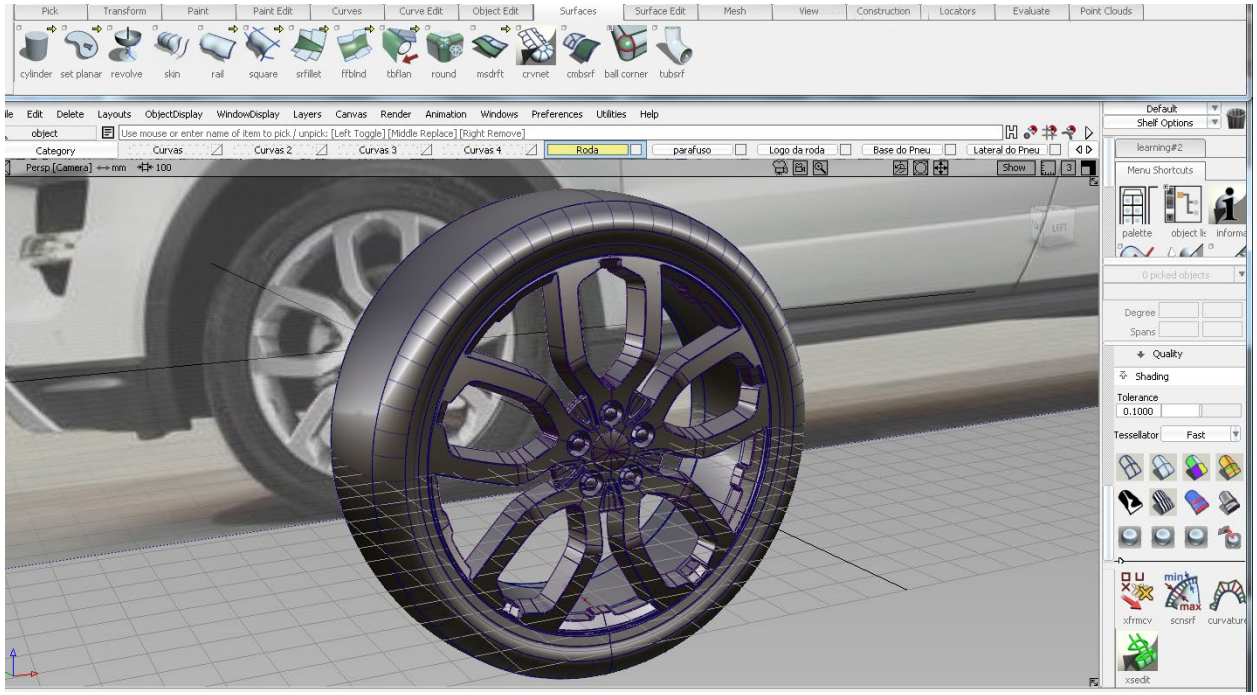
1.3 What is Alias?

Before the bachelor thesis started it was asked which computer software will be used, the decision felt for Autodesk Alias Surface.
Alias is a computer-aided industrial design software that allows the user to create curved surfaces in the third dimension and build car parts for example (Illustration 7). Certainly that is not the only benefit of Alias Surface, but it is for the Silberform AG. This software package contains tools for sketching, modeling and visualization. Very useful for designers is the freedom to experiment with shape and form. For evaluation the program contains diagnostic shades, measuring instruments, demolding functions and many more.

Autodesk, publisher of Alias, made an easy data exchange with other CAD packages possible as well as the freedom to use either Windows or Mac OSX.

All in all, Alias offers a huge variety of options, functions and possible applications.

At Silberform also other programs are used such as ICEM or Maya polygon modelling. Alias adventage is the easy use during free developement compared with ICEM. ICEM for example goes more in detail work, also called ‘strak’. This means the model will be checked and changed at connections and fittings to fullfill precisions of even 5/1000 mm.



Ill. 7: Alias Surface software use example [3]

Chapter Conclusion

Now that the background of the thesis is luculent, one can go further to the important stage of analyzing. Especially the 'assignment origin' gave useful information that can be used during several conclusions like the fact that the vehicle body kit must be cheap and easy changeable.
What that means exactly will be explained and analyzed during the next chapter.

Chapter 02: Analysis

Content:

The upcoming chapter is the analysis stage, one of the most important stages during a design process. The early-made choices of the analyses will affect the whole following process.
The reader awaits analyses of where the product will be relaunched as well as the inherent people of this market. What are the demands, wishes and requests of the customers?
Furthermore, Mercedes will be dissected: what makes a vehicle a Mercedes? What are the typical face characteristics of these vehicles?
In the end of this chapter, the important demands and wishes will be listed with required explanations.
After these steps certain constraints are determined which will limit the freedom but on the other hand lead to possibilities.

2.1 SWOT Analysis

The SWOT analysis can help to find the strengths and weaknesses of the today's Sprinter design, which may indicate the further way of procedure.

SWOT	Strengths	Weaknesses
Opportunities	Analyze old design, is there a better market location with more interest in the vehicle	New Design to fulfill customers' wishes and to raise sales
Threats	More and better advertisements for the Sprinter Classic compared to the NCV3 (W906)	Change design disadvantages to create a competitor to the Sprinter NCV3

Ill. 8: SWOT Analysis diagram

It was looked for the strengths, weaknesses, opportunities and threats of the Sprinter Classic (Appendix C). Afterwards the four properties were confronted with each other and arranged in the SWOT table (Illustration 8). As one can see, the green pattern "Strengths vs. Opportunities" seems to be good, but, however, the location of Russia will not be changed. In this case a new market is no option for adaptation.

For the subsequent process it was focused on the orange and red areas: "Weakness vs. Opportunities" and "Weakness vs. Threats".
By this action the product (in this case the bumper) gets a real redesign which can push back other competitors.
The goal of this assignment was to gain sales by getting the Sprinter Classic to the same level as the Sprinter NCV3 (Illustration 14). However, if one compares these two interiors, one can hardly tell which belongs to the old exterior (Illustration 9 and Illustration 10). The T1N has an interior that more looks like a personal car interior, the NCV3 interior is more clean and straight which is often found in working vehicles.

After the redesign process, the blue pattern of the SWOT table is a concluding opportunity to gain sales. Good advertisements can influence people in a way they don't even realize it but still gain interest in the product [4].

Ill. 9: Sprinter NCV3 [5]

Ill. 10: Sprinter Classic (T1N) [6]

2.2 Market Analysis

The Market analysis is one of the first steps to take when a new product has to be designed and created. What do others do, what does their products look like. To get a clear overview it's simple to use a collage with many pictures of different brands and comparable products (Illustration 11).

Ill. 11: Market analysis collage

As one can see, the market already has many options of pickups and body kits for sprinters. Other brands like Volkswagen provide vans with an SUV option (Illustration 12 and 13).

Ill. 12: Volkswagen Saveiro Surf [7]

Ill. 13: Volkswagen Saveiro Surf [7]

Even Mercedes has a good looking van: the Mercedes NCV3 (Illustration 14) is a fully facelifted sprinter that makes the Sprinter T1N the ugly duckling. To describe it more objective, the T1N is a modern car in an old dress; the interior is state of the art but the exterior didn't had great changes since 1995. At this point one should start the change.

Ill. 14: Mercedes Sprinter NCV3 [7]

Next up, a mood board represents the desired feelings and connections people should have when looking at this car. This kind of collage shows not only the product itself, but also other products, surroundings, people; all the things that belong together with this topic. Designers can create new ideas by the shown shapes and forms of other products.

Ill. 15: Mood board collage

The mood board (Illustration 15). As one can see the sprinter design could be influenced by aspects of luxury, sharp shapes and elegance. One great disadvantage is the image of this car, it is a utility vehicle and it is also seen as one. As a result it is mostly used in the industry sector, not in the private sector. In the further process it is tried to change this situation. The Sprinter shall gain more attractiveness by changing its face. That's what will make the difference.
Bluntly said the exterior scares away customers although the interior is modern and high-quality. Let's bring this down to a common denominator so that interior and exterior fit each other.
The mood board already gives the idea of a new desired target group.

2.3 Target Group Analysis

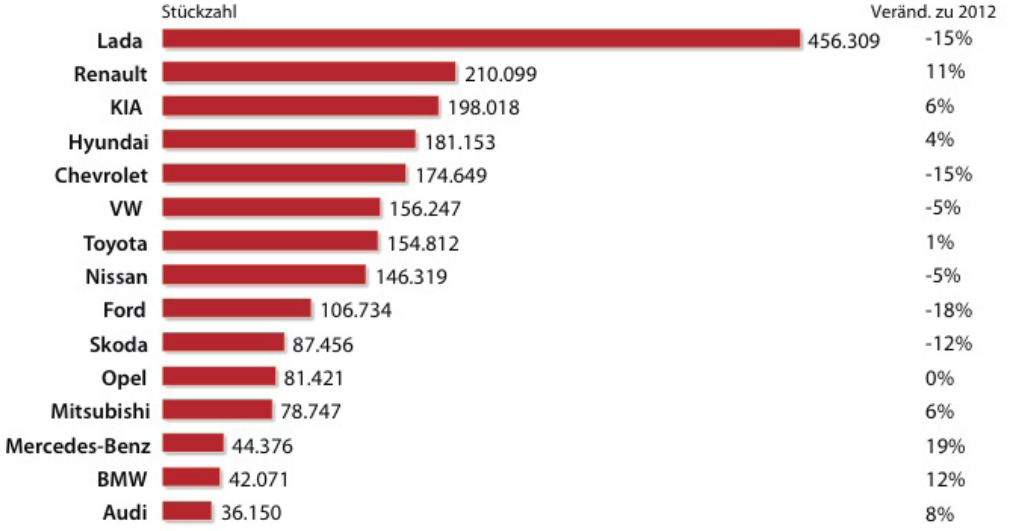
The Russian market is two-parted – Many very cheap and old cars and on the other hand very expensive cars, often tuned to make them even more expensive. Since the crisis in 2014 the car market in Russia dropped by around 40%. Brands like Ford in fact had a decrease of 78% [8].
Contrasting are the sales of the luxury car market: Despite the crisis it held up. Russians are more likely to live very Spartan life but drive an expensive car.
"That's because everyone sees how I drive, but no one sees how I live." [8].

That leads to an interesting basis: Make a Mercedes Sprinter a luxury car or at least interesting for the expensive market. Even when it is not going to be the daily one, the Sprinter has to look good by the side of a luxury car. The Sprinter has to fit into a luxury car pool.

What do Russians like about cars? Most Russians like German cars, fast sellers are Mercedes, Audi and BMW. The bigger the better! The German brands and designs attract enough Russians that the home brand Lada sales figures are low. In total, import cars are most sold. That makes it easier to design because the known design trends of Europe are wanted.
Additionally Russians like chrome on their cars; bling, gold-plated and everything that attracts more attention is installed (Illustraion 16).

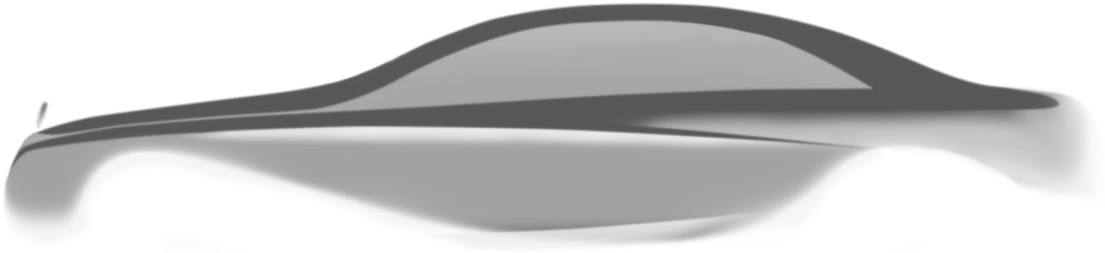
Ill. 16: Target group analysis, Russian luxury cars

As one can see there are some ridiculous tuned cars most of them tuned from expensive to even more expensive. Attract attention, that's the spirit! Noticable is the high frequancy of Mercedes vehicles.



Ill. 17: Russian car market, brand sales 2013 [9]

As mentioned earlier, one can see that except for the Lada mostly foreign vehicles were sold in Russia in 2013 (Illustration 17). Even when the sales of the Lada look incredibly high, the sales of all other 14 brands together are much higher. The Russian people are 4 times more likely to buy an import car than a Russian Lada.

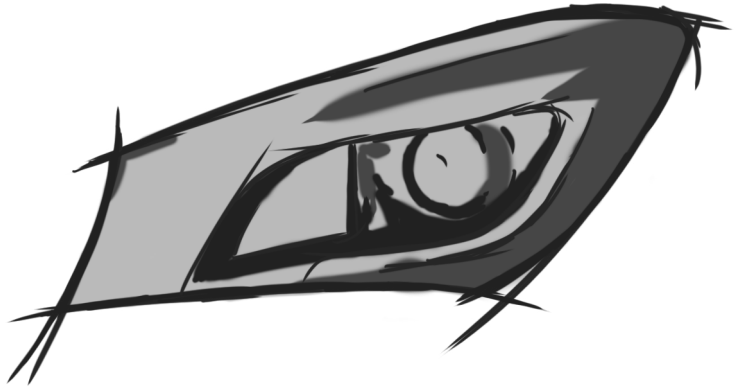


2.4 What is Typical ‘Mercedes’ Nowadays?

To develop a front bumper, that fits the todays Mercedes design line, typical Mercedes design characteristics had to be analyzed. Even the utility vehicle sector has several recognizable aspects. To start somewhere a collage was made to get a better look on many Mercedes models.

Ill. 18: Mercedes car-face analysis

Very noticeable is how almost every line aims towards the middle, like a spear. Every model has the edge lines on the hood starting at the A-pillar and going straight to the center directed side of the headlights. The intercooler-intakes, fake or real, are big extractions on the left and on the right. Some models additionally have a big notch under the license plate, for the look and for extra cooling. The earlier models have the three strictly separated intakes (left, second from above) compared with the CLS AMG (Left, buttom). This bumper has more fluent forms looking more futuristic and wide.
The shape of the headlights is also one of the most recognizable parts:
Vertical side towards the center and peaked proceed backwards (Illustration 19).



Ill. 19: Schematic headlight shape of Mercedes vehicles

Ill. 20: Mercedes chrome trim

Ill. 21: Mercedes chrome trim

Around the middle intercooler intake often an offset surface is placed to create more depth. To make it more eye-catching, a chrome emblem is attached (Illustration 20 and illustration 21). This creates a link between sportiness, elegance and modernity. Therefore it is definitely a feature one should take over in the design process.

2.5 Demands and Wishes

Demands:

- Look
  - The exterior has to fit the todays Mercedes Design line to make it comparable and interesting to the market, even in the private sector.
  - Two bumper versions, one standard cheap version and one optional luxury version
  - Demolding has to be possible with an angle of 1° or more.

- Performance
  - The air supply of the cooler was always a problem. The demand is to provide the same amount of air or even more to better the performance of the vehicle.
  - During assembly process the bumper must be a plug and play solution. The new design must not change anything of the chassis; all the screw points should be the same so the mechanics don't need training for a new assembly process.
  - The bumper has to have treads so the user can step on them to reach the top of the windshield for cleaning reasons.

- Costs
  - The costs of the bumper parts must be the same or even lower than the original €40,00 (Bumper, Grill, metal trim under the headlight, trim around the grill)

- Material
  - The material will be the same as the old bumper, polypropylene. This gets the price down which is a Mercedes' demand.

- Safety
  - Fulfill the Mercedes safety standards (TP-581-01) even after the facelift

Wishes:

- Manufacturing
  - It is desirable to produce the whole bumper with only one injection mold. This can lower the price and production time. Also the assembly time would be shortened as a result of less bumper subparts.

* TP-581-01 safety standards checkpoints will be found in the Appendix C.

Chapter Conclusion

With the just obtained information it is obvious where and in which society the redesign will be launched. But first of all a SWOT-Analysis led to the strategy of the changing process: what will be changed due to strengths and weaknesses. The goal is to change as much as possible to bring the Sprinter Classic to the level of the NCV3 and eventually become competitors.
The market analysis showed different pickup and van solutions of other brands. It is obvious, that an interesting grill-bumper-front can make a huge difference. Concluding one can say that changing these parts can achieve better sales.
The new appearance of the Sprinter should be sportier and more luxurious. This is evidenced by the mood board collage. The redesign should contain a mixture of sharp edges and gentile curves. This information will be processed in the next chapter.
The Russian target group makes the design process a bit easier – Russians like German cars, not only for the design but also for the quality. But still one can pick up some information of the target group analysis collage. Regarding the Russians interest, specific Mercedes shape aspects were analyzed which will be also used in the next chapter.
At the end of this subpart the 'Demands and Wishes' are listed to limit the design freedoms which can indicate a possible design direction.

