PORSCHE
Engineering Services, Inc.

12 Subsytems

ULSAB-AVC incorporates subsystems, which have been choosen for mass reduction potential with particular attention to packaging and advanced design.

12.1 Seat System

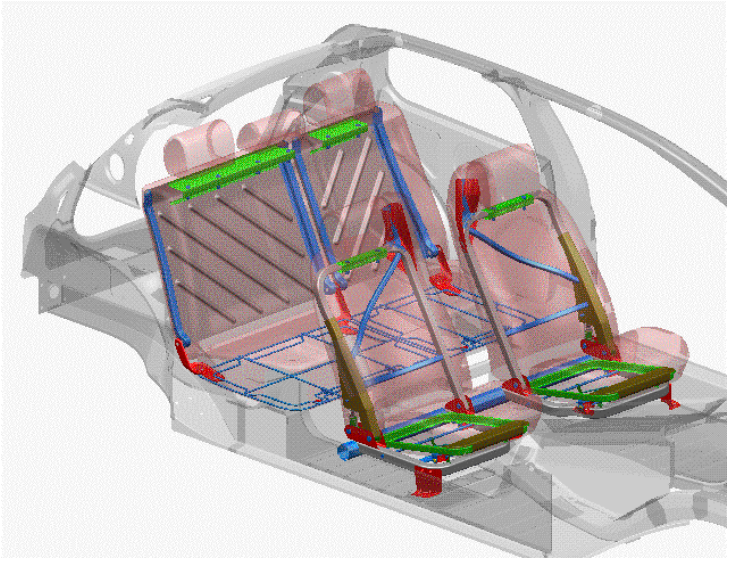


Figure 12.1-1 C-Class seat system

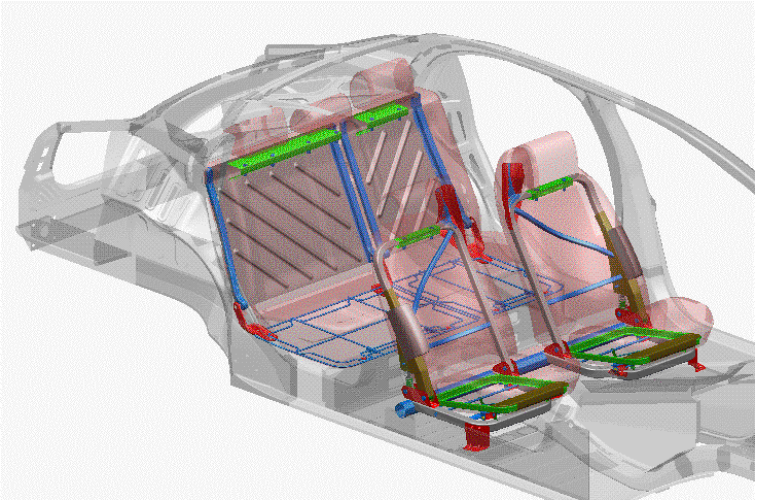


Figure 12.1-2 PNGV-Class seat system

12.1.1. Front Seat Module

The front seat structure design concept, shown in Figure 12.1.1-1, is based on the following requirement criteria:

- Left and right seat incorporated into a modular one-piece assembly for easy installation
- Fixed fore-and-aft seat adjustment, with integrated lateral beam providing enhanced side impact protection - seat adjustment substituted by
  - ⇒ Adjustable foot pedals
  - ⇒ Adjustable steering column
  - ⇒ Ergonomic design and placement of control panels, switches and actuation devices
- Fully integrated seat belt restraint system providing
  - ⇒ Greater comfort and safety, due to closer contact between belt and occupant
  - ⇒ Greater flexibility in body structure design
- Integrated airbag system providing side impact safety protection
- Spring assisted, lever operated backrest recline capabilities, for passenger comfort
- Spring assisted, backrest forward tilt capabilities, for (C-Class) rear seat passenger access
- Manual seat cushion adjustment for height, fore-and-aft, and tilt positions
- Manual headrest adjustment

The modular seat concept is based on a single cross-car beam, to which is attached the entire seat structure and trim components prior to vehicle installation. In vehicle position, the seat module is mechanically attached to the body structure, by way of the beam, inboard of the rockers. The beam, (*# AVC 11184 Crossmember Support Front Seat Rear*) is an octagonal-section straight tube, 60-mm across opposing flats, with a wall thickness of 1.2-mm. Manufactured from ultra high strength Martensitic steel, with yield strength of 950 MPa, it provides excellent crash energy absorption in event of side crash intrusion.

Welded to the (beam) crossmember, and providing a foundation for the seat cushion structure, is the seat frame. The frame is manufactured from a 40 mm square tube. Installation and attachment of the seat frame to body structure is achieved by way of vertical attachment of the crossmember at both ends to

body mounted brackets, and between the seats to the longitudinal rails. Furthermore, the seat frame - front inboard and outboard corners - are attached by way of brackets welded to the frame. Incorporated into the seat frame, and attached to it, is the seat cushion adjustment mechanism.

Welded to the seat frame are two brackets that provide attachment and tilt-pivots for the backrest. Incorporated into the outboard bracket is the backrest spring-assist tilt mechanism. In principal, the backrest comprises a frame, diagonal and lateral supports, and spring housing. The frame is manufactured from a 30 mm square tube, whilst the diagonal and lateral supports being 20 mm square tube. The headrest attachment bracket is welded to the frame. The spring housing, being a stamped part, is welded to the frame tube, and attached to the seat frame by way of the outboard mounted bracket.

Welded to the inboard corner, and rear surface, of the backrest frame, is the seat belt retractor attachment bracket. The retractor attachment reinforcement is welded to the front surface of the bracket and frame. The diagonal brace provides additional stiffness to the backrest, and reinforces the retractor attachment in this area. A side airbag is packaged on the outside of the seat back.

The ULSAB-AVC design concept incorporates the seat belt retractor housing on the inboard side of both seats. This location was chosen to achieve more space in the C-Class vehicle for better access to the rear seats. Nevertheless, the concept remains very flexible in terms of vehicle package, and customer preferences, etc., regarding the actual placement of the retractor. Being symmetrical in design, the seats could be exchanged, with appropriate changes made to the seat frame for installation reasons, thereby placing the retractors outboard both seats.

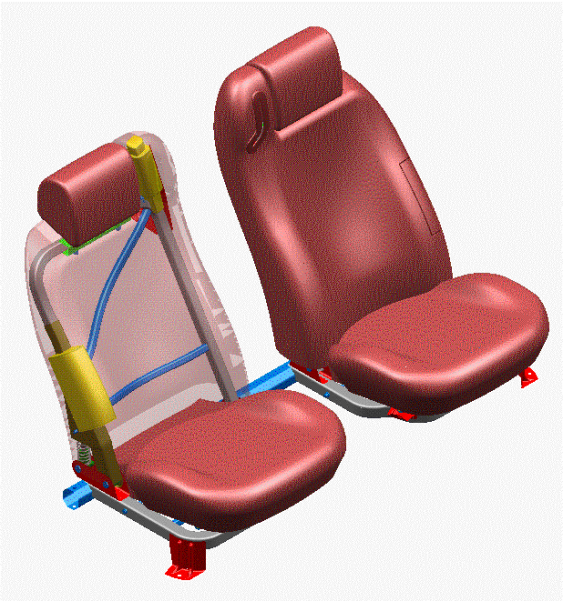


Figure 12.1.1-1 Front seats with trim

Figure 12.1.1-2 Front seat structure assembly

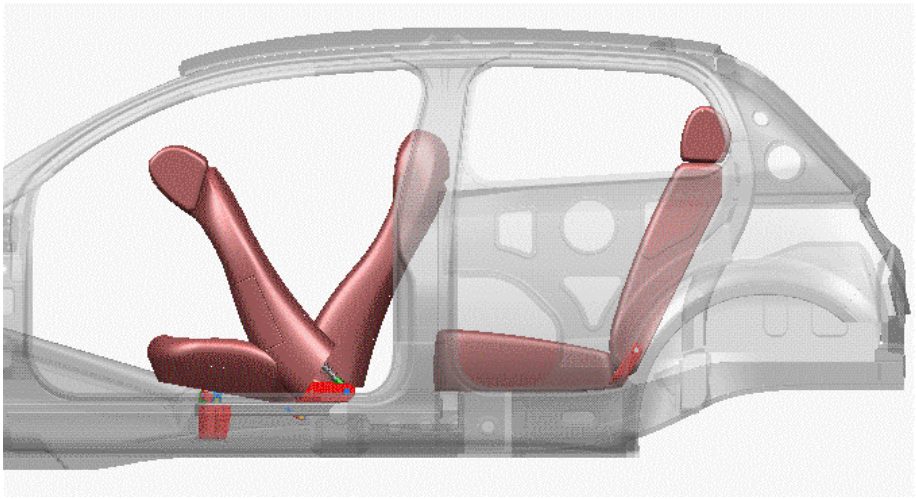


Figure 12.1.1-3 Front seat folded

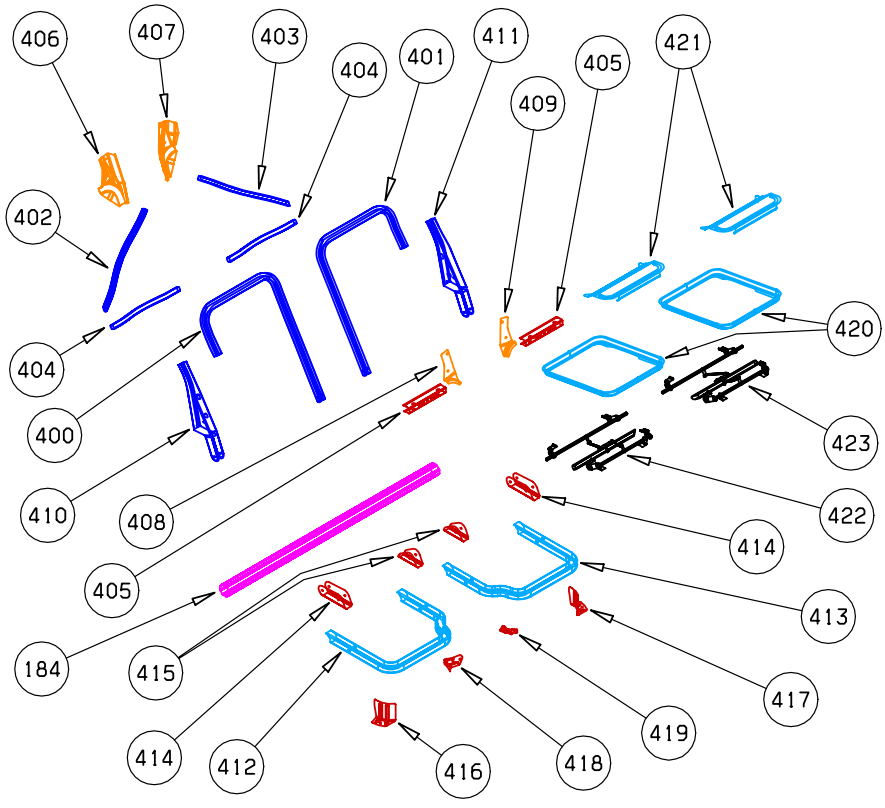


Figure 12.1.1-4 Front seat structure exploded view

Table 12.1.1-1 Front seat structure Parts List

Revision Level: A08 Date: 30 July 01

Number			Name	Revision Level	Date	Blank No.	Gage (mm)	Material Type	Grade (MPa)		Manuf. Process Code	Designed Mass (kg)	
									Yield Strength	Tensile Strength		C-Class	PNGV-Class
AVC	1	1184	Crossmember Support Front Seat Rear	C00	03-Nov-00		1.20	Mart *	950	1200	ST	2.568	2.568
AVC	1	1400	Frame Member Back Support Front Seat RH	A01	10-May-01		1.00	DP *	350	600	ST	1.120	1.120
AVC	1	1401	Frame Member Back Support Front Seat LH	A01	10-May-01		1.00	DP *	350	600	ST	1.120	1.120
AVC	1	1402	Diagonal Member Back Supt Front Seat RH	A01	10-May-01		1.00	DP *	350	600	ST	0.300	0.300
AVC	1	1403	Diagonal Member Back Supt Front Seat LH	A01	10-May-01		1.00	DP *	350	600	ST	0.300	0.300
AVC	1	1404	Crossmember Back Support Front Seat (x2)	A01	10-May-01		1.00	DP *	350	600	ST	0.500	0.500
AVC	1	1405	Bracket Head Support Attach Front Seat (x2)	A01	09-May-01		1.00	HSLA	350	450	S	0.400	0.400
AVC	1	1406	Bracket Retractor Attachment Front Seat RH	A01	10-May-01		1.50	TRIP	450	800	S	0.510	0.510
AVC	1	1407	Bracket Retractor Attachment Front Seat LH	A01	10-May-01		1.50	TRIP	450	800	S	0.510	0.510
AVC	1	1408	Reinf Retractor Attachment Front Seat RH	A01	10-May-01		1.50	TRIP	450	800	S	0.135	0.135
AVC	1	1409	Reinf Retractor Attachment Front Seat LH	A00	04-May-01		1.50	TRIP	450	800	S	0.135	0.135
AVC	1	1410	Retainer Spring Back Support Front Seat RH	A01	10-May-01		1.00	DP	500	800	S	0.710	0.710
AVC	1	1411	Retainer Spring Back Support Front Seat LH	A01	10-May-01		1.00	DP	500	800	S	0.710	0.710
AVC	1	1412	Frame Member Seat Support Front Seat RH	A00	04-May-01		0.70	Mild *	140	270	ST	0.931	0.931
AVC	1	1413	Frame Member Seat Support Front Seat LH	A00	04-May-01		0.70	Mild *	140	270	ST	0.931	0.931
AVC	1	1414	Bracket Back Supt Attach Outer Frt Seat (x2)	A01	10-May-01		2.00	HSLA	350	450	S	0.760	0.760
AVC	1	1415	Bracket Back Supt Attach Inner Frt Seat (x2)	A01	10-May-01		2.00	HSLA	350	450	S	0.480	0.480
AVC	1	1416	Bracket Seat Attach Outer Front Seat RH	A01	10-May-01		2.00	HSLA	350	450	S	0.260	0.260
AVC	1	1417	Bracket Seat Attach Outer Front Seat LH	A01	10-May-01		2.00	HSLA	350	450	S	0.260	0.260
AVC	1	1418	Bracket Seat Attach Inner Front Seat RH	A00	04-May-01		2.00	HSLA	350	450	S	0.100	0.100
AVC	1	1419	Bracket Seat Attach Inner Front Seat LH	A00	04-May-01		2.00	HSLA	350	450	S	0.100	0.100
AVC	1	1420	Frame Cushion Support Front Seat (x2)	A00	04-May-01		1.00	Mild	140	270	S	1.320	1.320
AVC	1	1421	Reinf Cushion Support Front Seat (x2)	A00	04-May-01		1.00	Mild	140	270	S	1.300	1.300
AVC	1	1422	Assy Tilt Mech Cushion Supt Front Seat RH	A01	09-May-01		Assy	Assy	Assy	Assy		1.952	1.952
AVC	1	1423	Assy Tilt Mech Cushion Supt Front Seat LH	A01	09-May-01		Assy	Assy	Assy	Assy		1.952	1.952
TOTAL												19.364	19.364

Code	Manufacturing Process
S	Stamped
ST	Straight or Shaped Tube
ROD	Straight or Shaped Rod

Code	Steel Types
DP	Dual Phase
HSLA	High Strength, Low Alloy
Mart	Martensitic
Mild	Mild Steel
TRIP	Transformation-Induced Plasticity

*** denotes tube**

12.1.2. Rear Seat Concept

The rear seat structure design concept is based on the following requirement criteria:

- To provide seating for three adult passengers
- Seat structure must be common for both C-Class and PNGV-Class vehicles
- Provide additional cargo space by means of tilt-and-stowage of the rear seats, so long as:
  - ⇒ The additional cargo space is accessible from the rear luggage compartment
  - ⇒ Either one, or two rear seat passengers have the option to remain seated

The rear seat design concept is based on a 2-seat 60/40 split. The seat structure comprises two seats, with the same design principals applied to both. The right side seat accommodates two passengers, whilst the left seat accommodates one.

The seat (cushion) support consists of two, 4-mm diameter, solid steel rod configurations. The smaller rod incorporates two small brackets, used for attachment to the rear floor, whilst allowing the rod to rotate within it. The larger rod is attached to the smaller rod, incorporating a second rotation axis. By this means, the seat support may be rotated into a vertical position, rear of the front-seat.

The backrest structure comprises a flat stamped panel with stiffening beads, with a vertical stamped reinforcement joined to it at both ends. The headrest attachment bracket is welded to the top of the flat panel. Three brackets are used for attachment of both backrests to the rear floor. Incorporated into the brackets are the bushing mechanisms used for attachment to the backrest reinforcements, whilst providing a tilt axis for the backrest. The two inner reinforcements share the same center floor attachment bracket. By this means, with the seat (cushion) support stowed in a vertical position, the backrest may be rotated to a flat position rear of it.

In normal installed seating position, for C-Class, the two backrests are latched to mechanisms attached to the hydroformed body side members. For PNGV-Class, the package tray and/or hydroformed body side members may be used for this purpose.

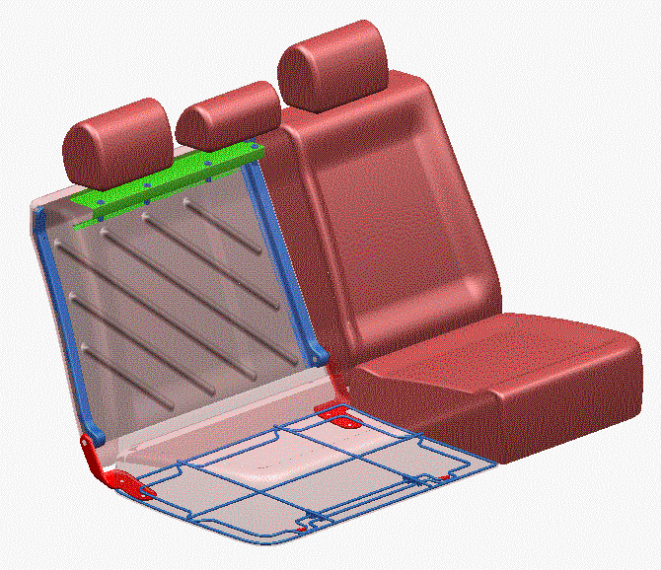


Figure 12.1.2-1 Rear seat with trim

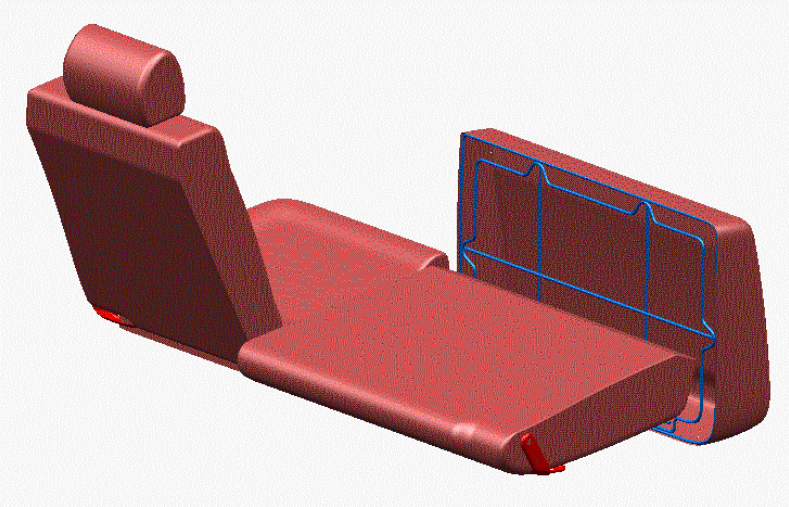


Figure 12.1.2-2 Rear seat folded

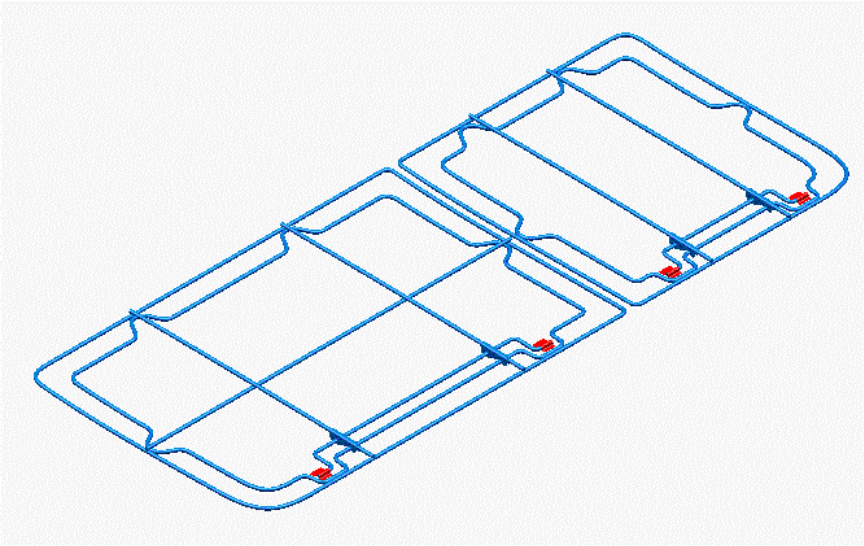


Figure 12.1.2-3 Rear seat structure lower

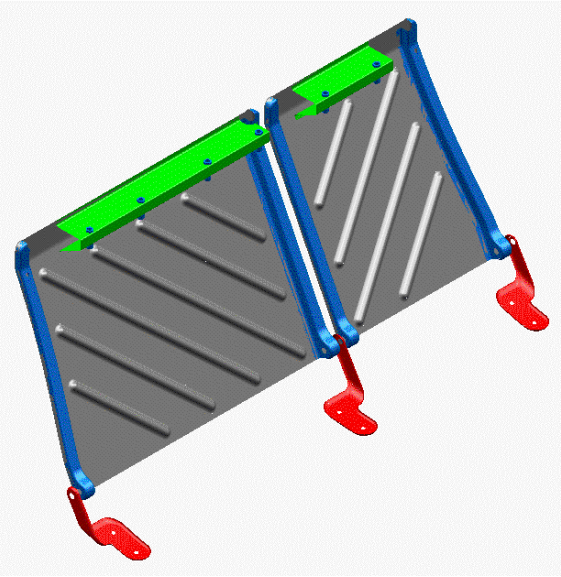


Figure 12.1.2-4 Rear seat structure back

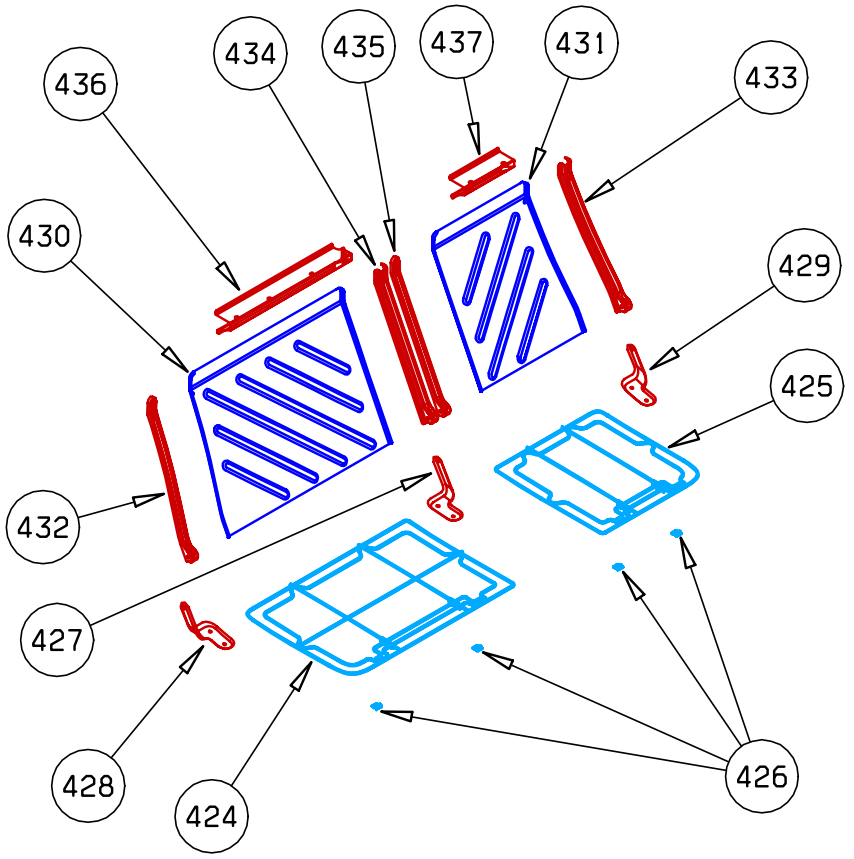


Figure 12.1.2-4 Rear seat exploded view

Table 12.1.2-1 ~~Rear seat structure parts list~~

~~Revision Level: A05 Date: 30 JULY 01~~

Number	Name	Revision Level	Date	Blank No.	Gage (mm)	Material Type	Grade (MPa)		Manuf. Process Code	Designed Mass (kg)	
							Yield Strength	Tensile Strength		C-Class	PNGV-Class
~~AVC 1 1368~~	~~Bracket Steering Column Attachment~~	~~A02~~	~~02 Mar 01~~		~~0.50~~	~~Mild~~	~~140~~	~~270~~	~~S~~	~~1.775~~	~~1.775~~
~~AVC 1 1369~~	~~Crossmember Instrument Panel~~	~~A01~~	~~28 Mar 01~~		~~2.00~~	~~DP *~~	~~350~~	~~600~~	~~ST~~	~~9.200~~	~~9.200~~
~~AVC 1 1384~~	~~Bracket C-Member Inst Panel Support RH~~	~~A00~~	~~27 Feb 01~~		~~2.00~~	~~Mild~~	~~140~~	~~270~~	~~S~~	~~0.220~~	~~0.220~~
~~AVC 1 1385~~	~~Bracket C-Member Inst Panel Support LH~~	~~A00~~	~~27 Feb 01~~		~~2.00~~	~~Mild~~	~~140~~	~~270~~	~~S~~	~~0.220~~	~~0.220~~
~~AVC 1 1386~~	~~Brace C-Member Inst Panel Support (x2)~~	~~A00~~	~~28 Feb 01~~		~~2.00~~	~~Mild *~~	~~140~~	~~270~~	~~ST~~	~~0.760~~	~~0.760~~
~~AVC 1 1387~~	~~Plate C-Member Inst Panel Attachment (x2)~~	~~A01~~	~~28 Mar 01~~		~~2.00~~	~~Mild~~	~~140~~	~~270~~	~~S~~	~~0.120~~	~~0.120~~
~~TOTAL~~										~~6.315~~	~~6.315~~