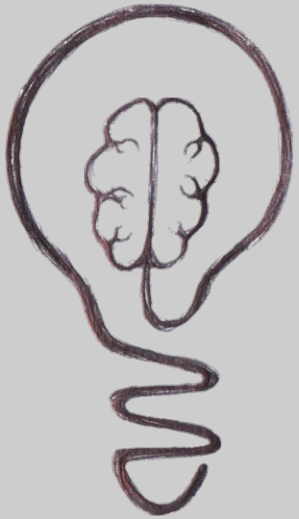
Chapter 03: Idea Generation

Content:

This chapter will show the process of idea generation starting at the origin of this project. As mentioned earlier, it all began with the idea of the transformation to a pickup.

During the process one backed away from the pickup and focused on the front bumper. Why this decision was made will also be described.

The stage of idea generation is important for the later form finding process. Shapes and arrangements are tried out and can get in the preselection for the final design. This stage also contains the 2D Photoshop designs that were important as a roadmap during the following chapter. One needs indications to properly design in Alias otherwise one starts somewhere with no clue what to do.



3.1 First Ideas

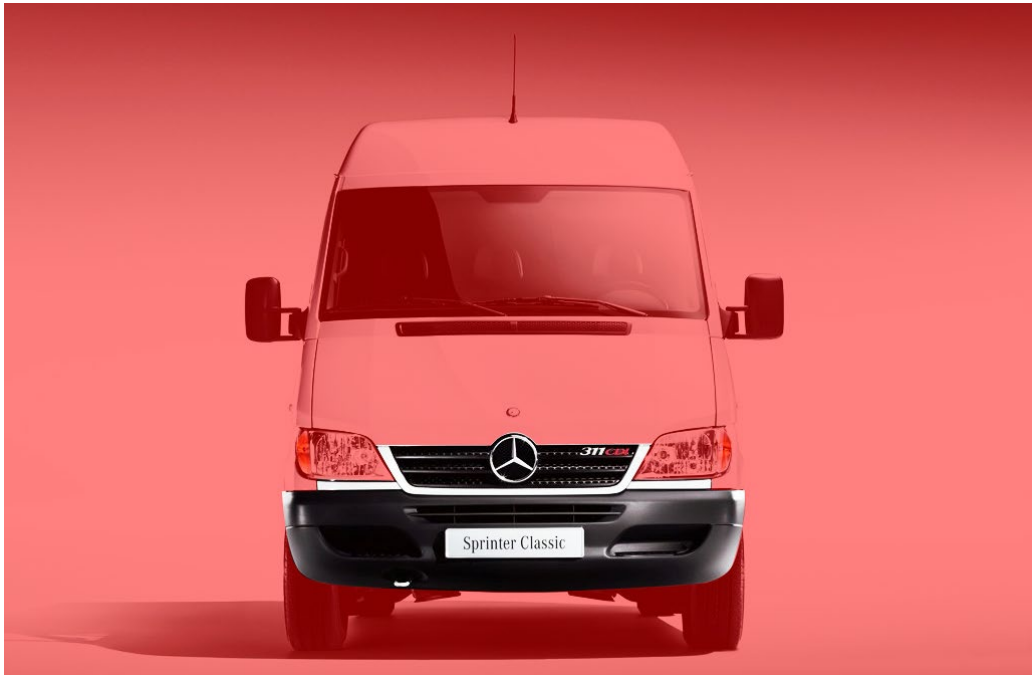
Ill. 22: Sprinter pickup version, 4-door

The first product idea, as told before, was to convert the basic Mercedes Sprinter into a Pickup.
It started with several ideas to create solutions; whole body kit changes were made including pickup trunk possibilities (Illustration 22, 23 and 24).
A tubular frame was added to the trunk based on the Mercedes G63 AMG 6x6. Options are an open trunk, a big car cabin with 2 or 4 doors and a fabric top to cover the trunk. The makeover also included sport rims, fender enlargement and another bumper.

Ill. 23: Sprinter pickup version, 2-door

Ill. 24: Sprinter pickup version, 2-door and fabric top

The focus was placed on the front bumper after the confirmation of Mercedes came.
But actually, why focusing on the bumper? Due to relocation of the production line of the Sprinter's bumper Mercedes wanted to reproduce the injection molds which made a new design possible. After some early calculations a facelift would be even cheaper than reproducing a perfect copy of the old bumper.
One important condition to let the facelift stay cheap was that it has to be a plug and play solution – no chassis changes. All connections and screw point positions had to be taken over.



Ill. 25: Sprinter Classic bumper parts (not red)

3.2 Focus on the front bumper

The focus on the front bumper narrowed the design freedom but on the other hand gave more time to spend only on this part. In the beginning parts of the AMG's E-class, the CLA's Star and grill brace, tried different daytime running lights of the E-class pre-facelift (Illustration 26) and facelift (Illustration 27) were taken configure a direction.

Ill. 26: Sprinter design I

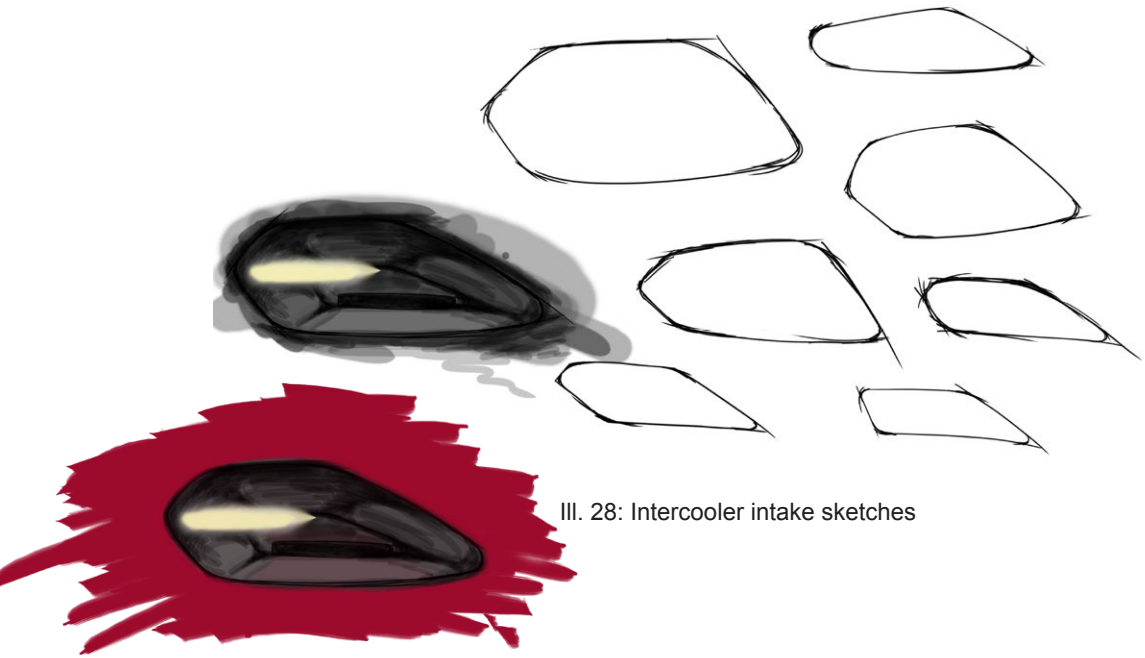
Ill. 27: Sprinter design II

Talking to Mercedes yielded the information that they want to keep the solution as cheap as possible: no painted body kit, no chrome (in first place). Also, the white design (Illustration 26 and Illustration 27) was too low and too close to the E-class. To make the body kit fit into the utility vehicle sector less design aspects from private vehicles had to be taken over.

A new shape of the treads had to be conceived; the decision was made on fake intercooler intakes. It is a shape that is on the one hand handy while using the there-located treads and on the other hand it fitts the design. Several shapes were tried out, flat, chubby (Illustration 28, Appendix D). Finally the middle course

had been chosen: Small enough to look angry and big enough to be useful when one has to step on the treads.

With these constraints the redesign process started:
A new bumper; Gray unpainted plastics, not too low, new intercooler intakes shape and also in two versions, one – the economy version (Illustration 29) without chrome, daytime running lights and other fancy extras and one luxury version with chrome braces, daytime running lights, even an AMG red sport line (Illustration 30), one can even think of a painted bumper.



Ill. 28: Intercooler intake sketches

Before starting with Alias the Photoshop render got refined, so a template for the work with Alias arose.

* The red line is an AMG feature for the sport lines.

Ill. 29: Sprinter Design Classic Version

Ill. 30: Sprinter Design Luxury Version

Ill. 31: Design when staring at Silberform AG

Ill. 32: Finished Photoshop design

During the refining process edges were changed again and a bar stripe on the hood was used to cover up the extract for the original star. The logos' position is now in the middle of the grill. Furthermore the lower bumper sides got a camber with sharp edges. This was done to not leave the side surfaces that empty and also brings back more tension.

At the end the grill itself got changed to create a bigger air passage. This resulted in only one bar that holds the star and a sporty looking grill grid. The red design stripe got changed to chrome offset*.
In the beginning of the grill redesign some optional looks of the grill bars were tried out (Appendix E) but it came down to the single bar (Illustration 32).

Chapter Conclusion

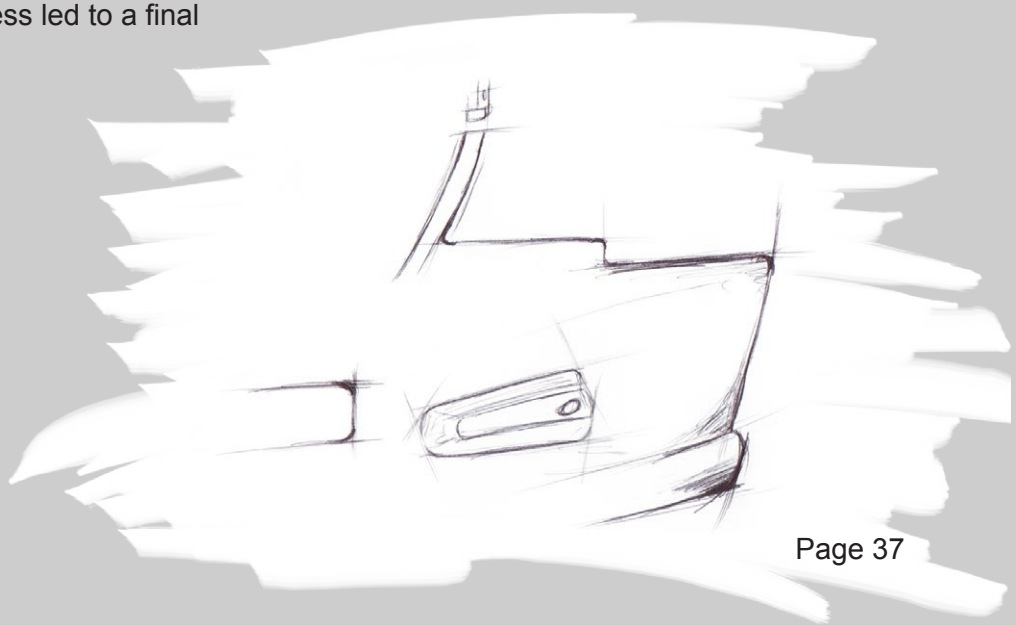
The sketches and renders led to a 2D end result that can be used as a guideline during the upcoming Alias modelling.
The final Photoshop render shows the bumper with a grill that covers the whole area from the hood to the license plate. Also, the star logo is only held by one horizontal bar just like the Mercedes sport cars.
Furthermore the treads are much more modern shaped than the original ones. Additionally daytime running lights and chrome trims can be added. With these shape references one can start modelling in Alias Surface.

Chapter 04: Concept Generation with Alias

Content:

The following chapter deals with the realization of the 2D design to a 3D model. During this chapter one passes through the results of three months of development. One is able to see the implementation of the references. Why did such a process take so long? Where did problems occur?

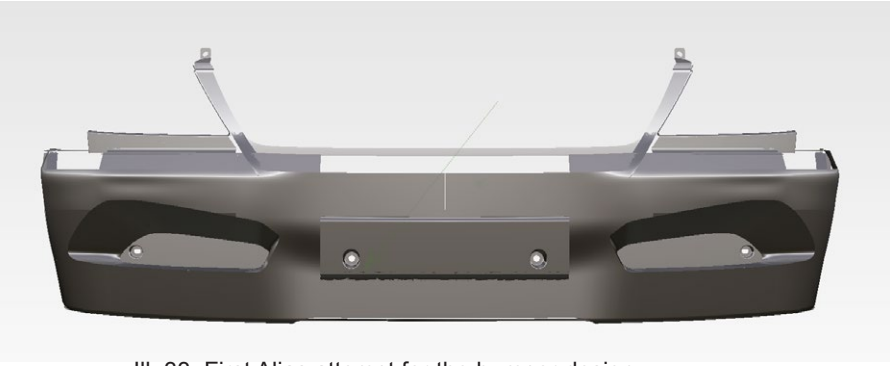
During this stage also many design possibilities were tried out, for example the license plate stage and several edges. This long process led to a final result on a presentable level.



The final form finding process happens during the 3D modelling. That differs from how it is taught at the University of Twente:
One was used to work on ideas and concepts in Adobe Photoshop® or on paper until a final version is defined. After that, a three dimensional model is made. At the Silberform AG one starts early building the ‘final’ product at the computer. The model evolves then from day to day. Reason for that is the long process of CAS Class A modelling.

4.1 First stage

In the beginning, right after the basic knowledge of Alias was learned, the first model was build based on a small amount of software knowledge. Original surface parts at important locations were recreated. Silberform AG received the bumper and many parts around the bumper as usable Catia documents. These parts served as framework to have references. For concealment reasons the original meshes of Mercedes will not be shown in detail.

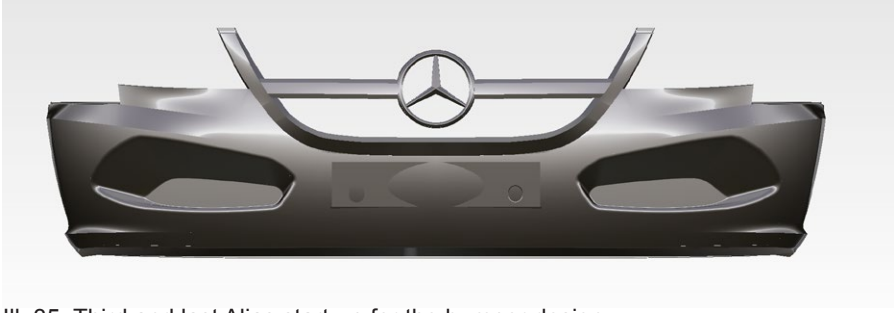


Ill. 33: First Alias attempt for the bumper design

4.2 Second stage

Ill. 34: Second Alias attempt for the bumper design

The lack of knowledge forced to two new start-ups as a result of too difficult constructions. After help from Mr. Cerkez and some coworkers, the final model got structured. It consisted of even bigger patches so the surface got smoother and were easier to work with.



Ill. 35: Third and last Alias start-up for the bumper design

4.3 Third stage

The third month contained the first part of finalization. Picture 36 shows the progress was made during the third start-up and mid-July.

Ill. 36: Final Design assumes shape

The basic form is finished and first details are included, for example the cut-outs for the tow eye and the under the license plate. Furthermore, the lower sides were improved due to rounding the edges. The intercooler-intakes got their final form – smaller but stronger. However, there was much to do. The brace that holds the star was still only conceptual, the offset above the cut-out was too tiny and the grill trim was also still for show.

4.4 Last stage

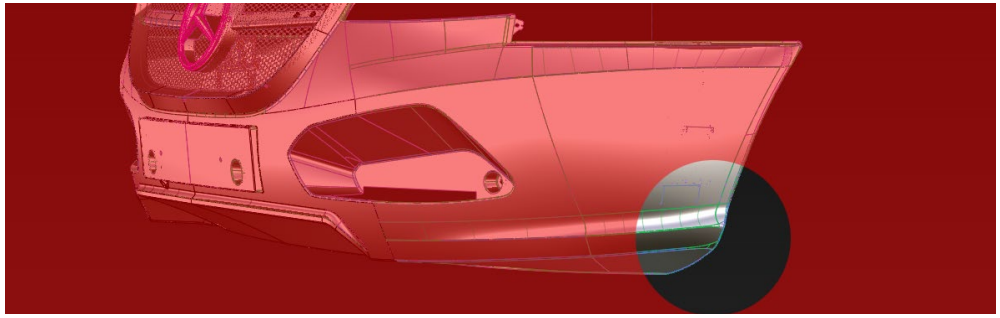
The last month of working on the model was spent on details like for example the offset under the license plate. It was too tiny and concave at the sides (Illustration 37 vs. illustration 38 vs. illustration 39).

Ill. 37: Offset shape first attempt...

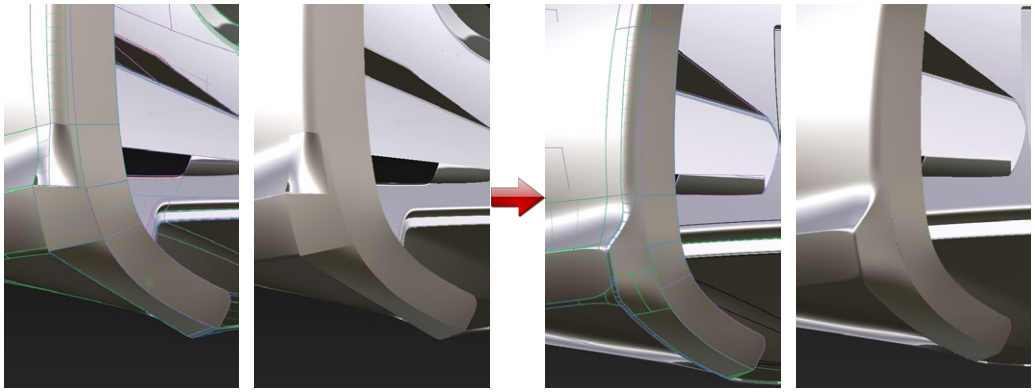
Ill. 38: ...second attempt...

Ill. 39: ...final attempt

It got re-shaped in several steps until it looked strong and stable (Explanation Chapter 5. a.)
Furthermore all the fillets got attached to the edges, to make it smoother and producible. A very tricky part was the border of the lower side edge towards the wheels (Illustration 40). Illustrations 41 to 44 show the patch work in progress.



Ill. 40: Place of one of the tricky surfaces



Ill. 41 & 42: No smooth light pathways

Ill. 43 & 44: Much better light after revision

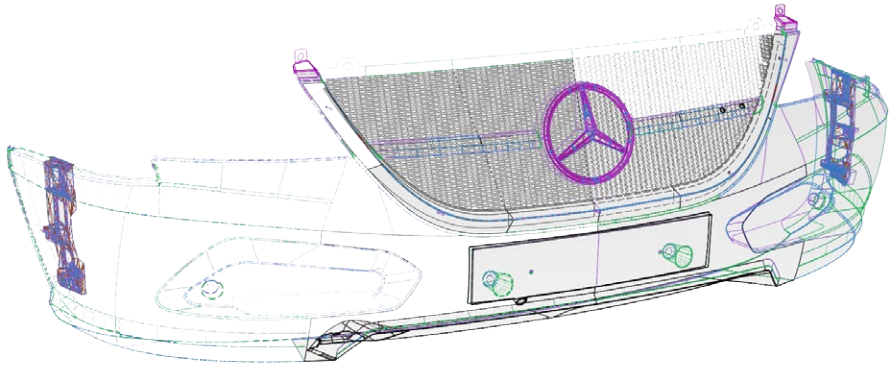
During the form finding process with Alias I tried to change the form of the license plate stage.

Ill. 45: License plate stage option

One option was to give the stage also some curve referring to the rim around the grill (Illustration 45). It was even tried to create parallel sides to the intercooler intakes; but all creations were in contrast to the license plate itself, which cannot be changed*.

Ill. 46: License plate stage in final design

For these reasons the recreation stopped and the traditional plate stage accepted (Illustration 46). The license plate breaks the face of a car ever since, one option is to make at least the stage as unnoticeable as possible to let it appear as if the license plate is directly attached to the bumper.



* Also important: The Russian license plate has a comparable size as the European license plate (520 mm x 110 mm) since 1993/ 94, so the shape of the stage can be the same for Europe and Russia.

Chapter Conclusion

The previous chapter resulted in a usable 3D model which differs a lot from the original bumper. Many changes were made and shapes from the Photoshop renders were implemented.
One can now use this model to check the compatibility with the vehicle chassis and use it in manufacturing processes.

Chapter 05: Design Completion

Content:

The upcoming chapter is about the end result. The design process is finished and now follows the discussion about all the changes. ‘Major design changes’ is about the changes of the bumper compared to the old Sprinter bumper. Making this clear is very important, because the whole intention of the project is to change the appearance.
Additionally the form language is discussed to describe why a specific shape decision was made.
Finally, an also very important part is reviewed: the compatibility. The goal of the facelift project was to make it cheap and easy to implement which requires a plug-and-play solution. Find out more in the following chapter.

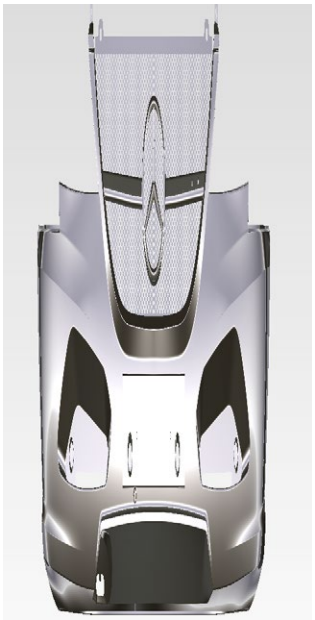
5.1 Major Design Changes

The front bumper face got three most conspicuously changes:

1. **The big grill.** This was a request from Mercedes regarding the intake air struggles of the Sprinter Classic nowadays. The grill is now one unit, from the hood to the license plate only once separated through one horizontal brace with the star in the middle. The chrome braces (optional) are lined out with the lower edge of the headlights. The grid of the grill has big racing vents with honeycomb forms to let a big amount of air in but still has a reputable appearance. The extract on the hood will be covered through a glued bar to create a decent finish.
2. **The tread notch.** This part is based on the nowadays Mercedes' intercooler intakes, to make it look sporty. The trick is to not change anything of the framing, so the position of the tread must be the same. The look has been changed dramatically but the function remained. Such as the chrome braces on the grill there will be an optionally LED daytime running light.
3. **The fillets.** Under and about of the tread notches are two fillets, directed softly downwards. This makes the bumper body doesn't look too soft and creates a sporty aggressive look. Furthermore, these fillets replace the old sprinters separation fillets. They gave the bumper a two-piece-appearance. As earlier said I wanted one unit with no interruptions in the front face.

5.2 Form Language

Through feedback sessions with Mato Cerkez the final design has been defined. Position and size of different parts of the bumper were adjusted to create a form-fitting unit.
The intercooler intakes had to go a bit more to the sides to not constrain the frame around the grill. The notch under the license plate got bigger and the angled edge has been cut parallel to the edge of the intercooler intake. This creates a cohesiveness that is important in such a body part of a car. The bumper is more or less the face of the vehicle. That makes it essential to shape it in a way that creates the desired statement. The todays sport look contains aggressive forms, sharp edges…

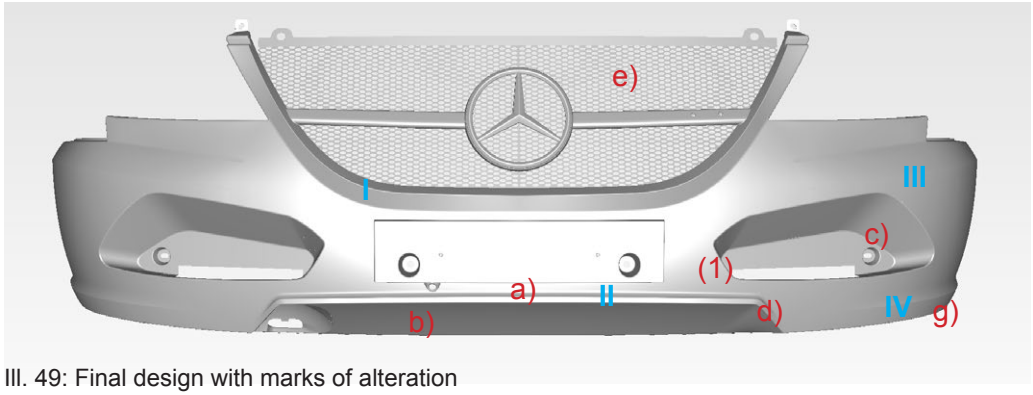


Ill. 47: Orthoface new design

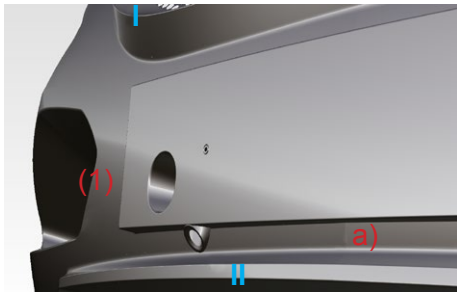
It's the face of a car you look at and it's the face you see in the mirror. To clear up the faces look, one contracts the image (Illustration 47). The intercooler intakes function as eyes which look evil, aggressive. The notch under the license plate is like a mouth that is opened screaming or roaring. This is even strengthened due to the highlight line at its edge. Under the intercooler intakes the sharp edges work as a war paint.

Ill. 48: Orthoface old design

5.3 Final Design Through Form Finding



Ill. 49: Final design with marks of alteration



Ill. 50: Close-up with marks of alteration

Most of the shapes designers develop do have a certain meaning. A single edge can make a difference between a normal standard car and a sporty interesting one. Here some explanations of the decisions that were made:

a) Little, subtle edge in the middle of the front. This is a nowadays gimmick to make the front bumper more aggressive. Like a spear head it cuts better through the front air pressure than a flat or rounded front.

b) The big indentation under the bumper towards the skid plate not only looks like an aerodynamic part of a race car, but also masks the tow eye. Now, the front face gets less distorted through not so pretty parts.

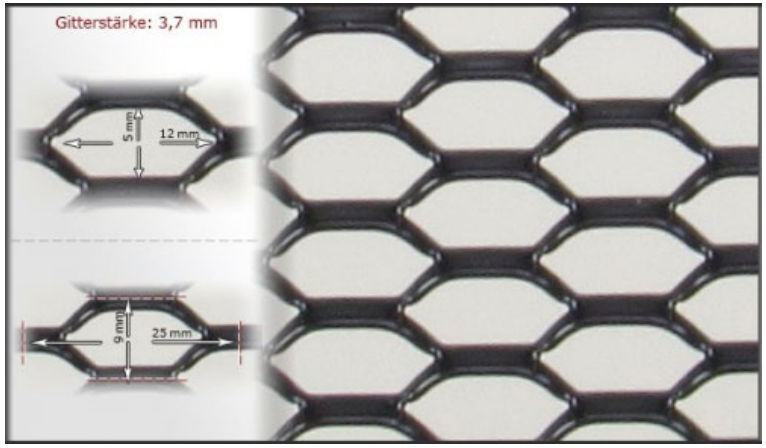
c) The ‘intercooler intake’ got smaller than intended in the first place. This was necessary to not bend the form too far. The inner line (1) is parallel to the line of the indention of b) to make it look more stable and strong. These lines can be compared to pillars of the star in the middle: wide and strong standing.

d) Strong standing is also the highlight offset. It goes parallel from the middle, accelerates in the corner and opens beneath at the end. This is a typical AMG way to design. It can be compared to the A of AMG itself: It also has pillars to stand; the form of the A opens beneath to make the letter stand stable.

e) The grill frame. The grill frame is based on the ‘elegance race’ frame of racegitter.de [10]. It’s a small honeycomb form, 25mm wide and 9mm high (Illustration 49). By not using the race mesh or even the ultimate race frame, the look won’t be over the top. The elegance race mesh preserves an elegant and modest appearance even when it looks sporty. This is important: The rest of the car will not be changed. The front bumper has to change the appearance of the sprinter, but still has to fit!

f) Several sharp edges with only 1mm fillets (blue I, II, III, and IV): The sharp edges bring the tension. The front bumper has very big, soft rounded surfaces. To make it interesting you attach strong lines that break these curves. III and IV building a V-shape that opens backwards. Again, it’s like a spear head pointing towards the middle of the bumper, or even connects in the little edge of a).

g) Closure lower side part. The shape is rising to follow the AMG's style of "showing tire". Showing tire is an AMGs manner of making a cars' appearance more aggressive.



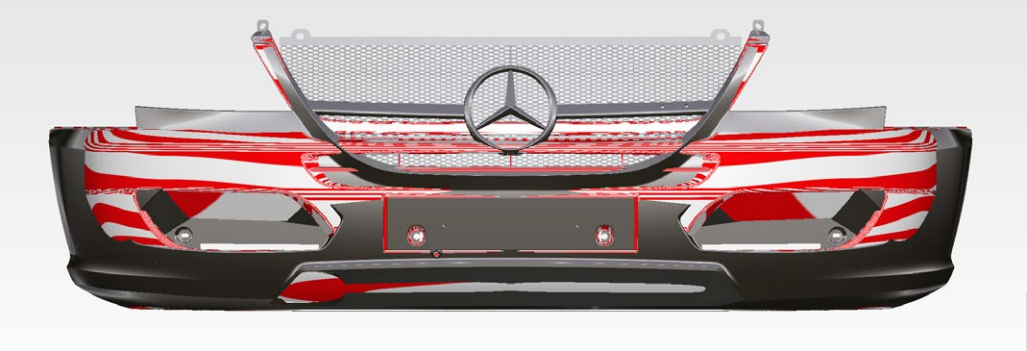
Ill. 51: Race grill grid of *www.racegitter.de* [11]

5.4 Compatibility With Sprinter Car Frame

To accomplish one of the main goals – make the bumper a plug-and-play solution – all the screw point positions were taken over. This was able to accomplish due to the availability of the original Catia documents of the front parts of the original bumper. The screw holes were copied and rebuilt so it is ensured that the bumper fits and can be mounted to the original frame without adaptations. This method makes a facelift bumper cheap, because no expensive chassis parts have to be changed. That would influence the whole production line.
Now, the complete car can be mounted the exact same way as before, except for the fact, that the new bumper would replace two other metal parts (under the headlights and around the old grill). That can actually save production time because fewer screws are needed to mount and less parts have to be placed.

Ill. 52: Compatibility overlay bumper old / new

To show the compatibility, the following pictures illustrate the final new front bumper (Gray) with an overlay of the original bumper set (Red/White shade).
Noticable are the exactly over-taken important parts, such as outer edges, the screw points (treads, license plate stage,…) (Illustration 52 to illustration 56). Only the inner surfaces were modified.



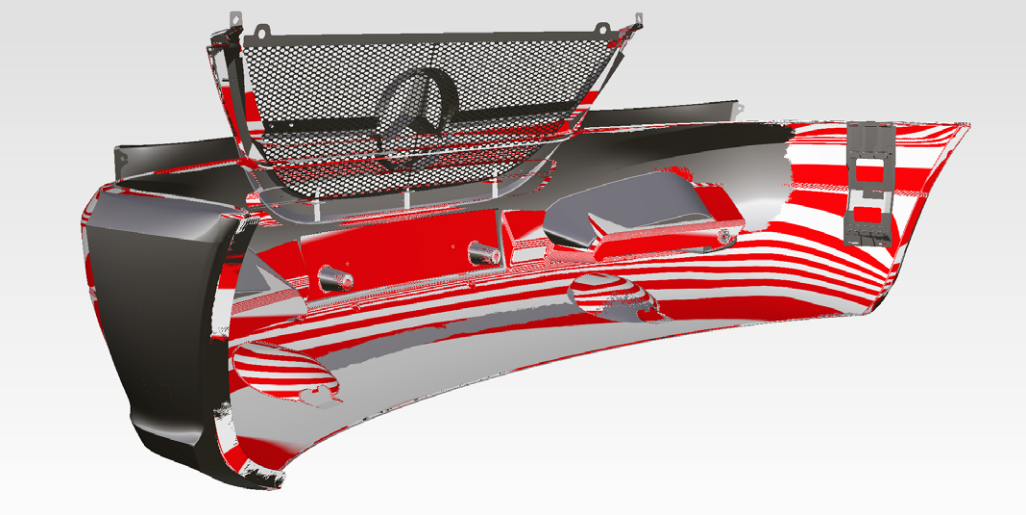
Ill. 53: Final new bumper (Gray) with old bumper overlay (Red/White) - Front view

Ill. 54: Final new bumper (Gray) with old bumper overlay (Red/White) - Side close-up

Illustration 54 for example shows exactly how precisely fitting the edges are. The demand of a plug-and-play solution has been fulfilled.