Code	Manufacturing Process
S	Stamped
ST	Straight or Shaped Tube

Code	Steel Types
DP	Dual Phase
Mild	Mild Steel

* denotes tube

12.1.3. Seat System Mass

Table 12.1.3-1 Mass of Seat System Front and Rear

Name	Target C-Class (kg)	Target PNGV-Class (kg)	C-Class and PNGV-Class Mass (kg)
Seat Structure Front Seats	n/a	n/a	**19.364**
Seat Cushions Front Seats	n/a	n/a	**4.100**
Trim Front Seats	n/a	n/a	**2.560**
Headrests Front Seats - without trim	n/a	n/a	**1.160**
Side Airbag Module incl. Brackets	n/a	n/a	**1.360**
Seat Structure Rear Seats	n/a	n/a	**10.151**
Seat Cushions Rear Seats	n/a	n/a	**4.800**
Trim Rear Seats	n/a	n/a	**1.260**
Headrests Rear Seats incl. trim (x3)	n/a	n/a	**3.000**
Seat Cover Back incl. Brackets	n/a	n/a	**0.600**
*Seatbelts	n/a	n/a	**---**
Total Mass	63.00	69.00	**48.355**

* included in interior trim

12.2. Instrument Panel Structure

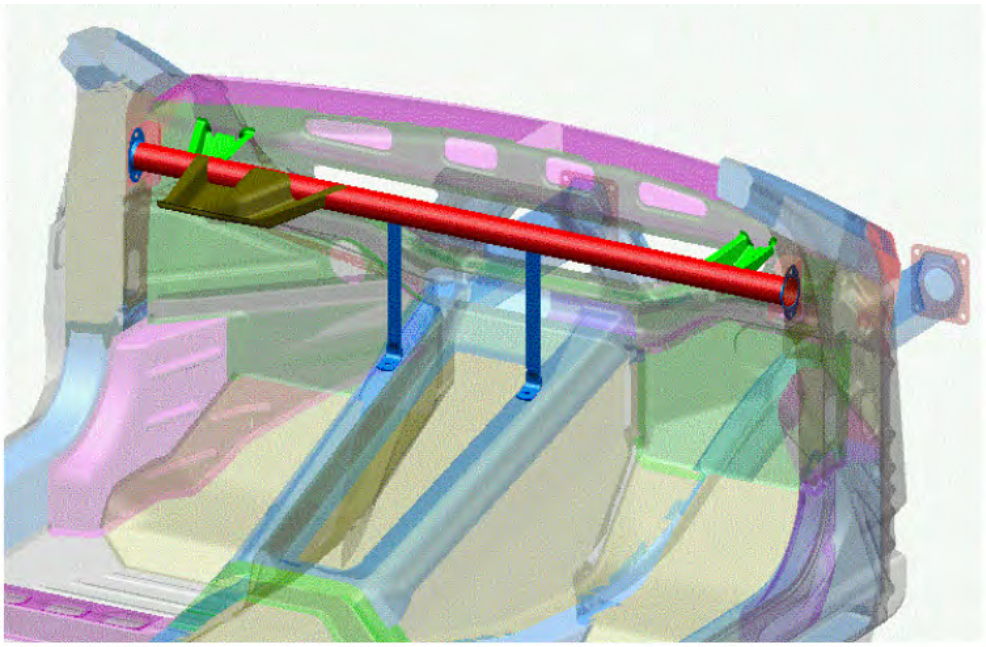


Figure 12.2-1 Instrument panel structure

Figure 12.2-1 shows the Instrument Panel Structure in the body structure.

The assembly Instrument Panel Structure (see Figure 12.2-2) is designed for stiffness to support the steering column, which is mounted from underneath to the bracket steering column attachment. Additional functions include supporting the instrument panel with the support for the passenger airbag. The crossmember instrument panel is designed as a straight tube made of DP 350/600 as described in the Parts List (Table 12.2-1).

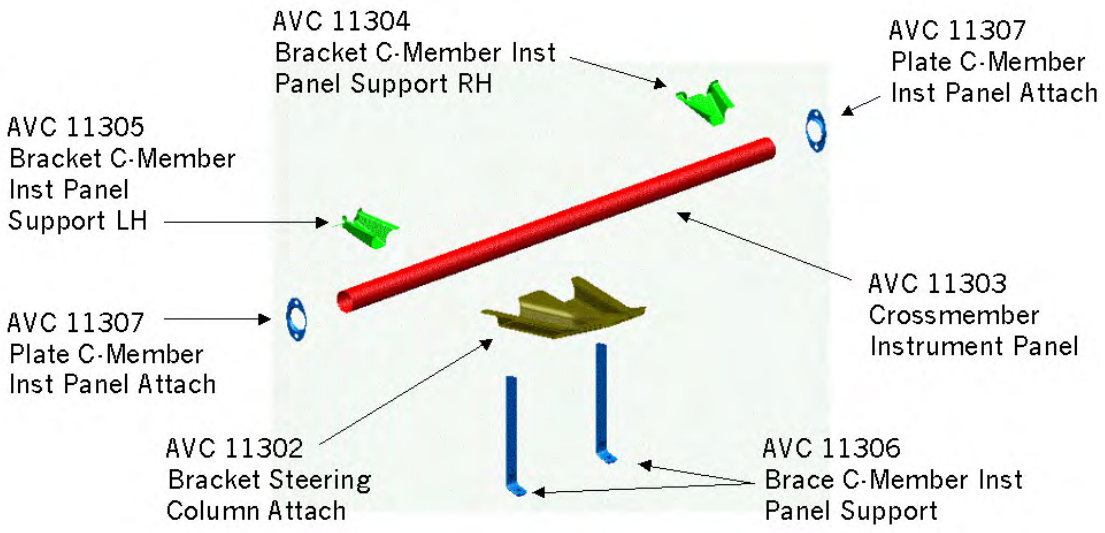


Figure 12.2-2 Instrument panel structure exploded

Table 12.2-1 Parts list Instrument Panel structure

Revision Level: A05 Date: 30 JULY 01

Number			Name	Revision Level	Date	Blank No.	Gage (mm)	Material Type	Grade (MPa)		Manuf. Process Code	Designed Mass (kg)	
									Yield Strength	Tensile Strength		C-Class	PNGV-Class
AVC	1	1302	Bracket Steering Column Attachment	A02	22-Mar-01		2.50	Mild	140	270	S	1.775	1.775
AVC	1	1303	Crossmember Instrument Panel	A01	20-Mar-01		2.00	DP *	350	600	ST	3.260	3.260
AVC	1	1304	Bracket C-Member Inst Panel Support RH	A00	27-Feb-01		2.00	Mild	140	270	S	0.220	0.220
AVC	1	1305	Bracket C-Member Inst Panel Support LH	A00	27-Feb-01		2.00	Mild	140	270	S	0.220	0.220
AVC	1	1306	Brace C-Member Inst Panel Support (x2)	A00	28-Feb-01		2.00	Mild *	140	270	ST	0.720	0.720
AVC	1	1307	Plate C-Member Inst Panel Attachment (x2)	A01	20-Mar-01		2.00	Mild	140	270	S	0.120	0.120
TOTAL												6.315	6.315

Code	Manufacturing Process
S	Stamped
ST	Straight or Shaped Tube

Code	Steel Types
DP	Dual Phase
Mild	Mild Steel

* denotes tube

12.3. Fuel Tank

In the ULSAB-AVC vehicle concepts (C-Class and PNGV-Class) for both engine variants, the same fuel tank (see Figure 12.3-1) is utilized. The fuel tank is located under the rear floor in front of the twist beam rear suspension and behind the kick-up cross member.

The fuel tank is made of two stampings of Mild steel 140/270 as shown in Figures 12.3.2 and 12.3.3. The fuel filler (see Figure 12.3.4) is the same in both vehicle concepts sharing the same fuel filler routing. The fuel tank capacity is 40 L.

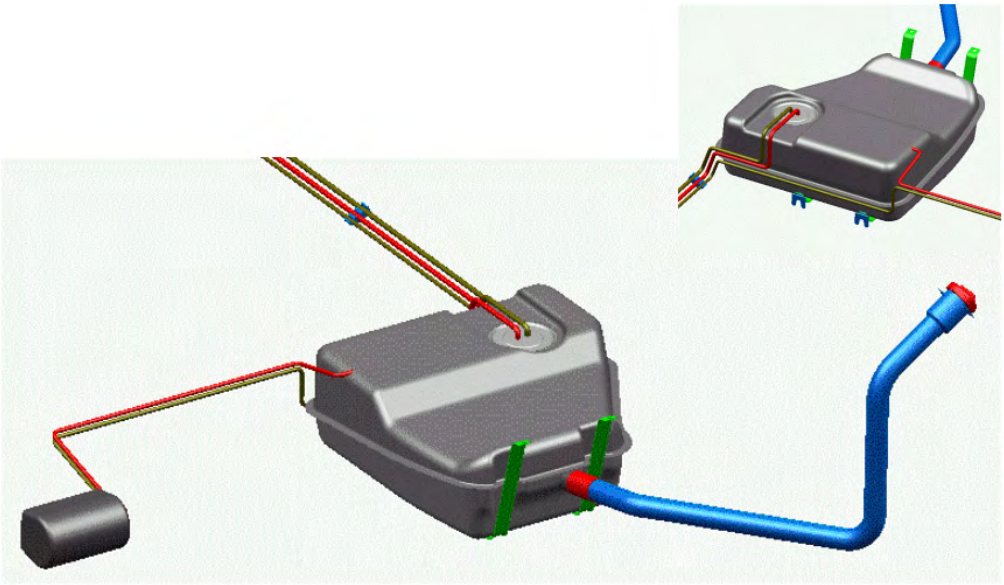
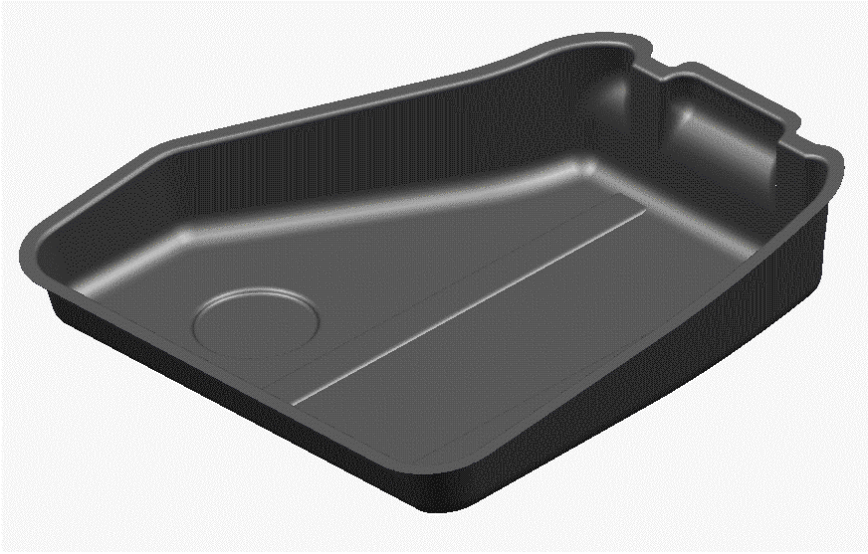


Figure 12.3-1 Fuel tank

Material = Mild 140/270
Material Thickness = 0.6 mm
Mass = 1,811 kg

Figure 12.3-2 Fuel tank upper stamping



Material = Mild 140/270
Material thickness = 0.6 mm
Manufacturing process = stamping
Mass = 1,859 kg

Figure 12.3-3 Fuel tank lower stamping

Tube ∅ = 40 mm
Material = Mild 140·270
Material thickness = 0.8 mm
Mass = 0.750 kg

Figure 12.3-4 Fuel filler tube

Table 12.3-1 Fuel Tank mass summary

Component	Mass	
	C-Class (kg)	PNGV-Class (kg)
Fuel tank including fuel filler	4.456	4.456