With an overlay image one can obviously see the difference in shape: The old bumper is much narrower on the side but has much more material towards the middle compared to the new bumper.

The only thing left to check are the fake intercooler intakes. They changed in shape but still must not collide with other components. Silberform didn't receive the CAD data of the engine compartment so it was not possible to check how these parts snug in. This will properly be done at a Mercedes facility.



Ill. 55: Final new bumper (Gray) with old bumper overlay (Red/White) - Back/ Side view

Ill. 56: Final new bumper (Gray) with old bumper overlay (Red/White) - Front/ Side view

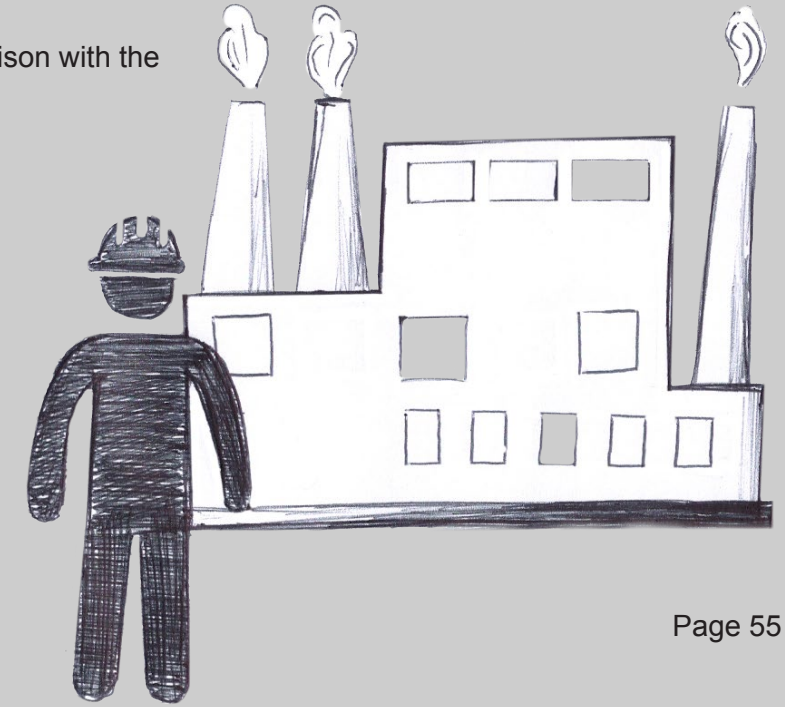
Chapter Conclusion

Completing this chapter one can say that the required time was worth it. After the comparison of the new bumper with the old one it became clear that the fittings are equivalent.
That means theoretically the bumper would be a perfect exchange part. This fact makes it easy to continue with the coming task in chapter six: The manufacturing process.
Continuing with the manufacturing analysis requires a model with good surfaces.

Chapter 06: Manufacturing

Content:

As already mentioned the CAD model is now used for the manufacturing analysis. To manage this, a business trip had been attended to get an external, professional opinion about the feasibility. Zimmermann Formenbau GmbH was willing to help and made time available. During the meeting Subjects such as choice of material and model adaptations were discussed.
Later on it was possible to make a rough cost calculation in comparison with the original bumper.



6.1 Business Trip

Ill. 57: Zimmermann Formenbau GmbH [12]

On 19 June the business meeting with the company Zimmermann Formenbau GmbH [13] in Gladenbach, Hesse took place. Zimmermann Formenbau is an injection mold construction company of the automotive sector.

The CAD model had been checked for the first time if it was feasible. Mr. Hofmann, Sales Manager of Zimmermann Formenbau GmbH, gave necessary information for the design process to make the bumper fit perfectly. The great question was how to realize the grill grid. First intention and demand from Mercedes was to make the whole bumper from one piece.

Mr. Hofmann indicated that it would be impossible to produce. And if it could be realizable, the plastic surface would look terrible. He suggested splitting the bumper into two pieces. Furthermore it was alluded to design the surfaces able to demold. The angles is crucial to make the bumper pop out of the molds later.

Using this information it was possible to make a part list:

- Bumper with star brace (new)
- Grill grid (new)
- Hood bar (new)
- Star (old, carry-over part)
- Mounting options (old, carry-over parts)

Compared to the old bumper set, the list is a bit shorter. But it is about the details: There will be no metal trims anymore which are much more expensive than plastic parts*.
The totals are more obvious:
The new bumper has 5 subparts, the old bumper set contains 7 subparts. It is a small but distinct reduction.

Bumper set T1N 2015:

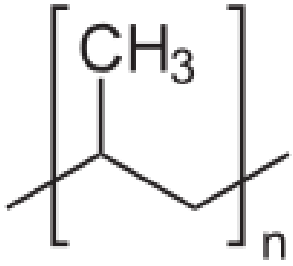
- Bumper
- Grill with star pod
- Grill trim (Metal)
- Star
- Trim onder headlights (Metal, 2x)
- Mounting options (old, carry-over parts)

* Molds for sheet metal materials are normally more expensive than plastic injection molds. This is due to the wearout: Injection molds can be made from aluminium but last for several thousand pieces, but molds for sheet metal have to be made of steel itself and still have a faster wearout. Milling a steel mold is much more expensive than milling an aluminium mold.

6.2 Choice of Material

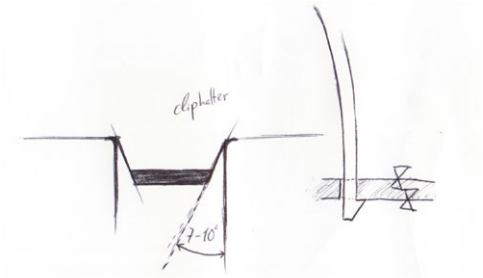
An important choice for the manufacturing process is the material. The material defines quality of the inject molding and costs. Mercedes demanded to continue with the original material:

Ill. 58: Recycle Symbol PP [14]



Ill. 59: Chemical Symbol PP [14]

Polypropylene. PP is a thermoplastic that is quite cheap as raw material combined with good flow properties, which make it attractive for injection molding, extruding, blow molding and many more*. The good flow properties ensure better surface qualities even in a complicated design. The only real disadvantage is, due to the very low surface energy the bad ability of painting, printing and gluing this material.



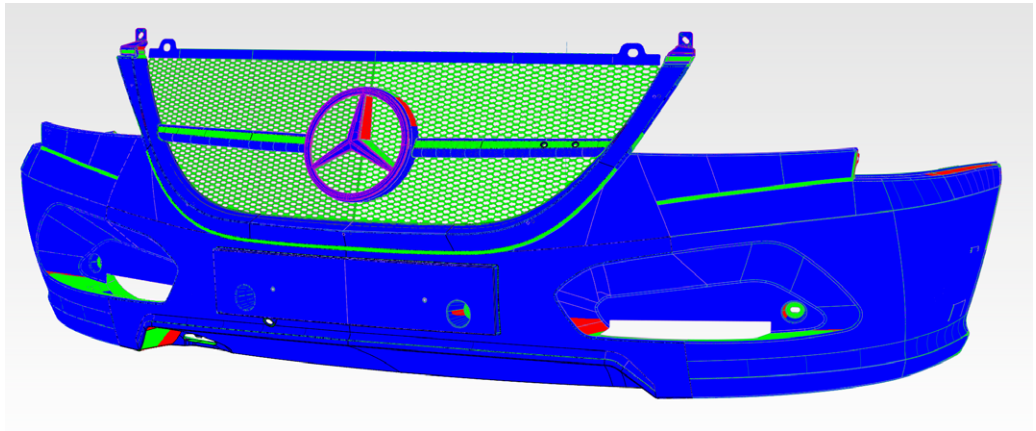
Ill. 60: Schematic illustration of a clip system

6.3 Design Adaptions

As mentioned earlier Mr. Hofmann suggested a demolding angle of at least 1°. During the surfacing process a demolding angle of 3° was applied to avoid as much problems during manufacturing as possible.

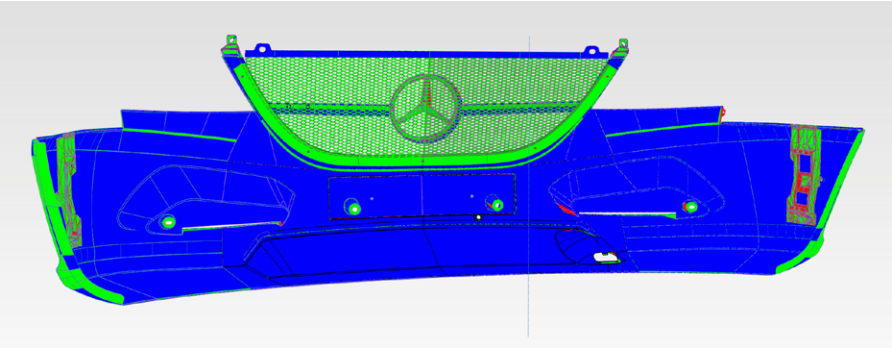
Alias Surface has a demolding plugin, which gives one the possibility to check the models surfaces on the ability of demolding. The CAD model gets colored in 3 different colors: red, blue, green. Red are the surface parts that can lead to demolding problems; blue surfaces are acceptable to manufacture and the green ones are perfect (Illustration 61 and illustration 62)

One tries to eliminate as much problematic surfaces as possible during the early stages. That reduces the amount of later revisions.



Ill. 61: Demolding Analysis Front

* PP has good flow properties due to the density of 0,895g/cm3 to 0,94g/ cm3. This material is hard-wearing, flexible and has a high stretchability. 6 For more information look up the Appendix C.

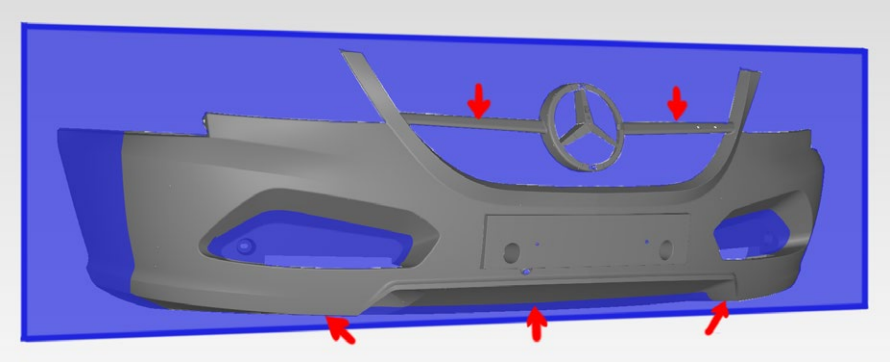


Ill. 62: Demolding Analysis Back

Now to the problem of the grill:
As already said the intention of a two-pieces bumper (bumper and hood bar) faded away due to manufacturing problems. It was declared as follows:

The plastics would get injected from the bottom and the upper part. The material would stream up towards the grid, lose the speed there and would possibly enclose air which all leads to an unattractive surface structure.

Now the injection mold would funtion like shown in illustration 63: Red arrows are the injection nozzles, the blue surface illustrates the seperation line of the mold.



Ill. 63: Structure of the injection molding setup

6.4 Costs

Up until now an accurate cost calculation was not possible to establish due to the late design finishing around 20 august 2015. Afterwards there wasn't enough time left to make a new appointment at Zimmermann Formenbau to let them run a simulation. That could have given more information about the costs.
Two months ago, during the meeting, the injection molding method wasn't chosen yet. There are several dependences, which influence the choice:
The size of the bumper; the amount of possible undercuts and therefore the amount of sliders; the depth of the product itself. All these calculations can only be done by skilled personnel who can simulate the molding process. However, it was clear that price would be lower than the original which should be round about 40€.

	Old Bumper Parts	Costs (approx.)		New Bumper Parts	Costs (approx.)
	PP Bumper	€ 20,00		PP Bumper	€ 22,00
	Grill	€ 8,00		Hood stripe	€ 5,00
	3 Metal trims	€ 7,00		Grill Grid	€ 3,00
	Star	€ 3,00		Star	€ 3,00
	Screws	€ 1,00		Screws	€ 1,00
Total Costs (approx.)		€ 39,00			€ 34,00

Ill. 64: Short cost calculation tabel

The first approximate calculation (Illustration 64) would obtain a cost reduction of € 5,00.
For a layman € 5,00 doesn't sound like a high reduction, but regarding an estimated yearly production of 20.000 Sprinters in Nizhny Novgorod it will add up to € 100.000 per year. And that has persuasiveness: A facelift that lowers the production costs up to € 100.000 *.

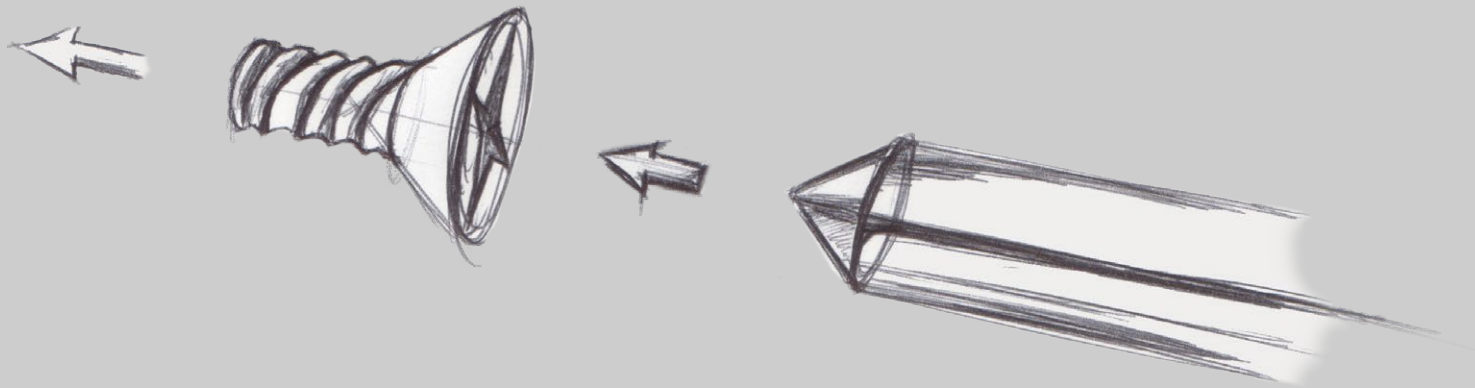
* All numbers are appraisals, to make a precise statement about the price one needs assistance of a mold maker.

Chapter Conclusion

Theoretically, the bumper kit is now ready for production. After the received information from Zimmermann Formenbau GmbH the model was revised to make it producible. The production costs of approximately €34,00 will be in the interest of Mercedes, meaning it is now presentable.
Finishing all the previous steps brings one to the new chapter. How will the vehicle part be attached to the car? Going also back to 5.3 supplies with information of the original screwing points and gives an idea of how it can be mounted.

Chapter 07: Mounting

The following topic treats the mounting process including the attachment of subparts to the main bumper (Grill, side brackets). Structuring the mounting process as good as possible saves time and money. How is it manageable to shorten the assembly time? Is it possible to also save money during this stage? The whole process will be explained with several illustrations.



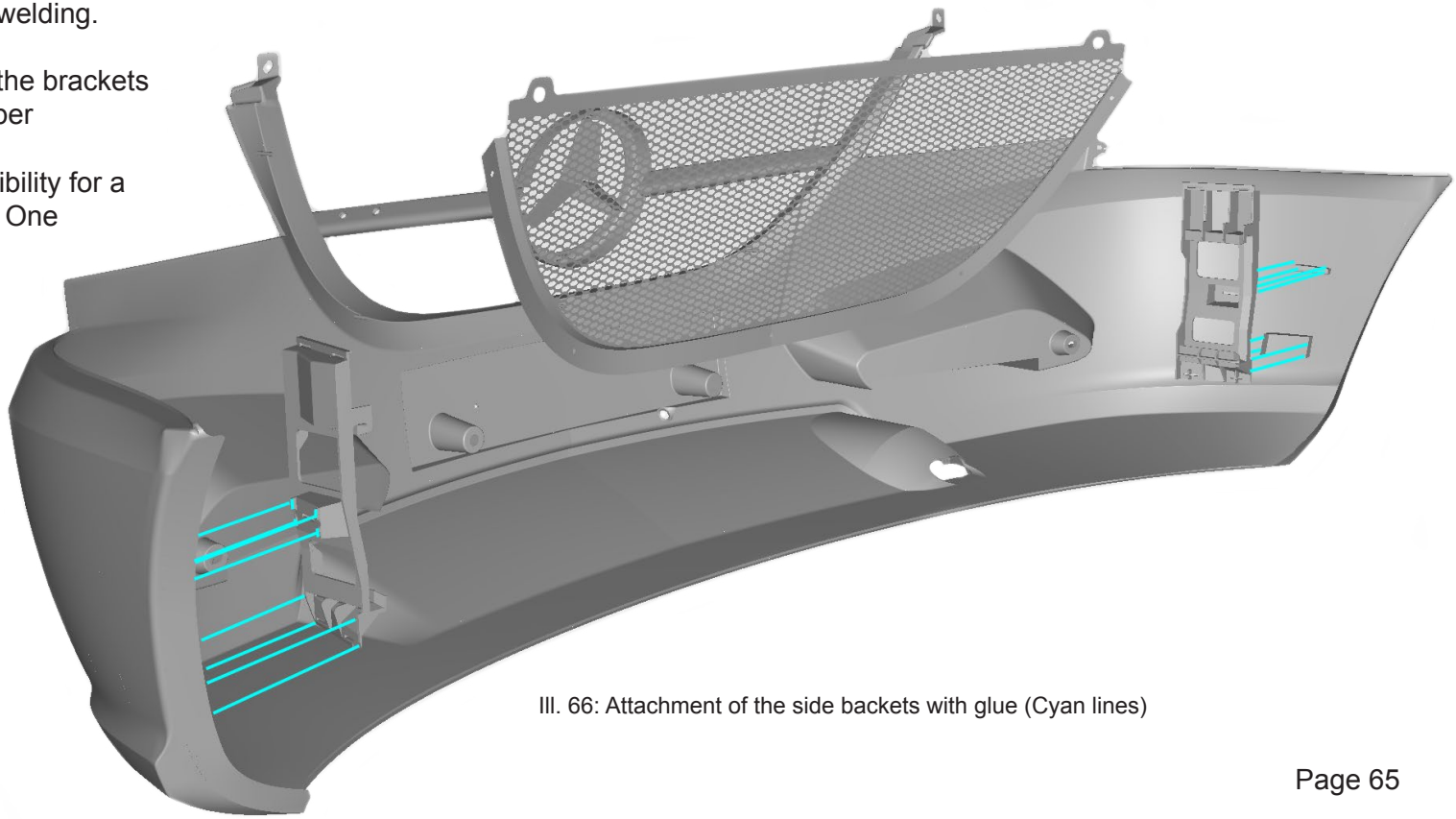
As in almost every industrial process, mounting is also an issue here that has to be thought of. Especially in the car industry the mounting time is money, so a faster mounting process is convincing.

Actually, the new design contains two screws less than the old design and it is made out of 4 parts (Bumper, grill grid, hood stripe, star) compared with 6 parts of the old design (bumper, trim under headlight left and right, trim around grill, grill grid, star) (See also Chapter 6.1). Before the complete bumper can be mounted, several subparts have to be attached to the main bumper part using glue, screws or plastic welding.

Ill. 65: Plastic welding in progess [15]

First step would be to attach the brackets to the inner sides or the bumper (Illustration 66, cyan lines). Plastic welding will be a possibility for a cheap but strong connection. One can imagine this method like the soldering process. The two plastic parts will be heated and connected using a hot pp spacing material (Illustration 65). The two parts melt together.

Plastic joining is a method not only used in the automotive industry, but also in medical engineering, mechanical engineering and pipeline engineering.



Ill. 66: Attachment of the side backets with glue (Cyan lines)

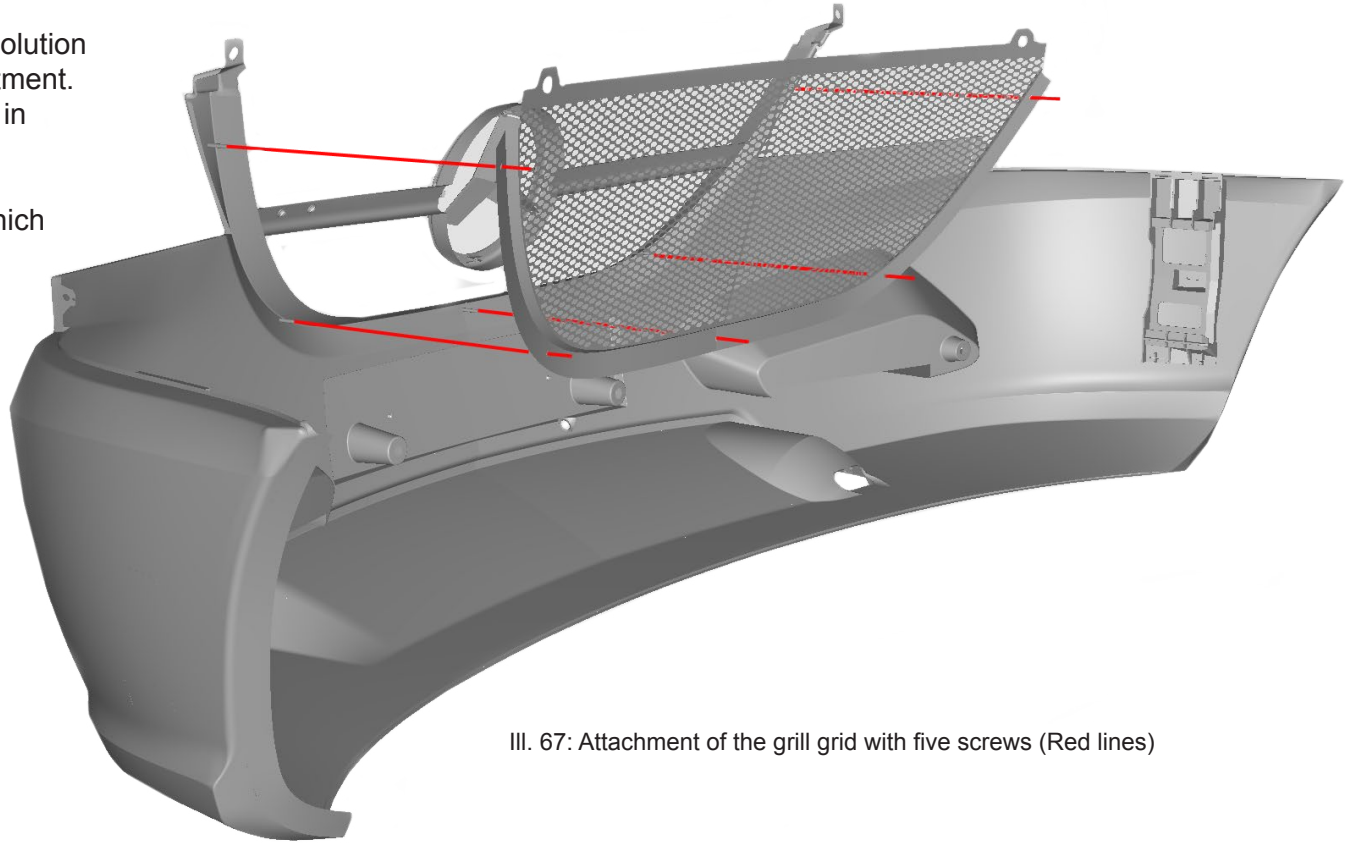
Next step would be the grill grid:
Probably the grid will be a cheap punch frame made from metal available by the meter. Due to the material difference (Polypropylene vs. metal) one has to gauge the best possibilities to attach the grid. One option would be to simply use screws, but it would be an expensive solution regarding the mounting time and material costs. Another possibility could be to glue the grid into a pre-designed holder-frame or also plastic welding.

Finally, this decision which attachment solution to pick is one of the development department. That's why I didn't spend too much time in evolving solutions.

I simply went for the screwing option, which would be a bit more expensive but very easy to implement.

The five holes in the outer edge of the grill grid have enough lash to ensure that the screws always reach the screw bosses on the inside of the bumper without any problems.

To sum up, in a fast and simple process the grill grid can be attached to the plastic bumper (Illustration 67, red lines) using five cheap tapping screws. These screws are, considering measurements, the same as the screws used for the license plate holder.



Ill. 67: Attachment of the grill grid with five screws (Red lines)

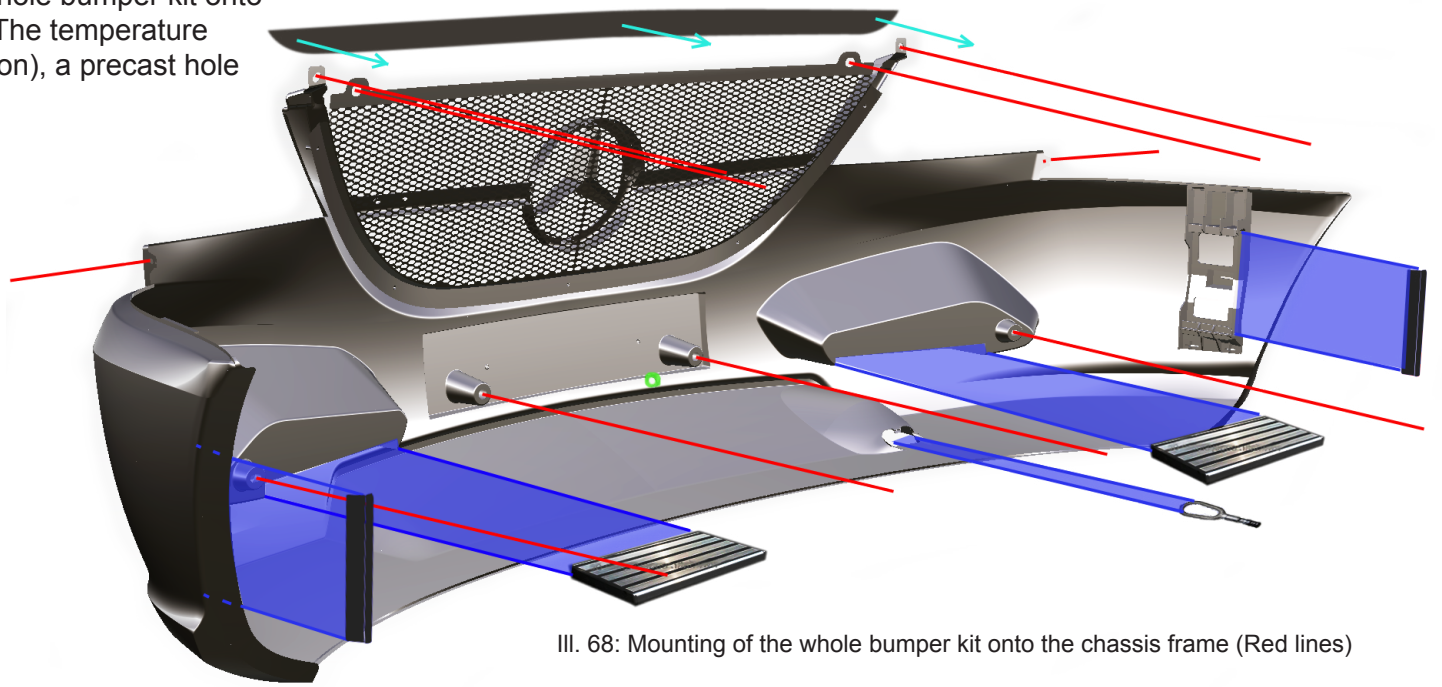
The mounting process can be realized as shown on the following graphic (Illustration 68). The blue areas describe the position of chassis parts where the bumper has to slide onto. The treads and the tow eye slip through precast holes; the brackets on the inner sides shove onto two bars that are fixed to the chassis.

The ten red lines describe the positions of mounting bolts. Ten of the twelve screw positions had been taken over so the chassis can remain unchanged. The two other screws are not used anymore.

The mounting process will be faster than before. One worker or a team of two slides the whole bumper kit onto the chassis while the hood is open. The temperature sensor is set into place (green position), a precast hole under the license plate.

The next step is to tighten all the ten screws with a maximum torque of 10Nm. Afterwards the hood can be closed and hood stripe will be glued into place (cyan arrows). The last step is to click the chrome star into the grill pot between the braces and place the specification plate onto the right brace (for example “313CDI”).

Now the mounting process of the front bumper kit is finished and one can go further finishing the rest of the vehicle.



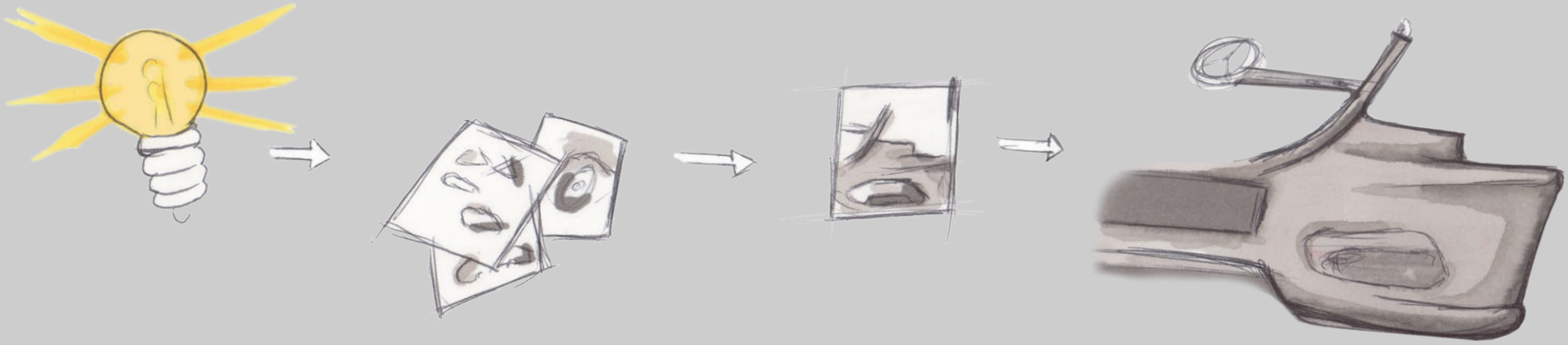
Ill. 68: Mounting of the whole bumper kit onto the chassis frame (Red lines)

Chapter Conclusion

Due to an elaborate mounting process there are only two parts left to attach during the production line period: The complete front bumper and the hood stripe. After all subparts are brought together before the production line, the mounting will be much faster. This is because only one big part will be connected to the chassis.

Chapter 08: Prototyping

This chapter provides the reader with the information about possible methods of prototyping and how these are deployed in the automotive sector. It is a small chapter, because of the not-existing prototype of the bumper, yet.



Prototyping is normally the completing stage of the development process. It serves as visualization of the product. During this process several methods can be used. In the vehicle sector many people use clay* or rapid prototyping for fast results. Clay is often used for complete car prototypes (Illustration 69).

Ill. 69: Lincoln MKZ Prototype as a working-progress clay model [16]

One uses a car chassis as base frame whereon a shell with a rough form of the car. To reach the almost perfect vehicle shape, the industrial plasticine gets attached to the shell and gets shaped. The result is a presentable show car for a car exhibition where often even some functions such as lights are included (Illustration 70). Some show cars can even drive with walking speed.

Ill. 70: Jaguar C-X16 real scale model as half clay half finish model [17]

Due to time and capacity issues rapid prototyping (3D Print) was not possible anymore. To have a presentable model during the bachelor presentation all options will be explored.

If the rapid prototyping would not succeed a short video was made to visualize the process of changes during the design process from the very begin until the final design. The video shows the particular bumper kit always mounted on a T1N Sprinter to actually see the alteration and how it appeals. The video is included on the CD attached to the Bachelor report.