12.4. Exhaust System

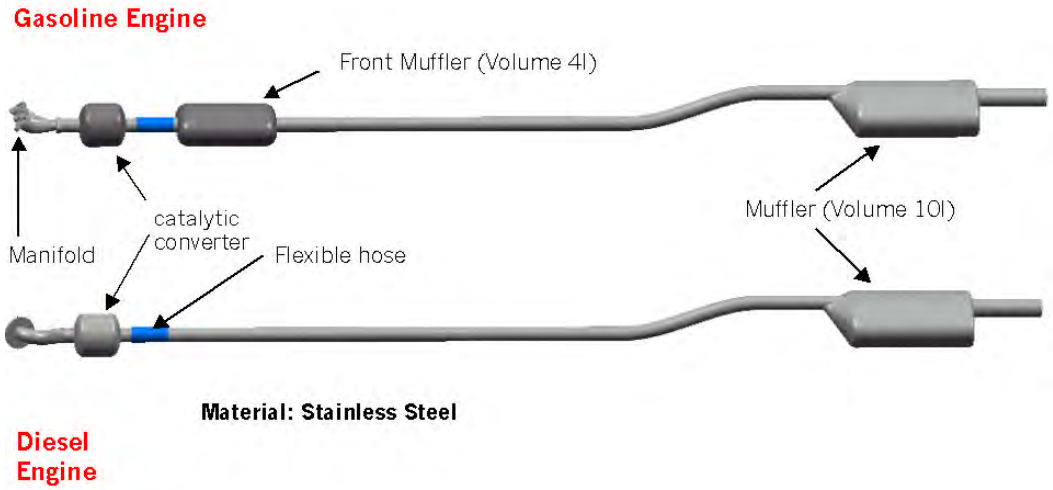


Figure 12.4-1 Exhaust system for gasoline and diesel variants

Table 12.4-1 Exhaust Materials

Component	European Material Identification	Type	Diameter (mm)	Thickness (mm)
Exhaust Manifold	X 15 CrNiSi 20 12	Austentic	42	1.2
Reinforcements	X 5 CrNi 18 10	Austentic	--	
Connectors (Front End)	X 5 CrNi 18 10	Austentic	--	
Tubes (Front End)	X 2 CrTiNb 18	Ferritic	--	
Catalyst Housing (Inlet/Outlet)	X 2 CrTiNb 18	Ferritic	--	
Muffler (Inner parts)	X 2 CrTiNb 18	Ferritic	--	1.0
Tubes (Rear End)	X 6 CrTi 12	Ferritic	50	1.0
Catalyst Housing (Middle Area)	X 6 CrTi 12	Ferritic	--	
Muffler (Inner Parts)	X 6 CrTi 12	Ferritic	--	0.5
Connectors (Rear End)	St 1203	Ferritic	--	
Muffler (Outer Shell)	St 1203 (aluminized)	Ferritic	--	1.0

Table 12.4-2 Exhaust system mass summary

Component	C-Class (kg)	PNGV-Class (kg)
Exhaust Diesel	10.5	10.6
Exhaust Gasoline	12.9	13.0

12.5. Adjustable Pedal System

For ULSAB-AVC, an adjustable pedal system concept was developed as a result of the decision to utilize a fixed seating concept for enhanced crashworthiness in side impact crash events. The pedal system (see Figure 12.5-1) was developed to integrate functions and combines the attachment of accelerator and brake pedal, the electric hydraulic brake unit, foot rest and the guide rail housing. Therefore, the base plate is designed as a casting (magnesium).

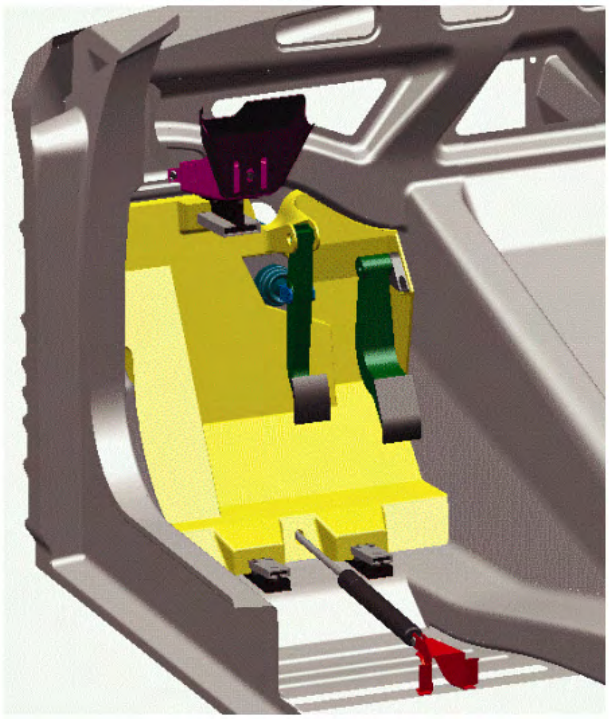


Figure 12.5-1 Adjustable pedal system

The adjustable pedal unit is attached to the instrument panel structure with the upper guide rail and to the floor with the two lower guide rails. Longitudinal travel, shown in Figure 12.5-3, is specified at 160 mm length and 30 mm and is a result of the packaging investigation. For comfort reasons, the pedal system is equipped with a lockable gas strut, which pulls the pedal system to the most rearward position when unlocked. Drivers can find their ideal pedal position by unlocking the gas strut and manually pushing the system forward (see Figure 12.5-4).

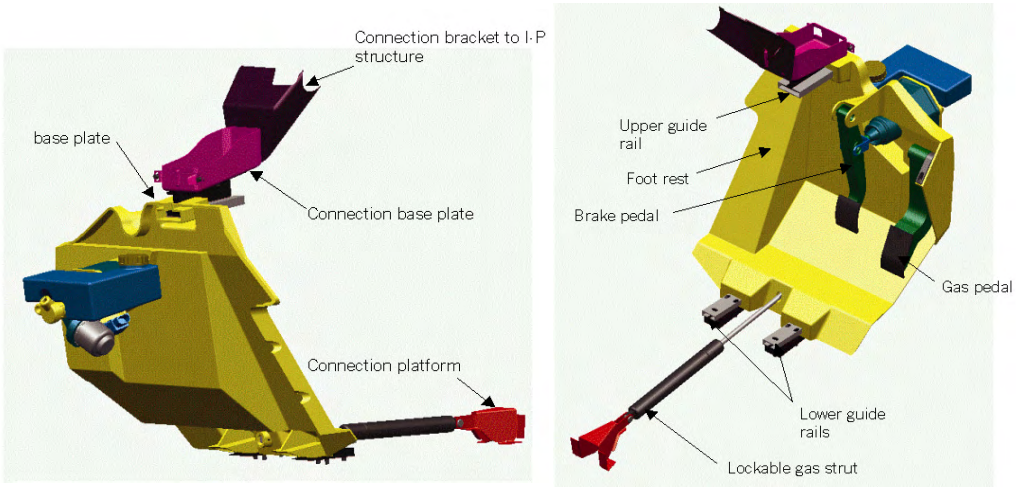


Figure 12.5-2 Pedal system

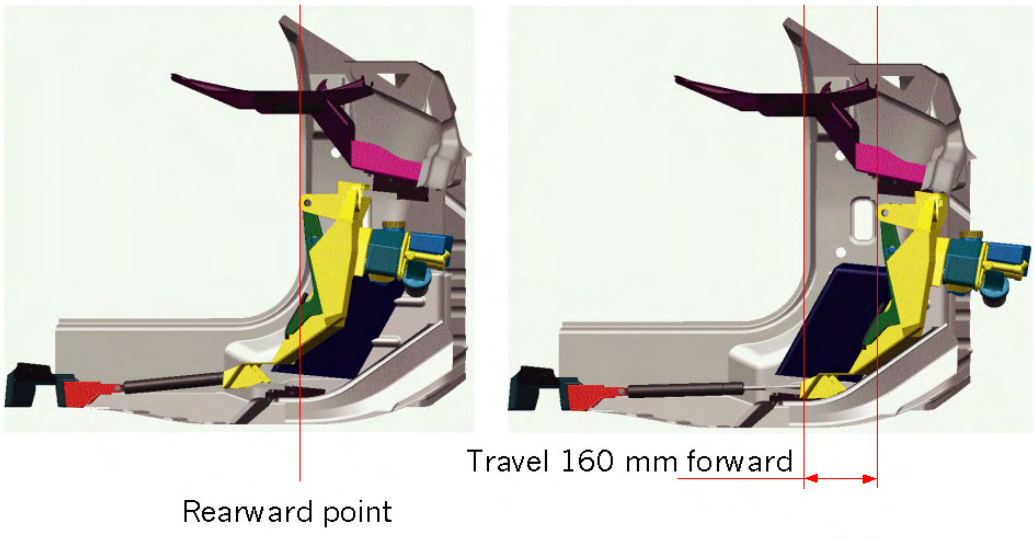


Figure 12.5-3 Adjustable pedal position

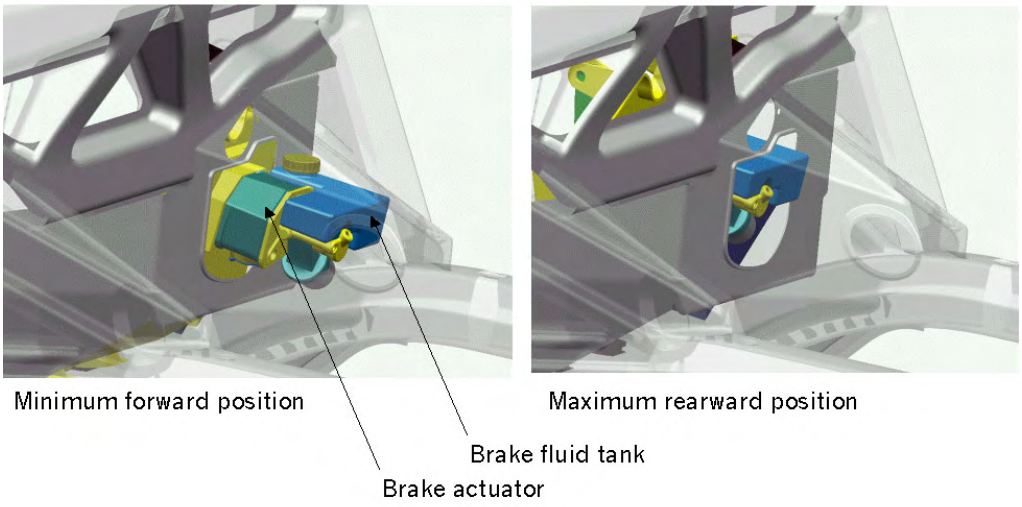


Figure 12.5-4 Electric hydraulic brake system unit

Table 12.5-1 Adjustable pedal system mass summary

Adjustable Pedal System Component	No. of parts	Mass (kg)	Material type
Base Plate	1	2.479	Magnesium
Connection Base Plate	1	0.428	Steel
Upper Guide	1	0.215	Fiber composite
Lower Guide	2	0.079	Fiber composite
Upper Rail	1	0.231	Steel
Lower Rail	2	0.241	Steel
Gas Pressure Spring	1	1.227	Steel/Plastic
Connection Platform	1	0.165	Steel
Connection IP Structure	1	0.558	Steel
Brake Pedal	1	0.415	Steel
Gas Pedal	1	0.215	Plastic
Cover	1	0.268	Plastic
Attachment Brake Pedal	1	0.050	Steel
Attachment Gas Pedal	1	0.031	Plastic
Bolts	16	0.118	Steel
Assembly Pedal Adjustment		**6.720**	

12.6. Fascia - Front and Rear

12.6.1. Front Fascia Module

The front fascia module (see Figure 12.6.1-1) is designed to be assembled in the final trim line as a pre-assembled unit to the vehicle. The module consists of fascia, bumper beam with crash box, radiator intake, duct, and radiator close-out model. These parts are shown in the exploded view, Figure 12.6.1-2 and 12.6.1-3. The difference in the modules between gasoline and diesel vehicle variants is caused by the difference in radiator/intercooler arrangement, which results two specific duct radiator intakes.