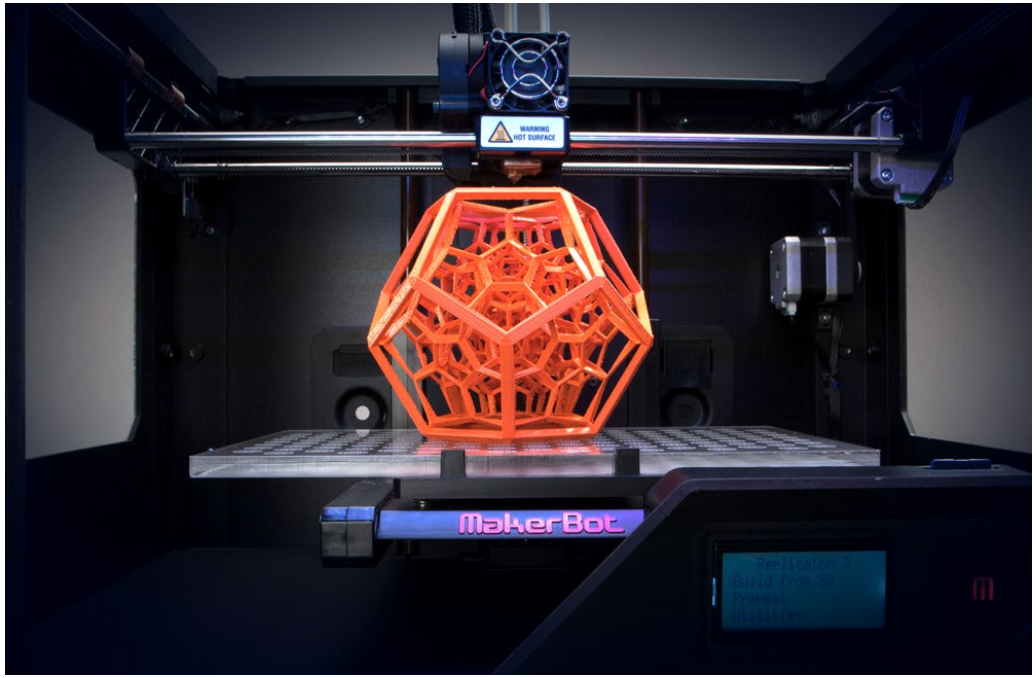
*Industrial plasticine, or “clay”, which is used for this purpose, is a malleable material that can be easily shaped, thus enabling designers to create models to visualize a product. Industrial plasticine is based on wax and typically contains sulfur. Clay modeling was soon adopted throughout the industry and remains in use today.

Another option is the one that would have been used for a small sprinter bumper visualization: Rapid prototyping. Rapid prototyping describes a machine that can print plastics not only in 2 dimensions like a common printer but also in the third dimension (Illustration 72).

One can imagine this method like a hot glue gun that lays the glue stripes next to each other and on top of each other. Like that a framework is being built and the model gets print even in the z-axis. Illustration 71 gives a better image of how such a printer works. It shows a handheld version that takes the raw material (blue cord), heats it up in the inside and pushes the fluent material out through the nozzle.

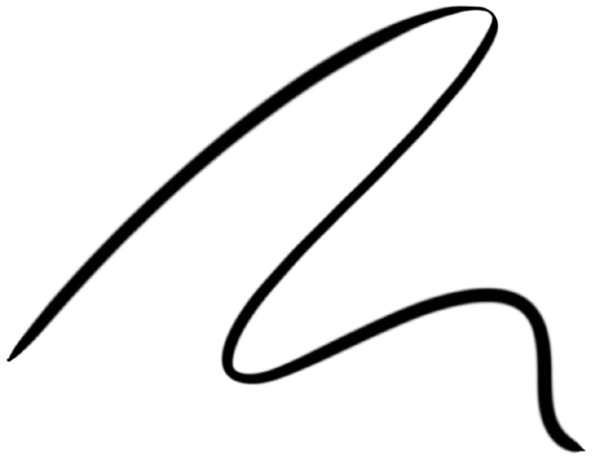
Ill 71: Handheld version of a 3D printer for more understanding of its functioning [18]

The used materials are hardly conceivable: the professional machines can print several different plastics, wax, sandstone, ceramics, steel, bronze, brass, silver, gold and even platinum. Concluding one can say the huge variation of the materials gives high freedom to create ideas in different materials.



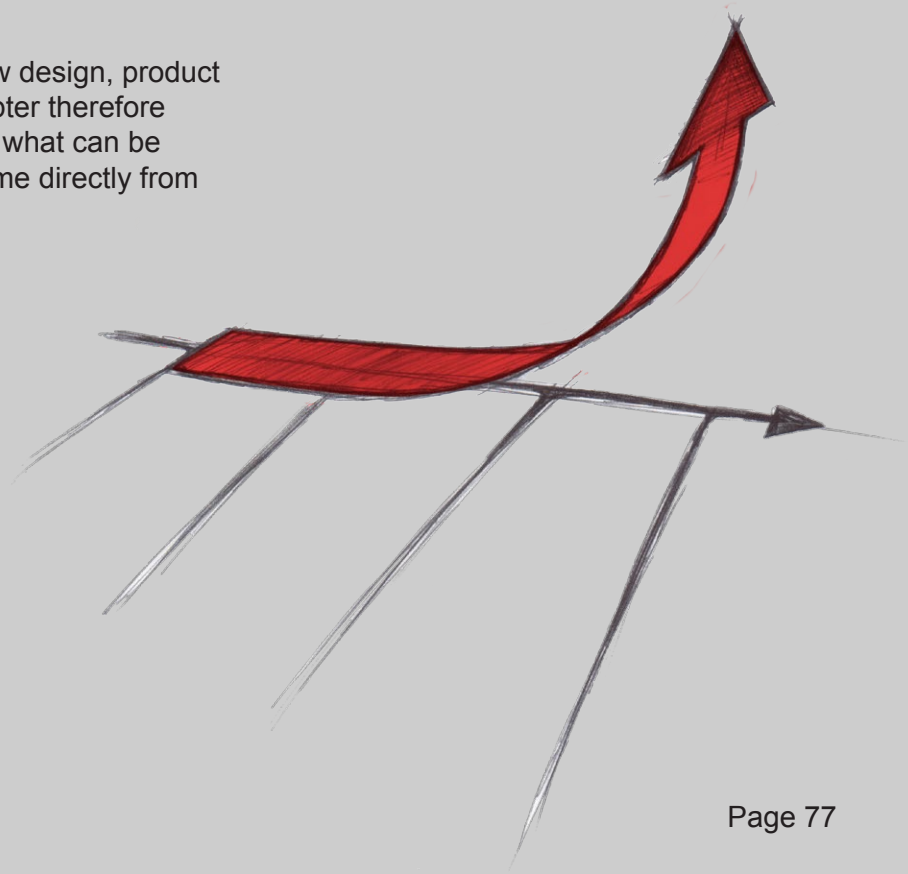
Ill. 72: MakerBot 3D printer [19]

2 years ago, 3D printing was a quite unknown process; now it has become famous and one can even buy a small printer in the hardware store. Even food is already getting ‘printed’.



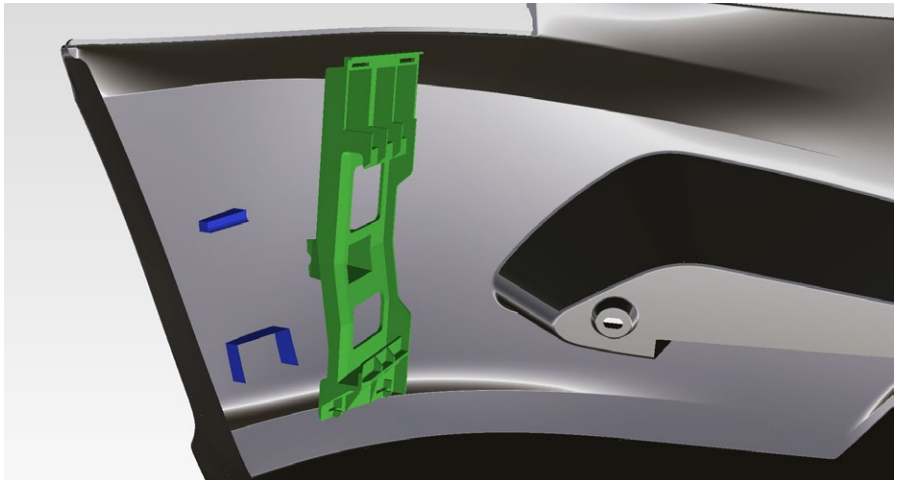
Chapter 09: Improvements

When there is development there is always improvement. A new design, product or something comparable is never totally perfect. The next chapter therefore deals with possible improvements. What can be done different, what can be changed? Many parts are carry-over parts. Even when they come directly from Mercedes, they can contain defects or capabilities of change.



An important improvement would be to spend more time in the straking of the surfaces the get better reflections on the surfaces which would result an even better outcome of the product. There were several connections which were highly difficult and still not totally connected.
Additionally the side mounting could have been improved. Now, the side bracket gets attached onto a retainer, which is part of the bumper itself. The retainer compensates the difference in height and shape between new and old design.

The holder-on-holder solution is not the best and as such redundant but was the fastest solution considering that it was demanded to use as much old parts as possible. The bracket (green part) was also part of the original old bumper and serves now as an adapter. The blue pieces belong to the bumper as connection (Illustration 73).
The more take-over parts one can use the better*.



Ill. 73: Holder-on-holder solution

In the end, one crucial point is the grill grid. As an improvement one can look for another solution than the metal grid with screw holes. The punch holes metal frame is not the expensive problem; the way of fixture is. Using screws is a solution that is easy manageable, but an employee needs time to set the screws. The working time costs money, the screws themselves have a value.

A better solution would be an automatic process, for example a grill grid that gets glued in place. The bumper has da grooved shape on the inside where the grill snugs in. a machine or an employee applies a two-component-glue (Epoxy) and attaches the grill. This process will be fast due to the lower precision demands of the grill position. Small deviants (approx. 3mm) can be compensated by the grill screw holes on the upper part.

Furthermore, the grill grid itself can be simplified: the border with the screw holes can excluded, because the gluing will also work on the grid surface. Due to the holes the glue can get even more surface. As a result this could make the connection even stronger.

Furthermore, one can think of a more spread out facelift: side bumpers, side panels, rear bumper. But in the end, this is the decision of someone else.

* For example the star-logo is often a take-over part from cars that were built a long time ago).

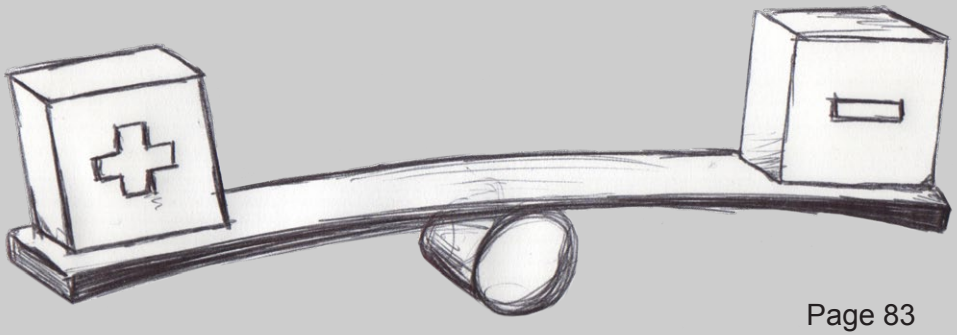
Chapter Conclusion

All in all the found solutions of the bumper are decent, but, as always, there are improvements. The grill is still an open case, but a decision will be made by another department. However, the model is in a good shape, got a lot of positive feedback and the list of improvements is not too long.

Chapter 10: Conclusion

Content:

The last topic of the bachelor report is the Conclusion, wherein the personal conclusion of the project and the conclusion of the outcome of the thesis will be reflected. To complete the circle there is the feedback to the demands and wishes from chapter 2.5.



In the end it was possible to build a cheap, new bumper that even replaces several other parts. There were some tricky parts regarding the grill grid (Not possible to make a one-piece bumper with such a grid) and to make the bumper look smooth but not boring. Also another complicated subpart was the tow eye notch, that was, in first place at a very unpractical position for the new design. It would have destroyed the whole face of the bumper.

There are still some partsnot fully thought through. One thing is the surface structure and texture. The todays design requires a specific texture that makes the surface appearance insensitive for scratches and other little damages. On the other hand, it makes the bumper look flat with few visual depth.
This could be changed by changing the surface structure and making it smooth or at least with no rough texture. As a result, the optional painting of the bumper would be much easier. There wouldn't be the need of a high amount of filler paint to remove the surface texture.

Furthermore, why does the bumper has to be gray? Clearly one reason is costs. A non treated bumper is cheaper than one that is painted. Also, as already said, it is more damage absorbable. But still, it's not pretty due to splitting the ensemble (Painted vehicle parts and non painted bumpers). Is there another option?
Perhaps one could change the raw material: White Mercedes Sprinter and also white bumper plastic pellets.

10.1 Personal Conclusion

During the design process at the Silberform AG I really learned a lot about how to get started creating a new car body part and how to deal with a totally new CAD program. I was positively surprised about the working atmosphere in the office; even it's an office, it's still very personal.

Furthermore I'm still very happy I had the meeting at Zimmermann Formenbau. It was the first time I saw in real life what we learned during the Courses of Manufacturing. I always had a very different perception of that. Now I know that injection molding is high-tech, and really impressive. I stood in front of a mold for truck bumper parts, round about my size, which weighs more than 30 cars. Just incredible!
Silberform gave me the opportunity to get inside the work environment of automotive design, which is different from what one thinks. In the end it is exactly what I want.

10.2 Feedback to the Demands and Wishes

Most of the demands and wishes could be fulfilled, which is perfect. The look is something subjective, if it’s a market success is not clear yet, but after some sessions with Silberform and Mercedes it was obvious that the new exterior appeals.

The luxury version is still only theoretically worked out due to await the issue of success.

Furthermore, all the performance demands were fulfilled, the air supply has to be checked for bureaucratic reasons, but will be the same or higher; it is a plug-and-play solution and the treads still remain.

After first assumed cost calculations the bumper will be cheaper. Also, the material will be the same, which is also confirmed by Mercedes and Zimmermann Formenbau.

But, in the end, the wish of only one injection mold for the whole model cannot be accomplished. This became obvious during the business meeting at Zimmermann Formenbau GmbH. For this reason an external grill grid was created, that can be attached to the bumper, for example by screws or glue.

Ill. 74: Mercedes Van lineup with new Sprinter Classic

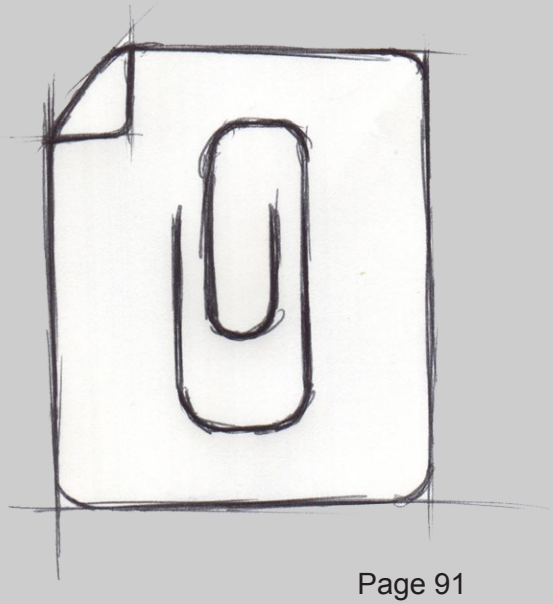

313CDI


Fine
Einde
Fin
Ende
End
конец
Τέλος
Max Hasselgruber

Chapter 11: Appendix

Content:

The following pages contain additional information for the bachelor thesis. The previous chapters often referred to the data treasured in the appendix.