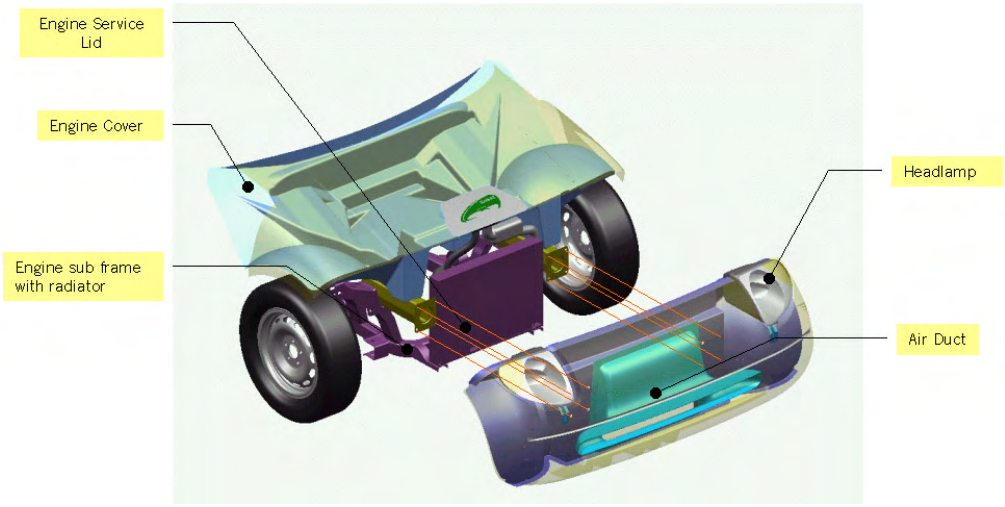


Figure 12.6.1-1 Front Fascia module disassembled

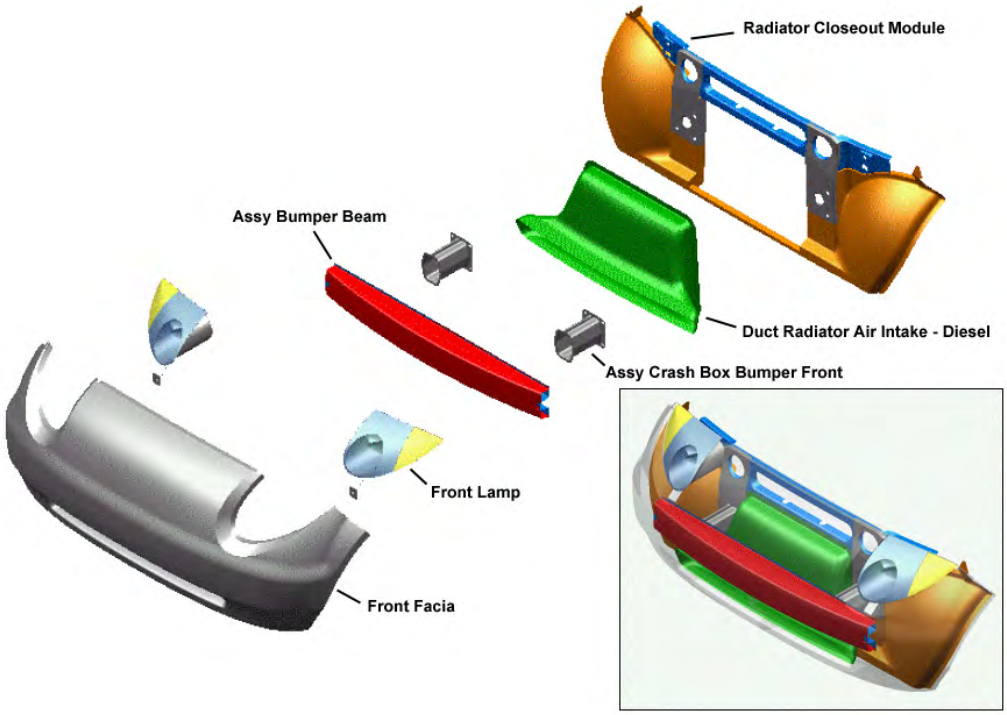


Figure 12.6.1-2 Front fascia module exploded view (diesel)

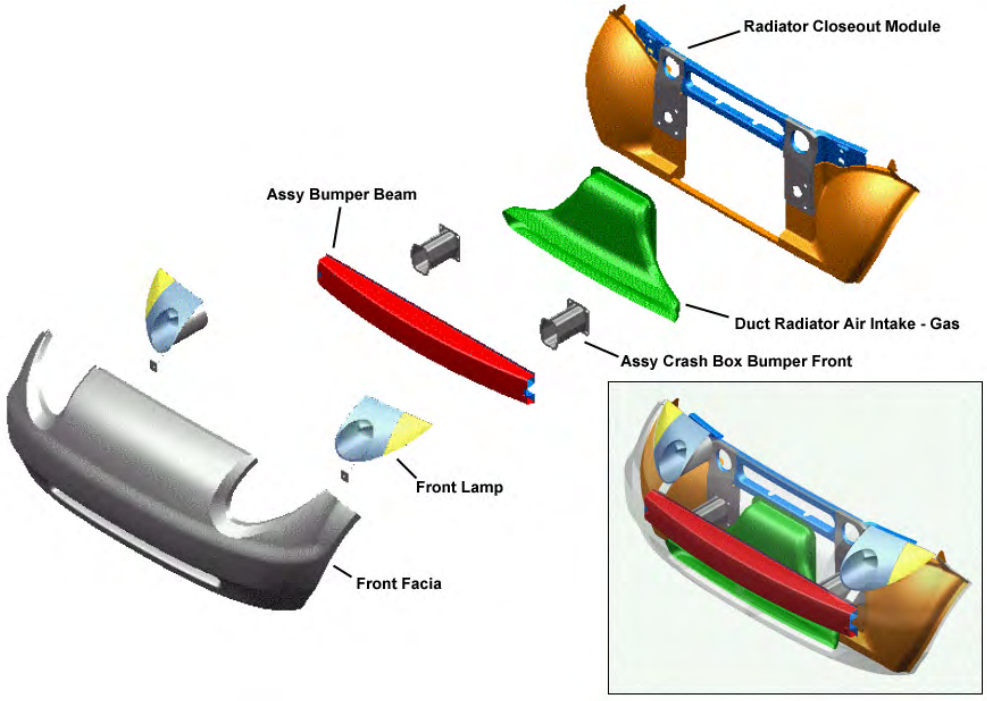


Figure 12.6.1-3 Front fascia module exploded view (gasoline)

The radiator close-out module is a hybrid design combining nylon and steel. This module integrates the front of the wheelhouse covers, which is shown in Figure 12.6.1-3 and 12.6.1-4.

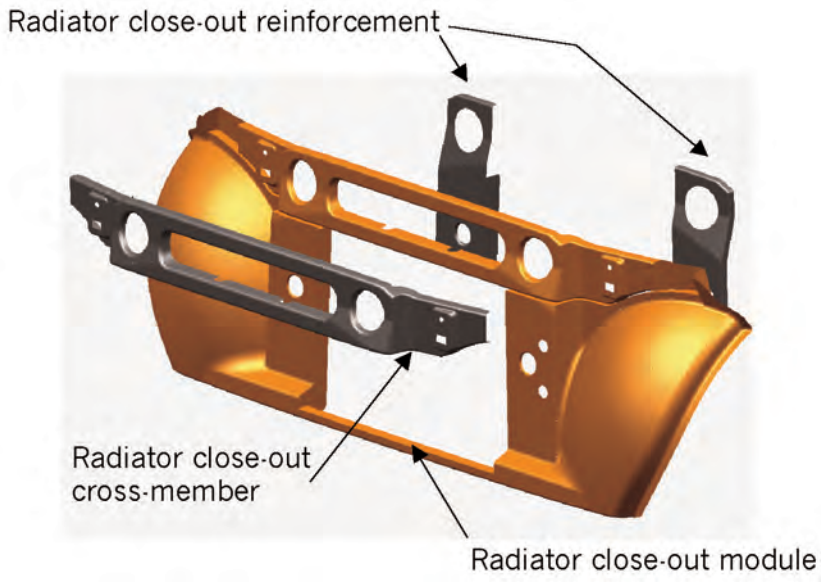


Figure 12.6.1-4 Radiator Closeout exploded view - Bayer hybrid steel/nylon technology

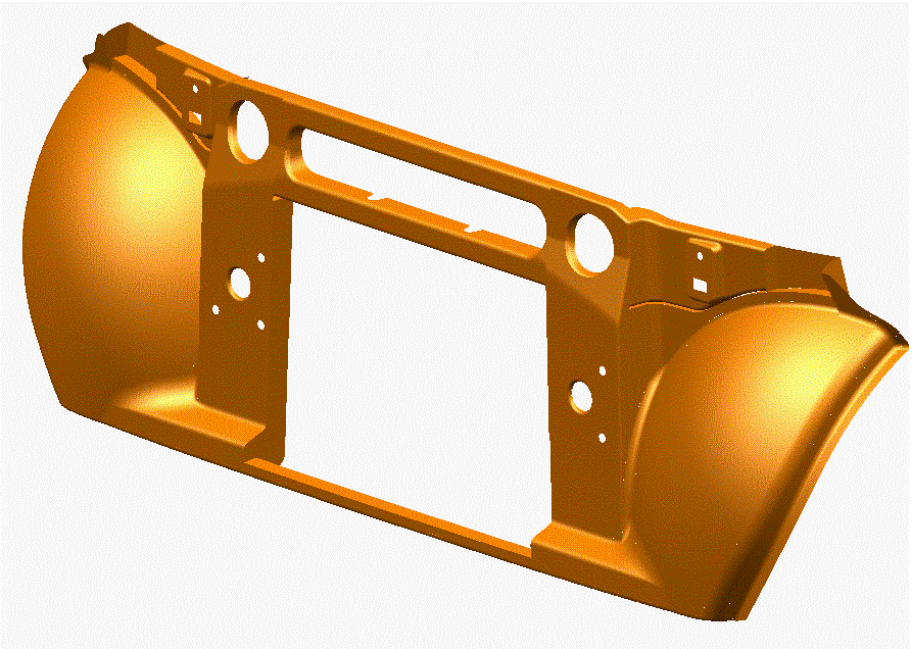


Figure 12.6.1-5 Radiator Closeout Module

Table 12.6.1-1 Parts List Front Fascia Module

Revision Level: A01 Date: 09 May 01

Number			Name	Revision Level	Date	Material	Mass (kg)	
							C-Class	PNGV-Class
AVC	1	4200	Radiator Closeout Module	A01	01-May-01	Nylon Steel Hybrid	2.296	2.296
			Radiator Closeout Reinforcement			Mild 140/270	0.810	0.810
			Radiator Closeout Crossmember			Mild 140/270	1.491	1.491
AVC	1	4201	Duct Radiator Air Intake - Diesel	A01	30-Apr-01	PP-EPDM	0.702	0.702
AVC	1	4202	Front Fascia	A00	29-Mar-01	PP-EPDM	4.290	4.290
AVC	1	4204	Front Lamp Module RH	A00	29-Mar-01	Plastics	n/a	n/a
AVC	1	4205	Front Lamp Module LH	A00	29-Mar-01	Plastics	n/a	n/a
AVC	1	4214	Duct Radiator Air Intake - Gasoline	A00	27-Apr-01	PP-EPDM	0.649	0.649
TOTAL DIESEL							**9.589**	**9.589**
TOTAL GASOLINE							**9.536**	**9.536**

12.6.2. Rear Fascia

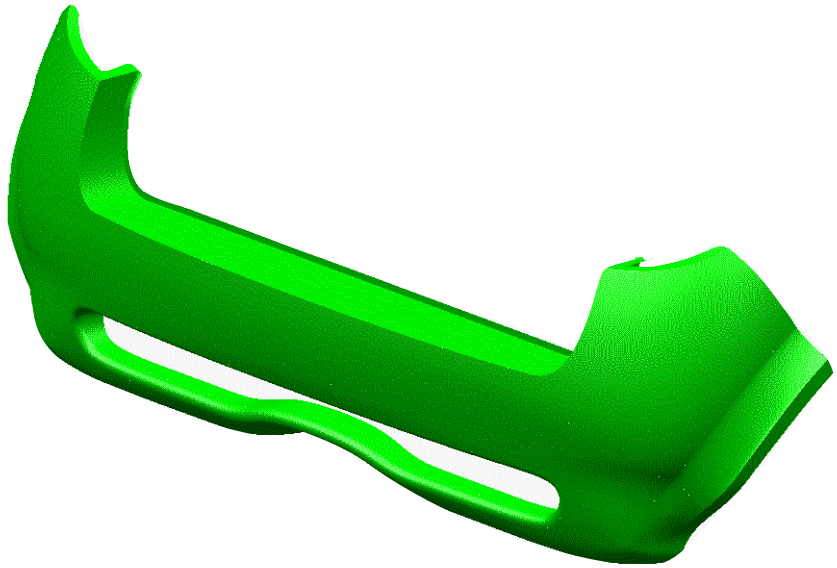


Figure 12.6.2-1 C-Class rear fascia

PORSCHE Engineering Services, Inc.

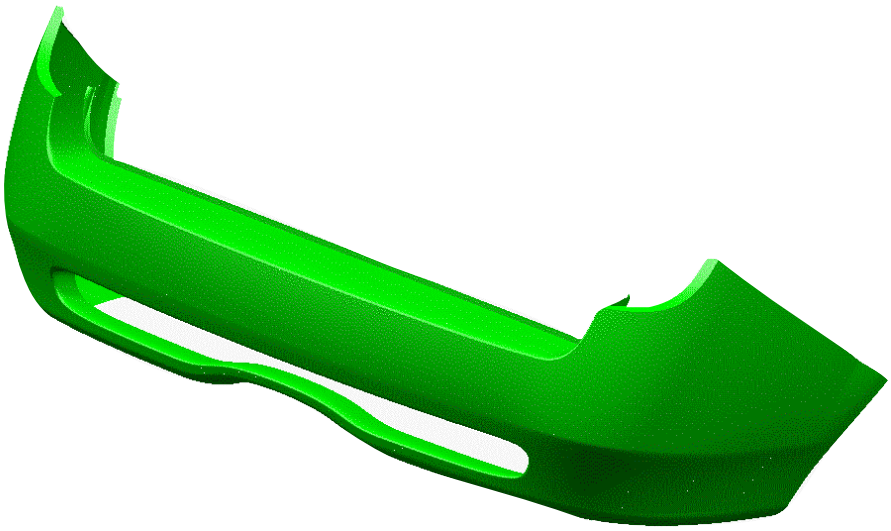


Figure 12.6.2-2 PNGV-Class rear fascia

12.6.3. Bumper Beam Structure

The Bumper Beam Structure is made up of the front and rear bumper beam. The front bumper is made of an assembly crash box bumper front is made from DP 400/700 in a material thickness of 1.10 mm, and a bumper beam front inner and outer, both made from Mart 1250/1520 in a material thickness of 1.0 mm. The assembly crash box rear is made of HSLA 350/450 in a material thickness of 1.0 mm.

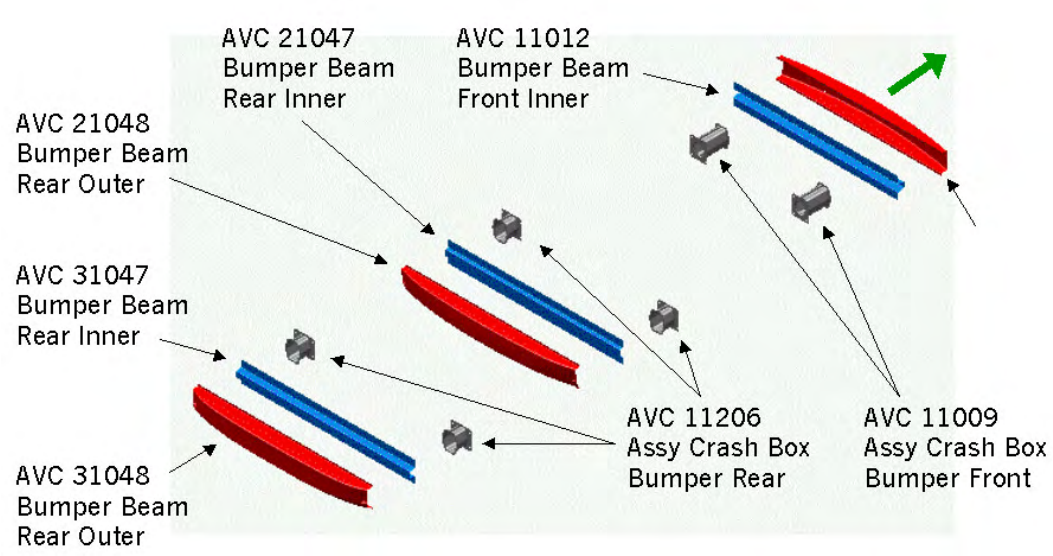


Figure 12.6.3-1 Bumpers Front and Rear exploded view

Table 12.6.3-1 Parts list Bumper Beam Structure

Revision Level: A02 Date: 22 MAR 01

Number			Name	Revision Level	Date	Blank No.	Gage (mm)	Material Type	Grade (MPa)		Manuf. Process Code	Designed Mass (kg)	
									Yield Strength	Tensile Strength		C-Class	PNGV-Class
AVC	1	1009	Assy Crash Box Bumper Front (x2)	D01	31-Oct-00		1.10	DP	400	700	S	1.408	1.408
AVC	1	1012	Bumper Beam Front Inner	E01	25-Jan-01		1.00	Mart	1250	1520	RF	1.940	1.940
AVC	1	1013	Bumper Beam Front Outer	F01	25-Jan-01		1.00	Mart	1250	1520	S	2.640	2.640
AVC	1	1206	Assy Crash Box Bumper Rear (x2)	B02	24-Jan-01		1.00	HSLA	350	450	S	0.920	0.920
AVC	2	1047	Bumper Beam Rear Inner	F00	24-Jan-01		0.80	Mart	1250	1520	RF	1.312	
AVC	2	1048	Bumper Beam Rear Outer	G00	24-Jan-01		0.80	Mart	1250	1520	S	2.064	
AVC	3	1047	Bumper Beam Rear Inner	F00	24-Jan-01		0.80	Mart	1250	1520	RF		1.536
AVC	3	1048	Bumper Beam Rear Outer	G00	24-Jan-01		0.80	Mart	1250	1520	S		2.336
TOTAL												10.284	10.780

Code	Manufacturing Process
S	Stamped
RF	Roll Formed

12.7. Engine Cover Module

The engine cover module (see Figure 12.7-1) integrates the HVAC system, intake air filter, engine service module and is pre-assembled prior to delivery to the final trim line.

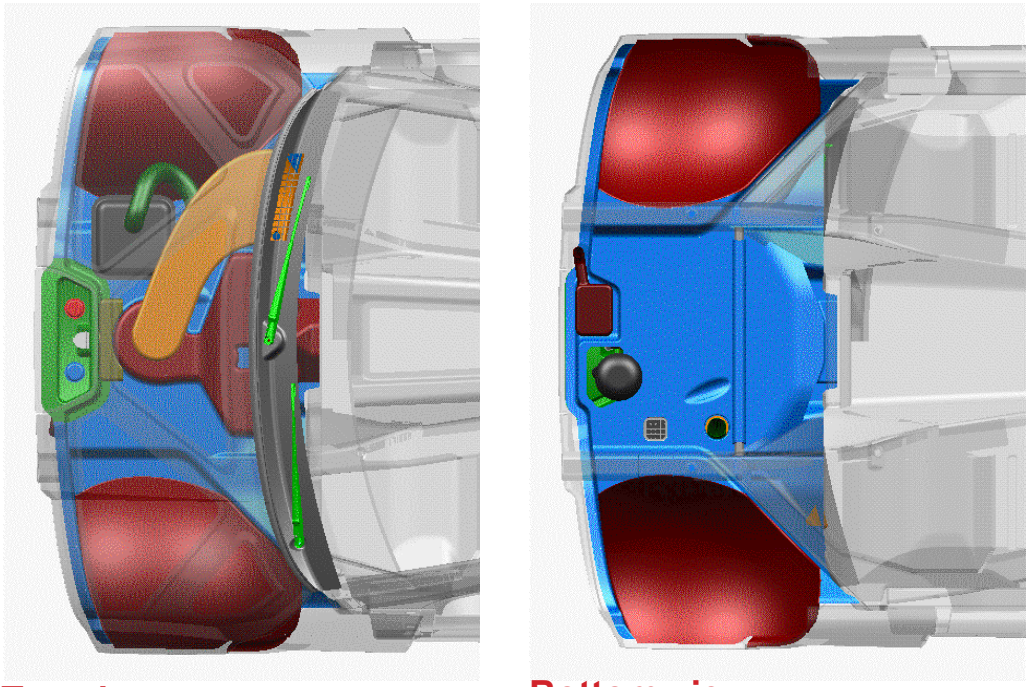


Figure 12.7-1 Engine cover module

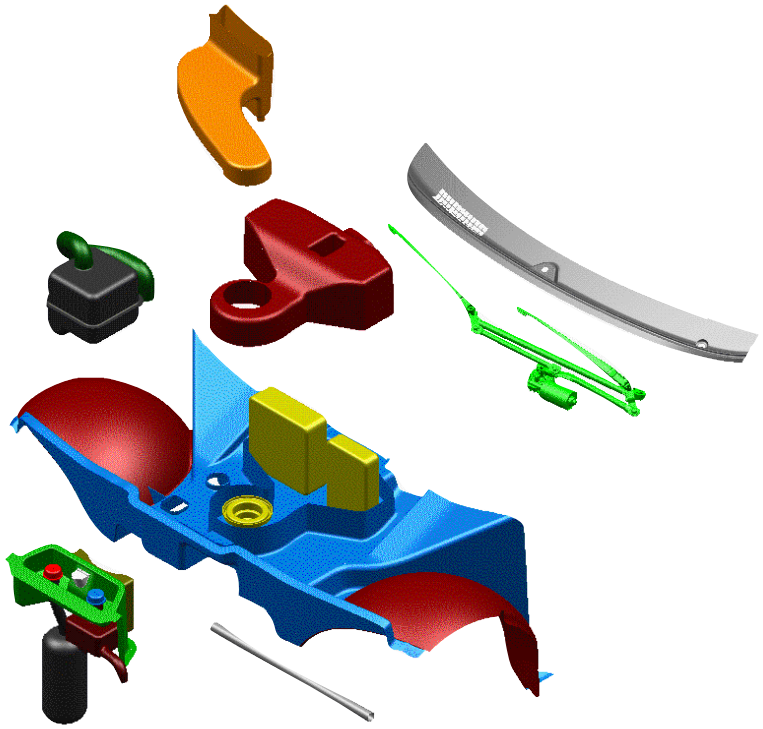


Figure 12.7-2 Engine cover module exploded view

The engine cover hybrid module (see Figure 12.7-3) is made of nylon with a steel reinforcement, also integrating the function of lower HVAC unit housing and wheelhouse cover rear.