A) Website Links

[1] https://www.silberform.de/

[2] (http://driving.ca/ford/auto-news/news/russian-car- market-in-freefall-but-luxury-brands-holding-up)

[4] (http://lifehacker.com/5824328/how-advertising-manipulates-your-choices-and-spending-habits-and-what-to-do-about-it)

[9] https://owc.de/2014/01/16/russlands-automarkt-ausgebremst-aber-auf-der-ueberholspur/

[10] http://www.racegitter.de/product_info.php?info=p140_Elegance-Race-25x9--in-50x30-cm--silber.html

[13] http://www.ziform.com/de/

B) Picture Links

[2] http://cdn1.stuttgarter-zeitung.de/media.media.1860f42b-bec1-48e0-a8ba-e34fe796935e.normalized.jpeg

[3] http://www.carbodydesign.com/media/2015/03/3D-modeling-an-Aston-Martin-One-77-in-Autodesk-Alias-Surface1-720x540.jpg

[5] http://www.piline.com/uploads/tx_userpilinereferenzen/Mercedes-Benz_Sprinter_NCV3_02.jpg

[6] http://cache.zr.ru/wpfiles/uploads/2013/05/201305311302-201305311302-mercedes_benz_sprinter_sprinter-classic.jpg

[7] http://s1.cdn.autoevolution.com/images/news/gallery/2015-volkswagen-saveiro-surf-is-a-hippie-s-dream-pickup-from-brazil_1.jpg

[8] http://mosselmanturbo.com/typo3temp/pics/796e3a9c30.jpg

[11] http://www.racegitter.de/popup_image.php?pID=140&imgID=1

[12] http://lh6.googleusercontent.com/-Sg7GmqwuR3I/VM7wF6ongII/AAAAAAAAAAo/ZXI3q583mwE/w967-h683

[14] https://de.wikipedia.org/wiki/Polypropylen

[15] http://www.orbi-tech.de/images/weldingrod_hotair.jpg

[16] http://www.carbodydesign.com/media/2012/10/Lincoln-MKZ-prototype-Clay-Modeling-01-720x480.jpg

[17] http://www.autovip.co.uk/news/wp-content/uploads/2012/05/clay-Jaguar.jpg

[18] http://www.pc-boxenstop.de/wp-content/uploads/2014/03/fs3.jpg

[19] http://s3.amazonaws.com/digitaltrends-uploads-prod/2012/10/Is-3D-printing-the-next-big-thing-or-the-next-big-bust.jpg

C) Additional Information

SWOT Analysis parts:
Strengths:

- Solid design
- Practical design due to easy reach treads and tow eye
- Cheap due to no coloring
- Classic Mercedes Sprinter look

Opportunities:

- Reintroducing the Sprinter classic and gain more interest
- Easy change through new bumper (new exterior look)
- Whole exterior would be changeable (new bumper, side panels, side bumpers, new back bumper, new grill, rocker panels)

Weaknesses:

- Consists of many parts, some made of metal, which is more expensive
- Old fashion looking
- On the edge of enough air supply for the cooler
- Number of sales going down due to old fashioned design (NCV3 as a concurrent car with a recent design)

Threats:

- Force back the NCV3 after reintroducing a cheaper sprinter with a facelift
- Unexpected costs that raise the total bumper costs
- Skeptic market: New design that is cheaper? Perhaps still no higher sales

Test Procedure TP-581-01

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15. DATA SHEETS

DATA SHEET 1
RESULTS OF NEW VEHICLE INSPECTION

MODEL YR/MAKE/MODEL/BODY: _____

NHTSA NO.: _____ ; VIN: _____

BUILD DATE: _____; TEST DATE: _____

TEST LABORATORY: _____ ; AMBIENT TEMP. : _____

OBSERVERS: _____

No.	INSPECTION ITEM	PREIMPACT		POST IMPACT	
		YES	NO	YES	NO
01	Does hood pop-up to secondary latch position when primary hood latch is released?				
02	When secondary latch is released, can hood be raised?				
03	Can hood be closed to primary latch position?				
04	Does radiator cap operate in the normal manner?				
05	Does radiator overflow reservoir cap operate in the normal manner?				
06	Is the radiator coolant at the full level?				
07	Do all doors operate in the normal manner?				
08	Do all door locks operate in the normal manner?				
09	Do the trunk lid and trunk latch operate in the normal manner?				

15. DATA SHEETS....Continued

No.	INSPECTION ITEM	PREIMPACT		POST IMPACT	
		YES	NO	YES	NO
10	Can fuel filler cap be removed and reinstalled?				
11	Is cooling system free of leaks as indicated by wet areas or drop formations with the engine off and the engine idling?				
12	Is the cooling system free of constrictions?				
13	Is the fuel system free of leaks as indicated by wet areas or drop formations with the engine off and the engine idling?				
14	Is the exhaust system free of leaks and constrictions?				
15	Does the vehicle leveling system operate in the normal manner?				
16	Are all exterior vehicle surfaces free of scratches, nicks and separations in their decorative coatings or finishes?				
17	Are the shielding panels free of "normally observable" deviations or separations?				
18	Is the vehicle free of any separations or releases of fasteners or joints?				
19	When driving the vehicle, do the propulsion, suspension, steering and braking systems operate in the normal manner?				
20	Are all exterior lamps in satisfactory condition?				
21	Are all reflective devices in normal condition?				

IndianOil

MATERIAL SAFETY DATA SHEET
Polypropylene (PP)

SECTION 1 – CHEMICAL PRODUCT AND COMPANY

Chemical Name & Synonyms : Polypropylene (PP) Copolymer
Chemical Family : Polyolefin
C.A.S. No. : 9010-79-1
Formula : -
Manufacturer's Name : Indian Oil Corporation Limited
Address : Product Application and Development Centre (PADC), Panipat Petrochemical Marketing Complex (PPMC), Panipat Refinery, Baholi, Panipat – 132 140
Telephone No. : +91 180-2578091
Fax No. : +91 180-2578098

SECTION 2 - COMPOSITION / INFORMATION ON INGREDIENTS

CHEMICAL NAME	CONTENT (Normal)*	CAS NUMBER	EXPOSURE LIMITS IN AIR		
			ACGIH TLV-TWA	ACGIH TLV-STEL	IDLH
Polypropylene	99.25 wt%	9010-79-1	10 mg/m3 (inhalable fraction)	NA	NA
Proprietary additives	<=0.75 wt%	Mixture			

* For different grades of PP, minor changes may be there.

SECTION 3 - HAZARDS IDENTIFICATION

Information Pertaining To Particular Dangers for Man And Environment
Negligible hazard at ambient temperature (-18^{0}C to +50^{0}C)

Classification System
Product is not considered to be hazardous under normal processing conditions.

SECTION 4 - FIRST AID MEASURES

GENERAL INFORMATION
At room temperature the product is neither an irritant nor gives off hazardous vapours.
The measures listed below apply to critical situations (Fire, incorrect process conditions).
Skin Contact
If molten material contacts the skin, immediately flush with large amounts of water to cool the affected tissues and polymer. Do not attempt to peel the polymer from skin. Obtain immediately emergency medical attention if burn is deep or extensive.
Eye Contact
Flush eyes thoroughly with water for several minutes and seek medical attention if discomfort persists.
Inhalation
If symptoms are experienced, move victim to fresh air. Obtain medical attention if breathing difficulty persists.
Ingestion
Adverse health effects due to ingestion are not anticipated.

SECTION 5 - FIRE FIGHTING MEASURES

Flash Ignition Temperature	: 335°C
Auto Ignition Temperature	: 350°C
Flammable Limits	: NA

Suitable Extinguishing Media: Water, Foam, Carbon Dioxide, Dry Chemical Powder

For Safety reasons, unsuitable extinguishing media: None

Protective Equipment: Respiratory & Eye protection for fire fighting personnel

Special hazards caused by the material, its products of combustion or resulting gases:
In case of fire it can release: Carbon dioxide (CO_2), and when lacking oxygen (O_2), carbon monoxide (CO), Ketones & Aldehydes. The products of the burning are dangerous.
The formation of hydrocarbons and aldehydes are possible in the initial stages of a fire (especially in between 400°C and 700°C).

Additional information
Heat value: 8000 - 11000 kcal/kg

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Spill and Leak procedure	: Sweep up spilled material for use or disposal. Good house keeping must be maintained to avoid potential slipping problem.
Caution	: Keep walking surface free of spilled material to avoid slipping hazard.

SECTION 7 - HANDLING AND STORAGE

HANDLING
Information for safe handling:
No special requirements necessary, if handled at room temperature.
Avoid spilling the product, as this might cause falls.

STORAGE
Requirements to be met by storerooms and containers:
This product may react with strong oxidising agents & should not be stored near such materials. Store the bags in areas protected with automatic sprinklers. Storage temperature should be below 60°C.
Do not smoke.
Take precautionary measures to prevent the formation of static electricity.
Electric safety equipment.
Open flames prohibited.
Store the product in bags, car silos, container, or large cartons.
Information about storage in one common storage facility: Not required.

Further information about storage conditions:
Protect from heat and direct sunlight.
Store container in a well ventilated position.
Store under dry conditions.
Specific applications For safe stacking follow the storage recommendations specific for this product

SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS:
Use in a well-ventilated area. If handling results in dust generation, special ventilation may be needed to minimize dust exposure. If heated material generates vapour or fumes, use process enclosures, local exhaust ventilation, or other engineering controls to control exposure.

PERSONAL PROTECTIVE EQUIPMENT:
Respiratory system
Product processing, heat sealing of film or operations involving the use of wires or blades heated above 300°C may produce dust, vapour or fumes . To minimize risk of over exposure to dust, vapour or fumes it is recommended that a local exhaust system is placed above the equipment, and that the working area is properly ventilated. If ventilation is inadequate, use certified respirator that will protect against dust/mist.
Skin and body
Hot material: Wear heat-resistant protective gloves, clothing and face shield able to withstand the temperature of the molten product. Cold material: None required; however, use of gloves is good industrial practice.
Hand
Hot material: Wear heat-resistant protective gloves able to withstand the temperature of the molten product. Cold material: None required; however, use of gloves is good industrial practice.
The correct choice of protective gloves depends upon the chemicals being handled, the conditions of work and use, and the condition of the gloves (even the best chemically resistant glove will break down after repeated chemical exposures). Most gloves provide only short time of protection before they must be discarded and replaced. Because specific work environments and material handling practices very, safety procedures should be developed for each intended application. Gloves should therefore be chosen in consultation with the supplier/manufacturer and with a full assessment of the working conditions.
Eyes
Safety glasses with side shields. Use dust goggles if high dust concentration is generated.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

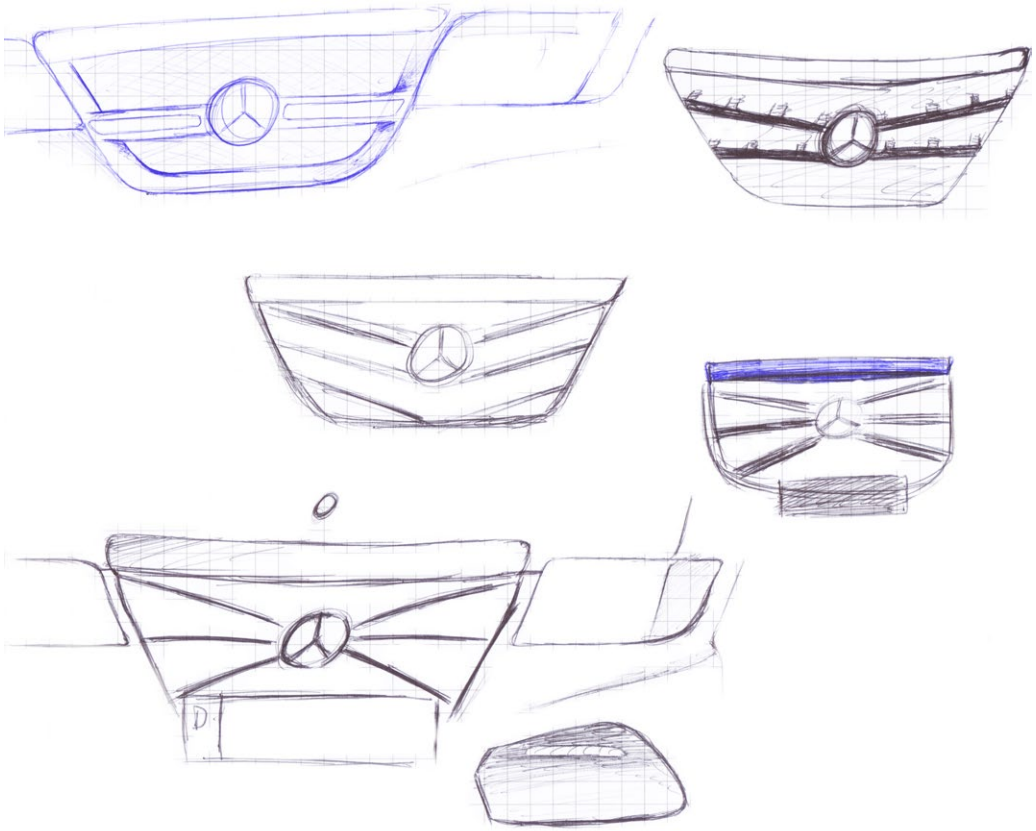
General Information	
Form	: Solid Granules
Colour	: Translucent to White
Odour	: Slight Waxy Odour
Melting point/Melting range	:130-167°C
Flash point	: > 329°C
Ignition temperature	: > 400°C
Decomposition temperature	: > 300°C
Danger of explosion	: Product is not explosive.
Density	: 0.89-0.94 g/cm3
Solubility in / Miscibility with Water	: Insoluble
Additional information	: Soluble in boiling, aromatic chlorinated solvents

SECTION 10 - STABILITY AND REACTIVITY

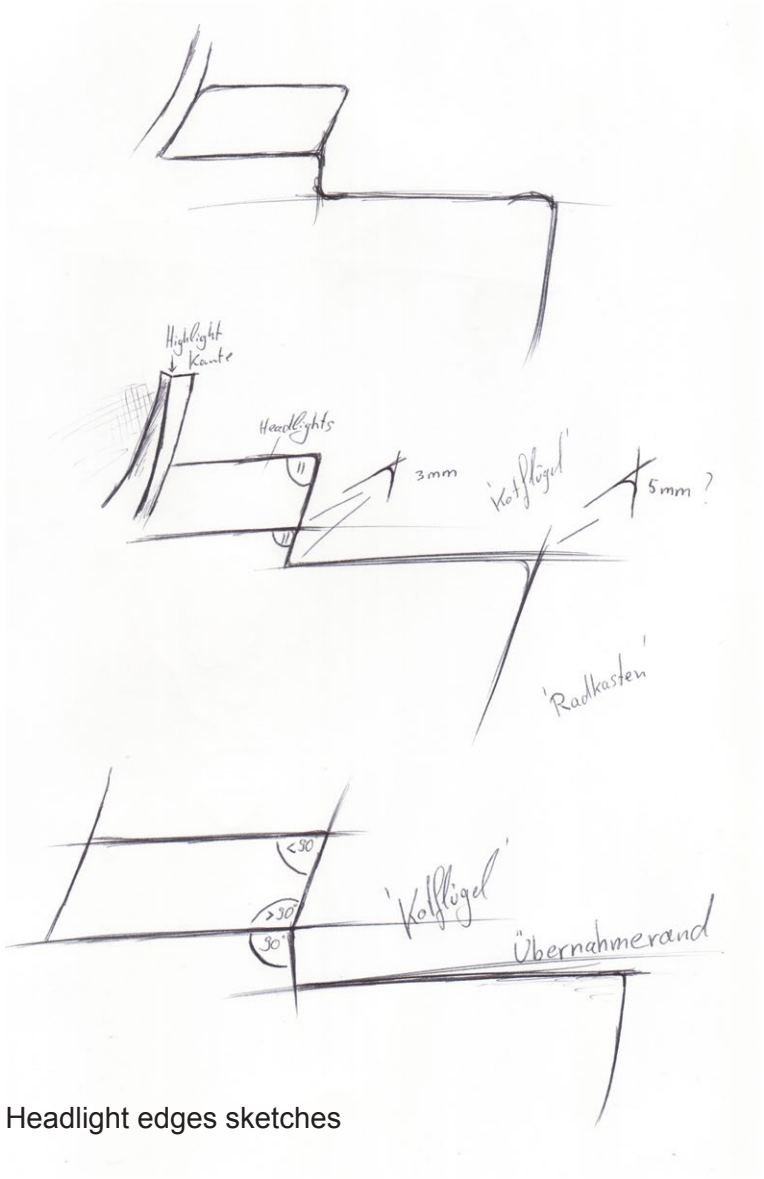
Chemical stability
This product is stable under normal use conditions for shock, vibration, pressure or Temperature.
Chemical stability - Condition to Avoid
Avoid strong oxidizing agents. Avoid Processing Material over 300°C
Hazardous Polymerisation
Not likely to occur
Corrosivity
Product is not corrosive

Dangerous products of decomposition: No hazardous decomposition products known at room temperature. At elevated temperature the material will begin to decompose producing fumes that can contain CO_2, CO, Ketones & Aldehydes.