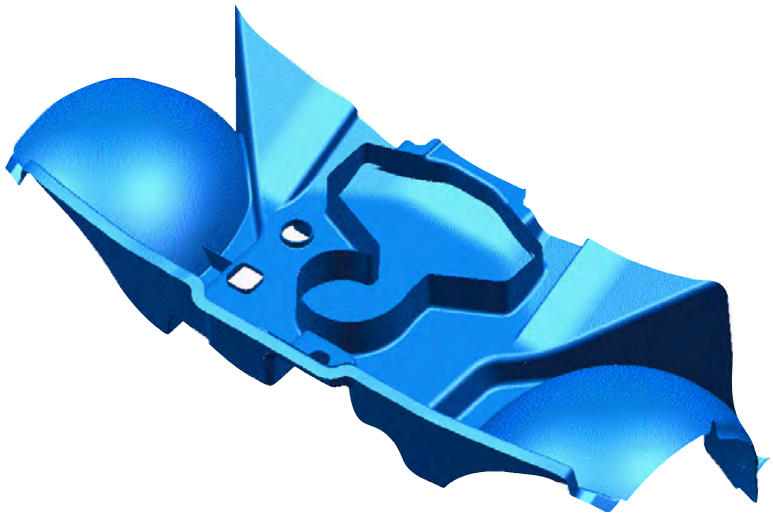


Figure 12.7-3 Engine cover hybrid module

12.8. Interior

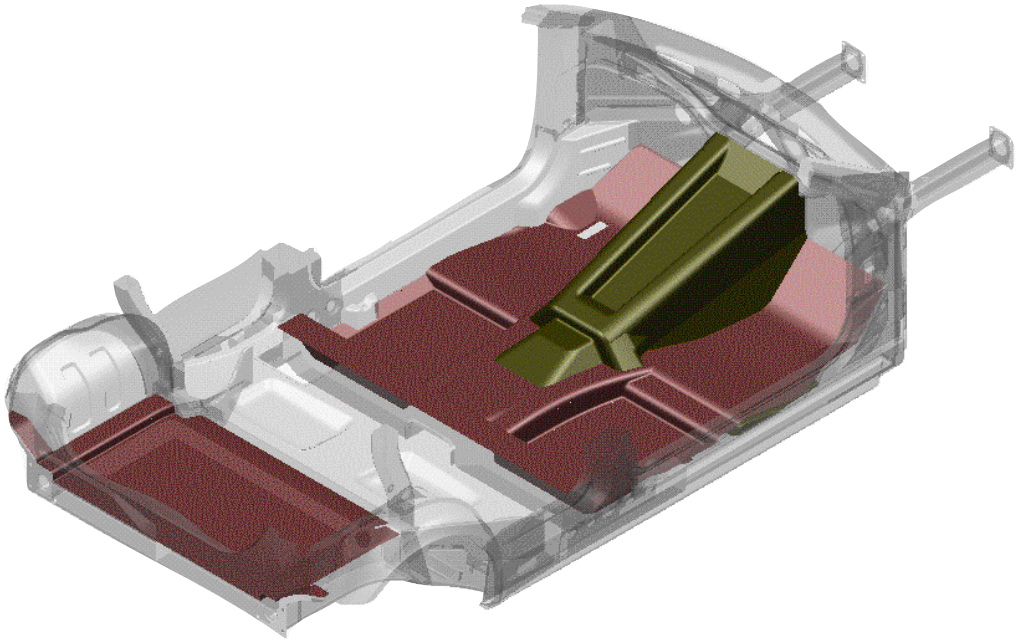


Figure 12.8-1 C-Class carpets

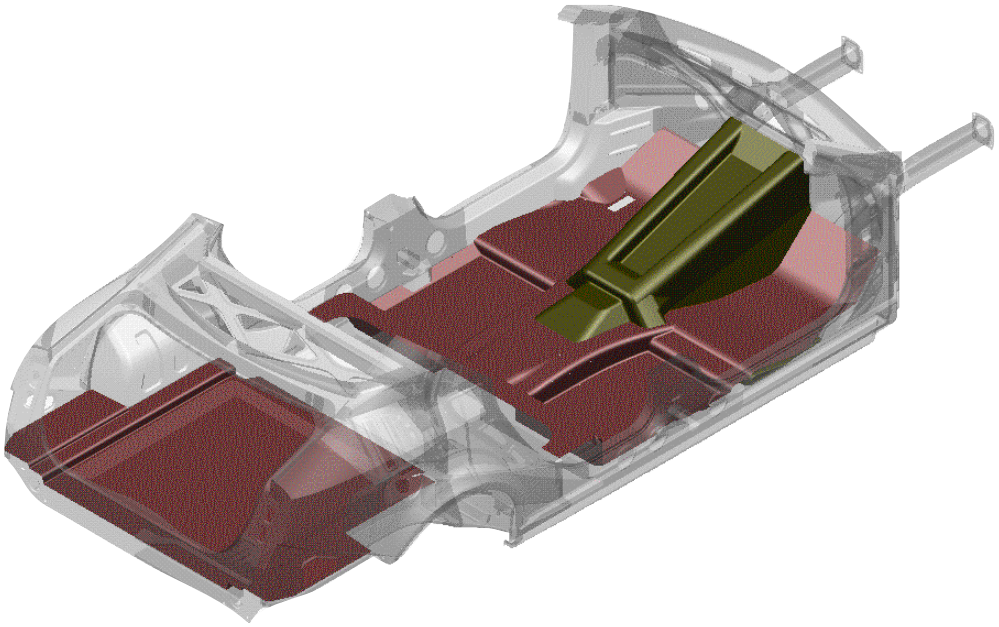


Figure 12.8-2 PNGV-Class carpets

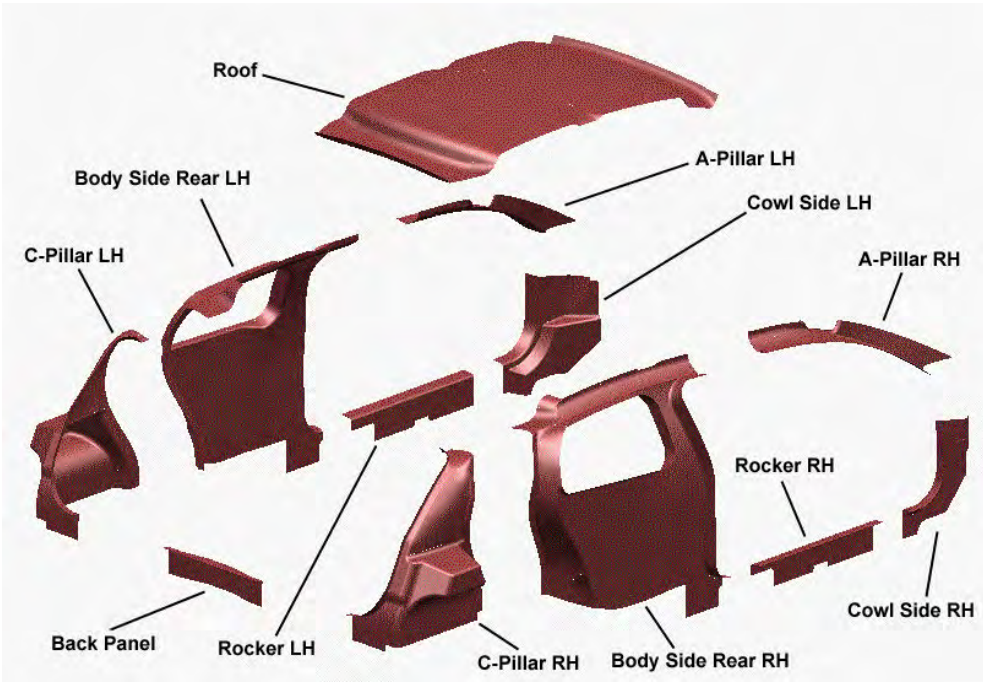


Figure 12.8-3 C-Class interior trim exploded view

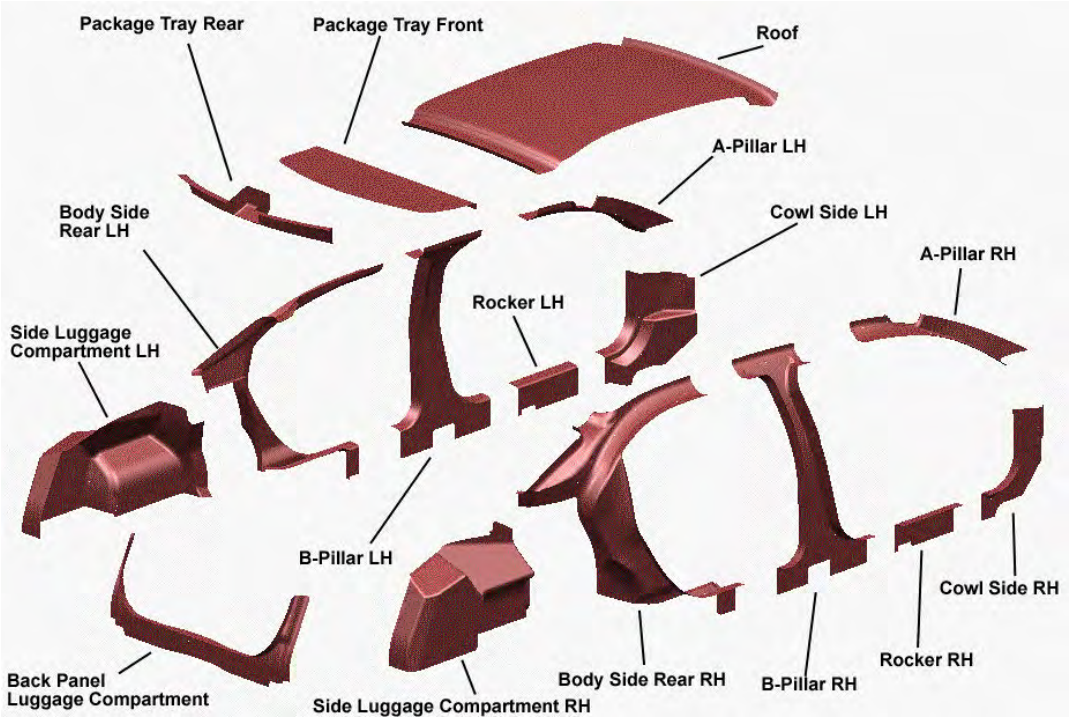


Figure 12.8-4 PNGV-Class interior trim exploded view

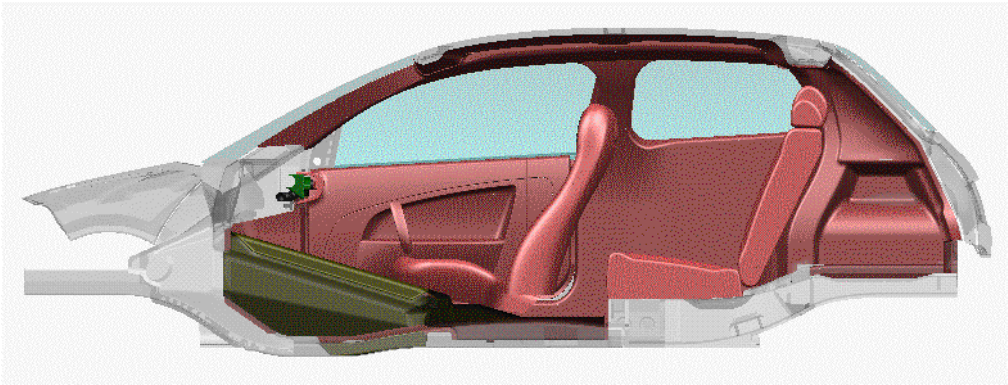


Figure 12.8-5 C-Class interior trim side view

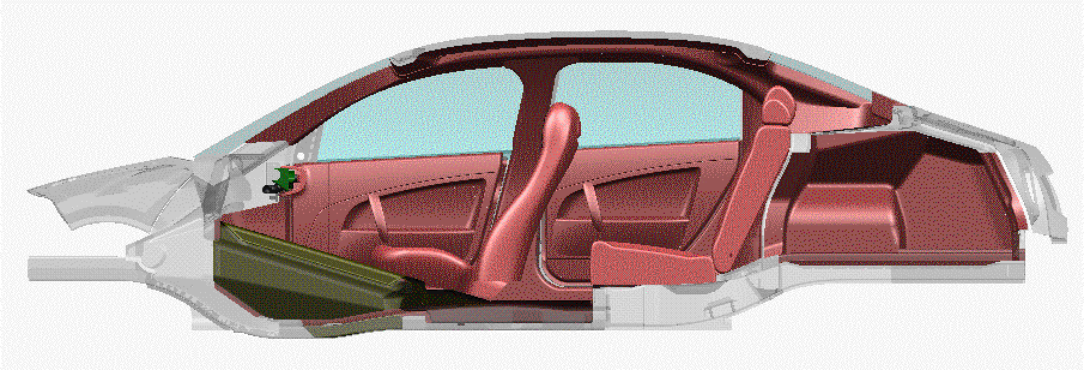


Figure 12.8-6 PNGV-Class interior trim side view

Figure 12.8-7 C-Class door trim

Figure 12.8-8 PNGV-Class door trim

Figure 12.8-9 Instrument panel top view

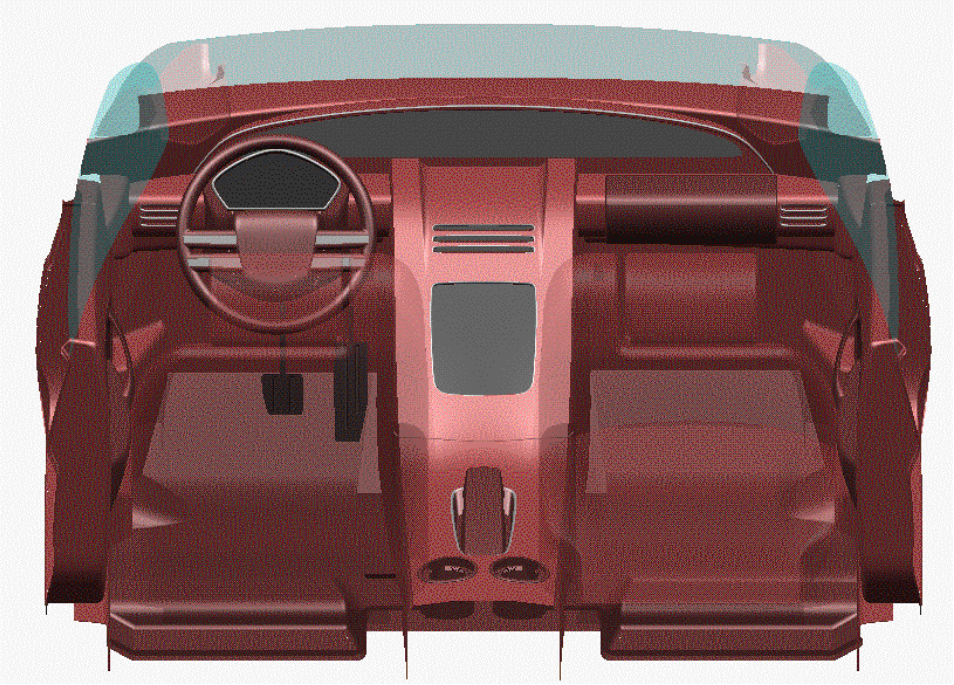


Figure 12.8-10 Instrument panel styling rear view

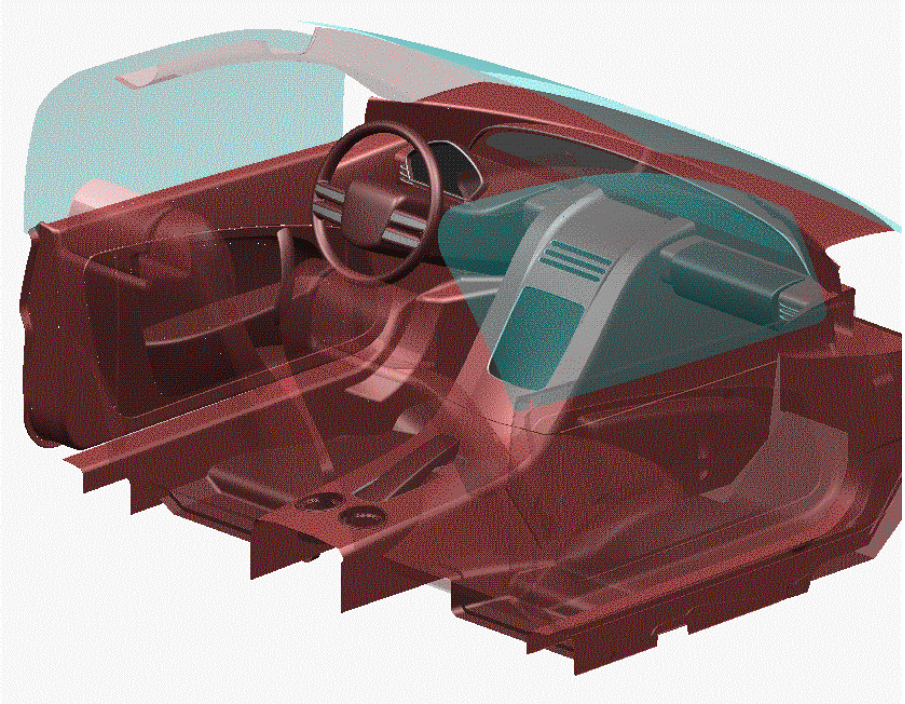


Figure 12.8-11 Instrument panel ISO view

12.9. Glazing

For the side and rear glass, state of the art glass with reduced thickness similar to other low emission production vehicles and prototype vehicles as utilized in ULSAB-AVC.

12.9.1 Glazing C-Class

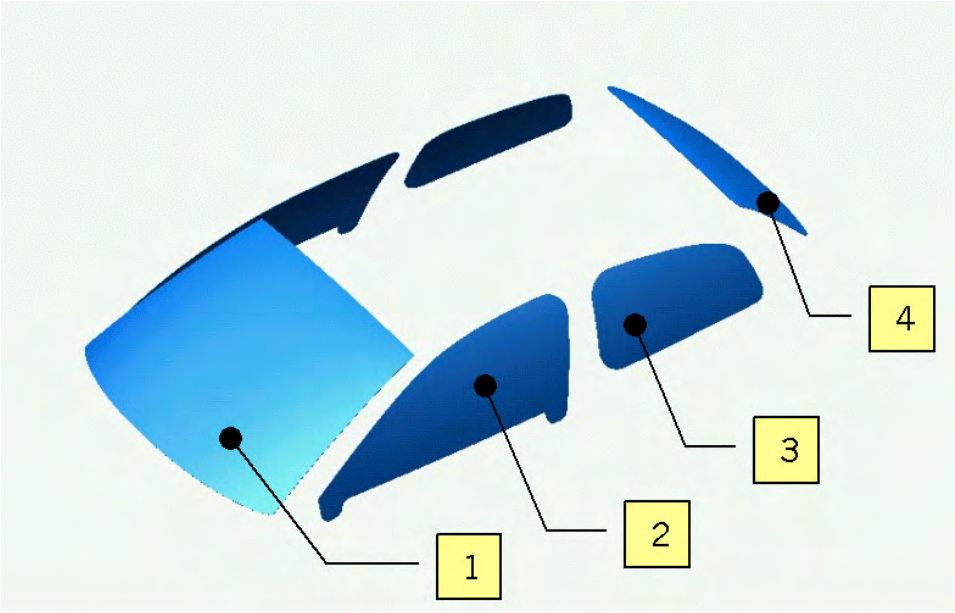


Figure 12.9.1-1 C-Class glazing

Table 12.9.1-1 C-Class glazing mass summary

Component Name	C-Class Results (kg)
Front	9.695
Side 2 Door	10.374
Rear	3.806
Total	**23.875**

12.9.2 Glazing PNGV-Class

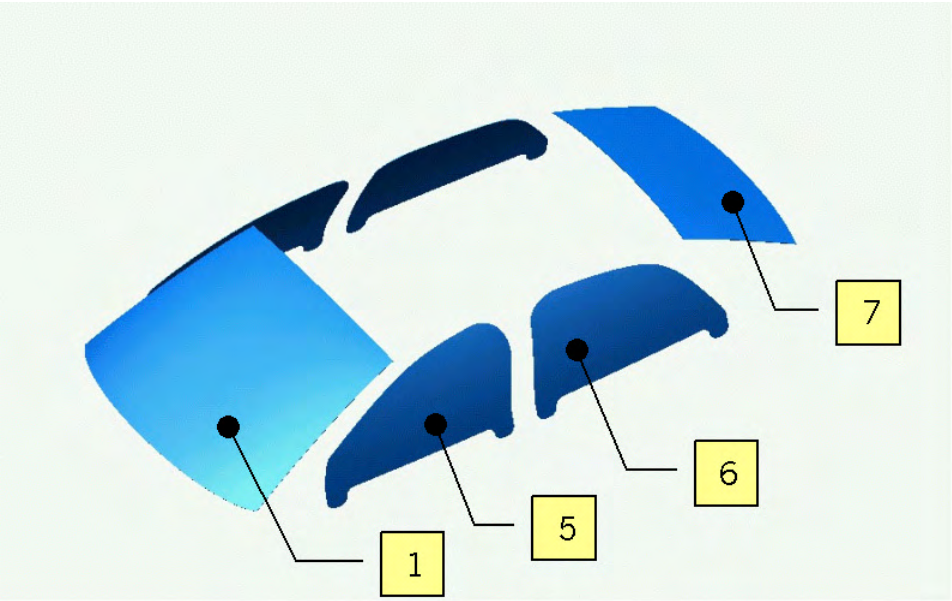


Figure 12.9.2-1 PNGV-Class glazing

Table 12.9.2-1 PNGV-Class glazing mass summary

Component Name	PNGV-Class Results (kg)
Front	9.695
Side 4 Door	11.458
Rear	5.298
Total	**26.451**

12.10. Electrics

Leoni Group Wire-Cable-Wiring Systems in cooperation with PES developed the wiring system concept for ULSAB-AVC.

The following standard equipment was defined for the ULSAB-AVC C-Class vehicle:

- Manual gearbox, automatic clutch
- Air conditioning
- Antilock brake system with electrical parking brake
- Airbags (driver, passenger and side)
- Seat belt tensioner
- Electrical power windows
- Central locking system with radio control
- Anti-theft lock and alarm
- Camera and display replace rear view mirrors
- Radio and mobile phone preparation
- Conventional lighting system (1 rear fog lamp, 1 reverse light)
- Windshield wipers for front and back with washers

Considerations for development of the wiring system on ULSAB-AVC included replacement of conventional wiring with Controller Area Network (CAN) (see Figure 12.10-1), utilization of load free switches, integration of switches into electronic modules, use of smart power switches in control units, placement of control switches near the actuators and diagnostic information using CAN.

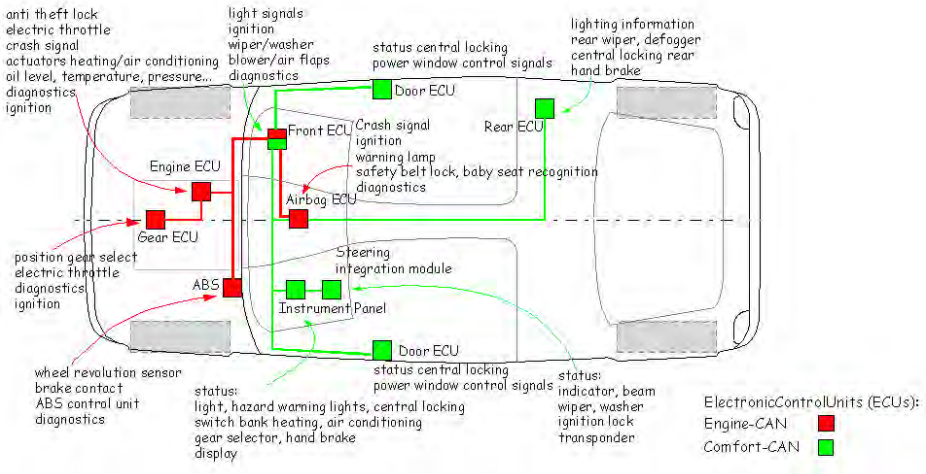


Figure 12.10-1 CAN-bus structure exchange of information

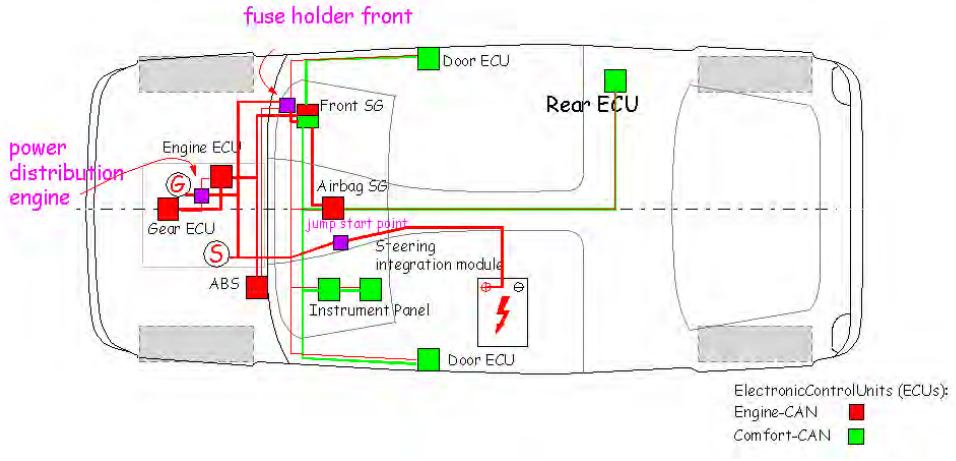


Figure 12.10-2 CAN-bus power distribution concept

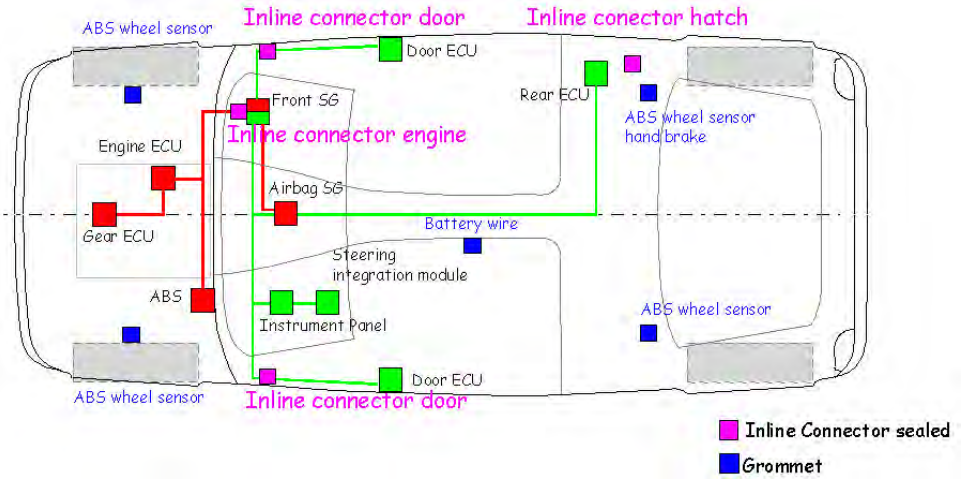


Figure 12.10-3 Inline connectors and grommets

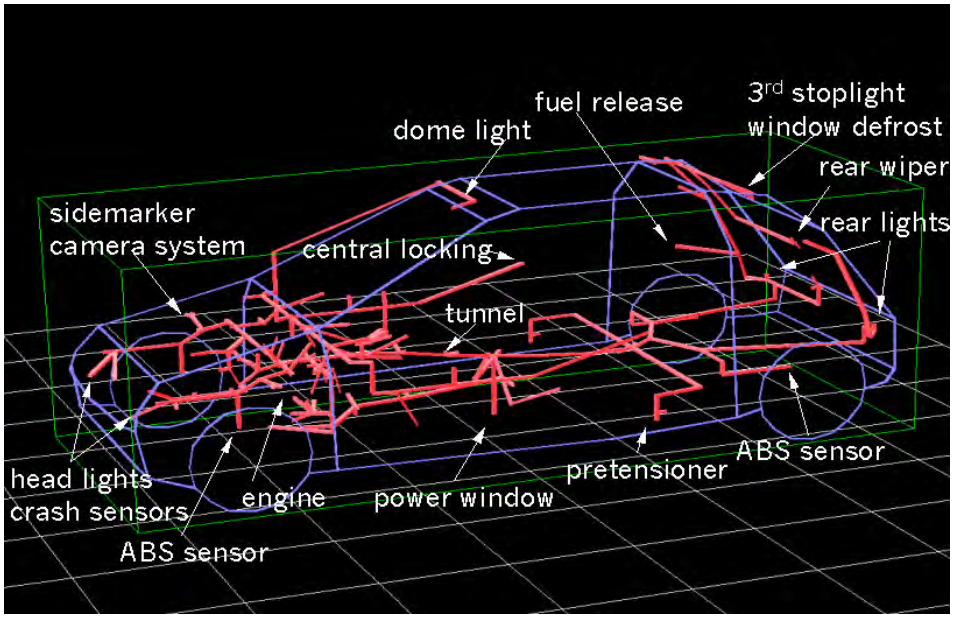


Figure 12.10-4 Dimensional (3D) wire harness structure

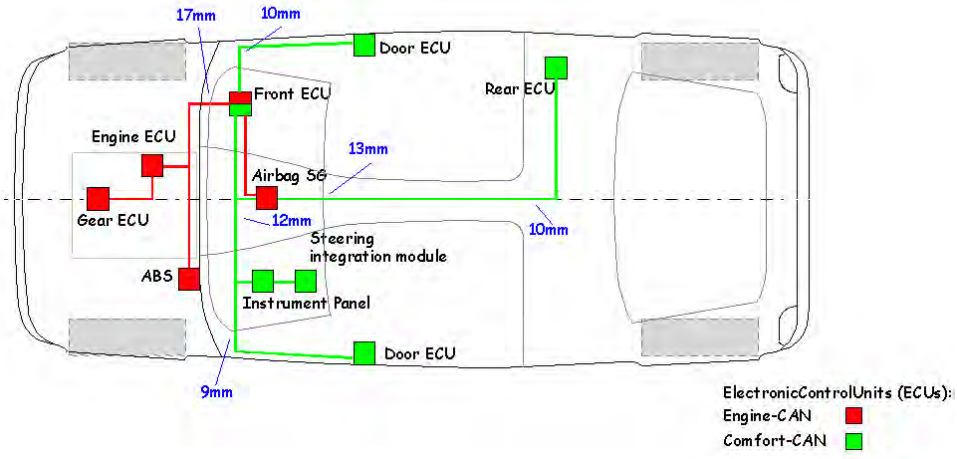


Figure 12.10-5 Bundle diagram

Table 12.10-1 Electrics mass summary

Component Name	Target C-Class (kg)	Target PNGV-Class (kg)	C-Class Results (kg)	PNGV-Class Results (kg)
Windshield Wipers (Front & Rear)	6.0	3.8	6.180	4.370
Lights (Front & Rear)	7.5	7.5	5.200	5.200
Electrics & Cables	13.0	15.0	10.412	11.032
Batteries (36 AH/ILV)	12.3	12.3	12.300	12.300
Radio (2 Speakers & Antenna)	2.9	2.9	2.590	2.590
Total	**41.7**	**41.5**	**36.682**	**35.492**