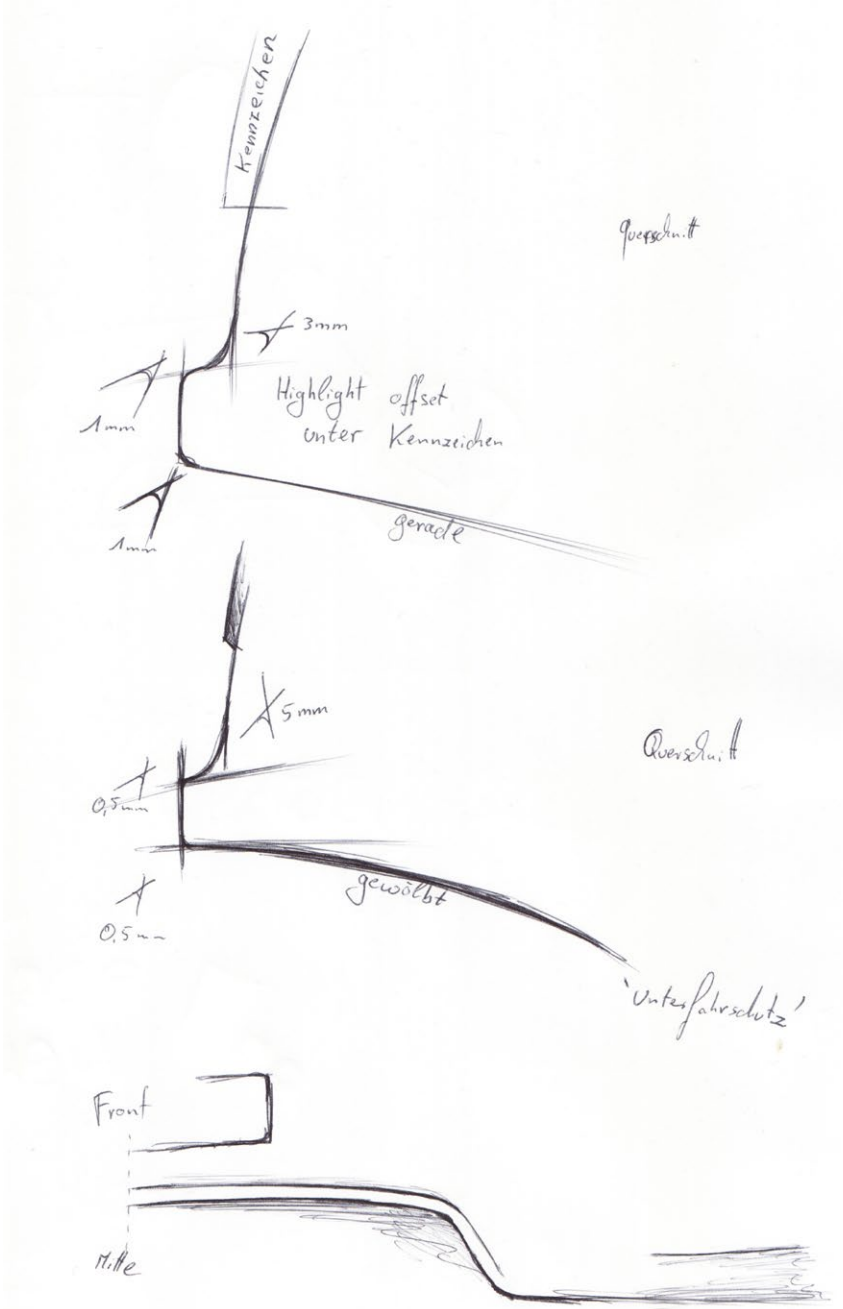
D) Sketches



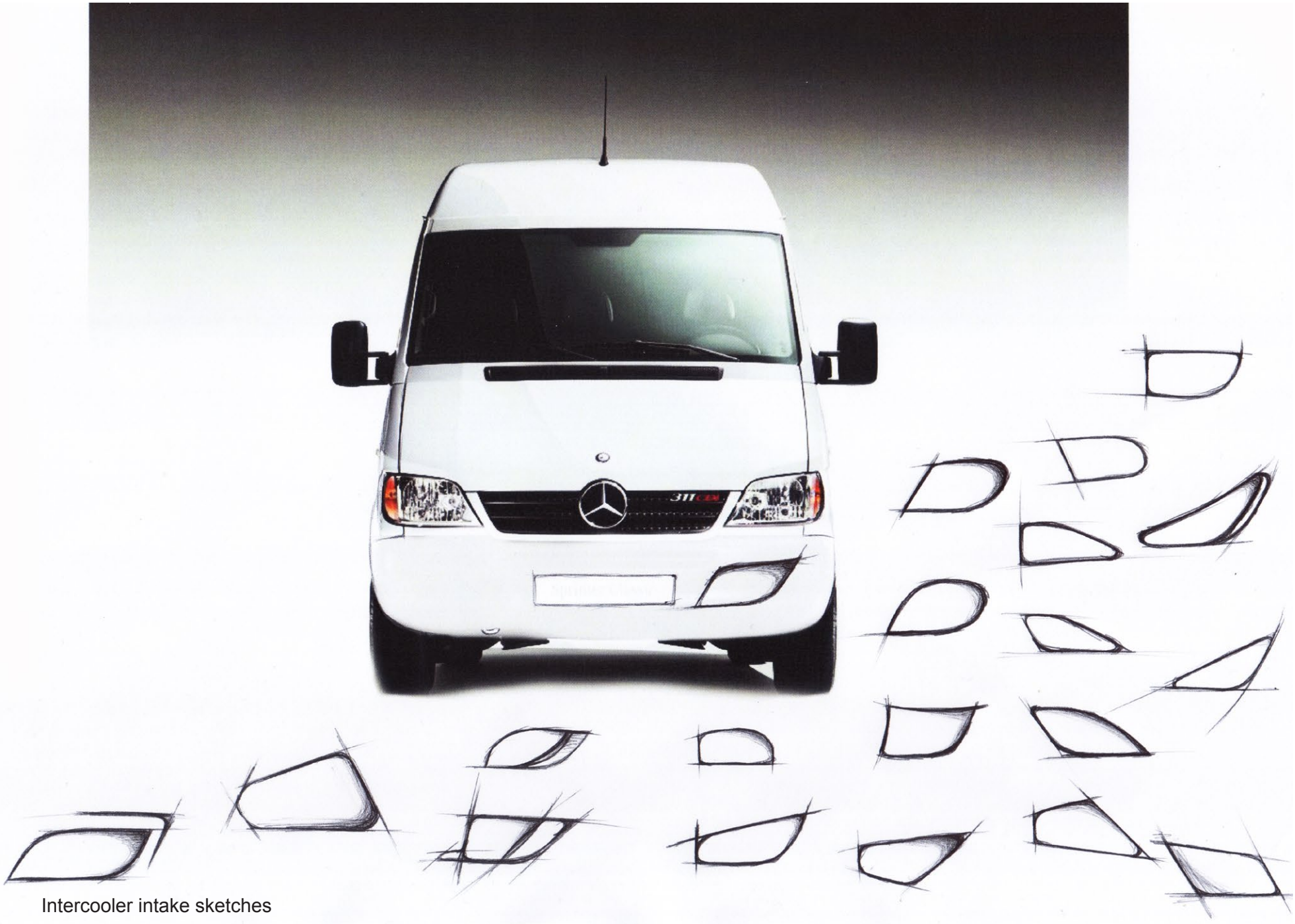
Grill sketches



Headlight edges sketches

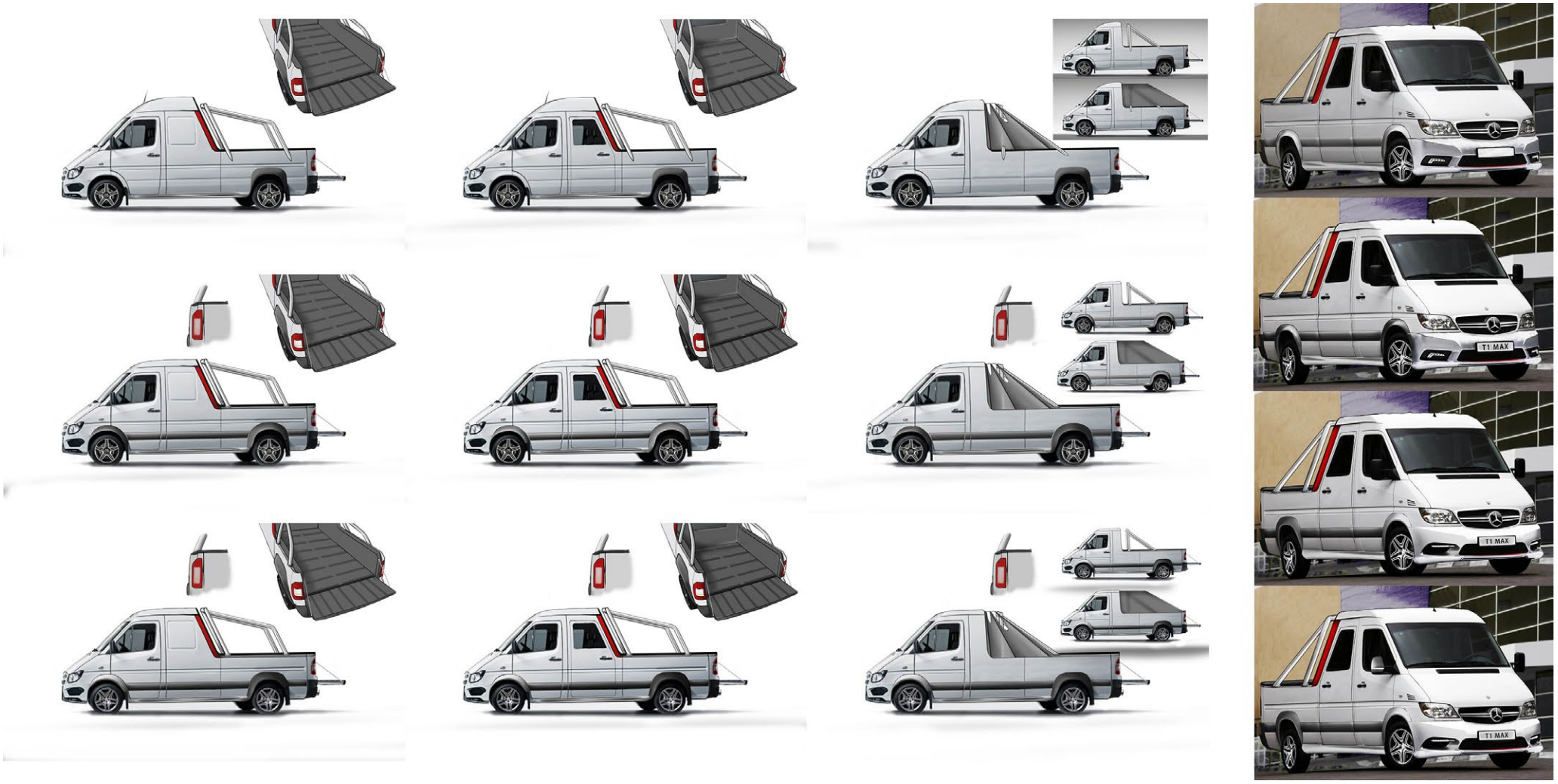


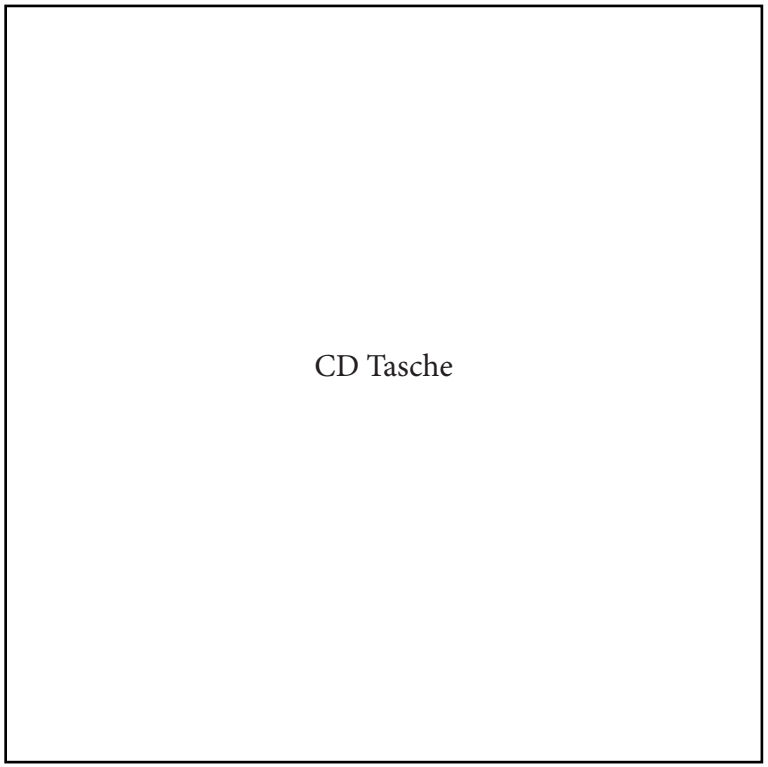
Highlight offset sketches



Intercooler intake sketches

E) Concepts Overview

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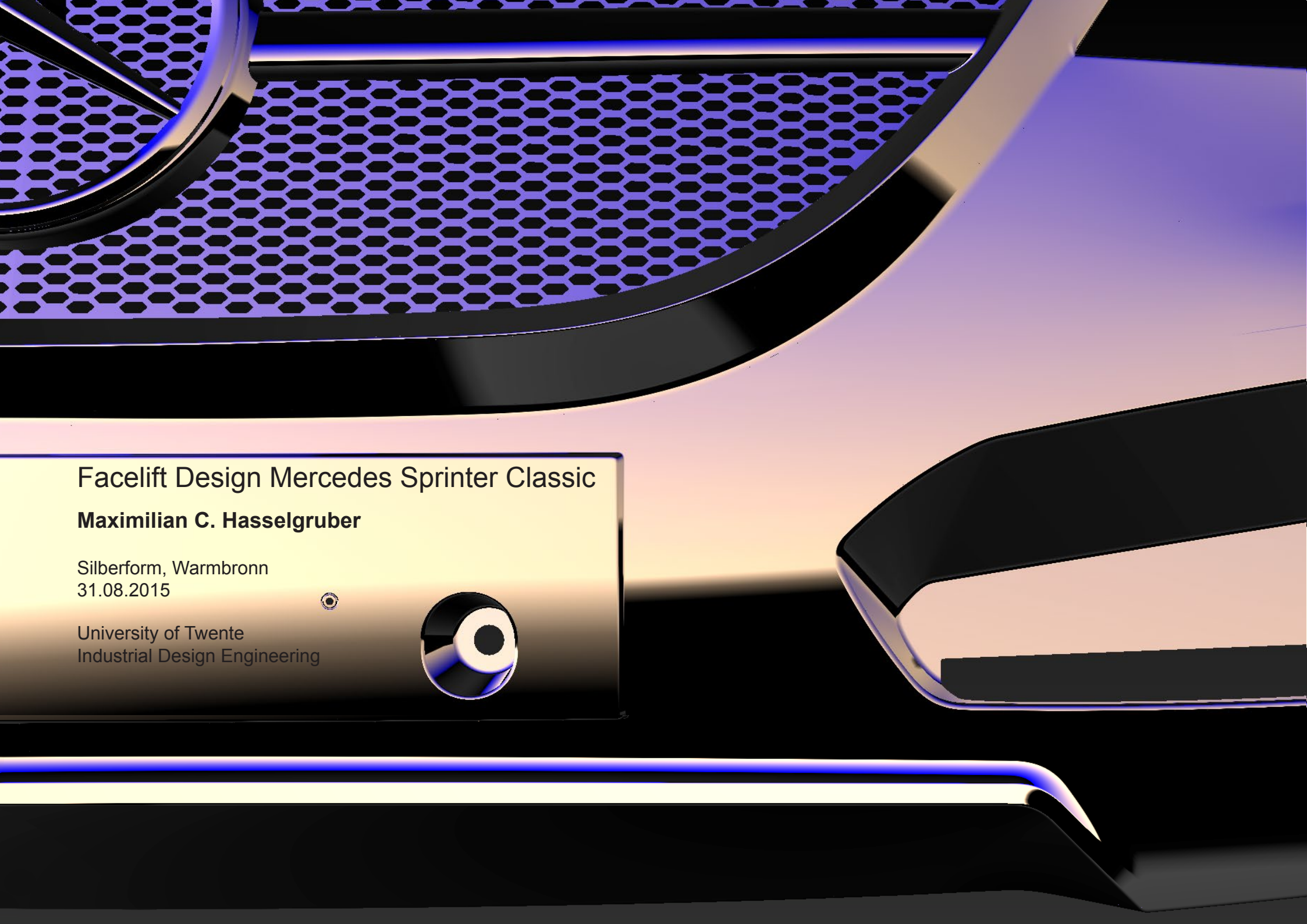

Facelift Design Mercedes Sprinter Classic

Maximilian C. Hasselgruber

Silberform, Warmbronn
31.08.2015

University of Twente
Industrial Design Engineering