

16

Program Achievement Summary

The ULSAB-AVC C-Class has achieved a mass reduction of 41.22 kg and the ULSAB-AVC PNGV-Class has achieved a mass reduction of 44.76 kg, compared to the average benchmark body structure mass.

16.1 BODY STRUCTURE

Table 16.1-1 shows that the targets for the design have been achieved.

Table 16.1-1 Body structure targets

Component Name	C-Class		PNGV-Class	
	Target (kg)	Results (kg)	Target (kg)	Results (kg)
Body-in-White	183 (+25)*	201.776	203 (+25)*	218.124

* estimated mass increase to ULSAB body structure due to more severe crash events

The C-Class body structure mass results show that the 25 kg anticipated for the more stringent target request could be offset by 6.3 kg. The PNGV-Class body structure shows that the 25 kg was offset by 10 kg.

In comparison with the C-Class average benchmark body structure mass of 243 kg (see Chapter 2 - Program Targets), the ULSAB-AVC C-Class has achieved a mass reduction of 41.22 kg. In comparison with the PNGV-Class average benchmark body structure mass of 263 kg, the ULSAB-AVC PNGV-Class has achieved a mass reduction of 44.76 kg.

16.2 Closure Structures

16.2.1. PNGV-Class Closures

Table 16.2.1-1 PNGV-Class Closure Structure

Closure Structures PNGV-Class	Target PNGV-Class (kg)	PNGV-Class Results (kg)	Target Normalized Mass (kg)	PNGV-Class Normalized Mass Results (kg)
Doors Front	27.0	19.186	15.5	13.900
Doors Rear	22.0	18.556	15.5	13.060
Hood	16.0	9.534	8.0	7.910
Decklid	10.0	10.270	8.0	7.960
Fenders	4.0	3.216	NA	NA
Total	79.0	60.762		

Table 16.2.1-2 PNGV-Class closure structure assembly parts

Closure Assembly Parts PNGV-Class	Target PNGV-Class (kg)	PNGV-Class Results (kg)
Doors Front	8.0	5.114
Doors Rear	4.0	4.354
Hood	1.0	1.190
Decklid	4.0	2.610
Electric Window Regulator (x4)	8.0	7.640
Total	25.0	20.908

Table 16.2.1-3 PNGV-Class doors assembly parts

Component Name	PNGV-Class Front Doors Results (kg)	PNGV-Class Rear Doors Results (kg)
Check Strap (2x)	0.820	0.820
Hinges Upper & Lower (2x)	1.478	1.478
Latch (2x)	0.740	0.740
Door Outside Handles (2x)	0.940	0.940
Outer Belt Seal (2x)	0.260	0.280
Mirror Flag Seal (2x)	0.280	NA
Boot Harness (2x)	0.080	0.080
Interior Trim Brackets (4)	0.016	0.016
Rearview Camera System, incl. Mirror Flag Patch (2)	0.500	NA
Total	5.114	4.354

Table 16.2.1-4 PNGV-Class hood assembly parts

Closure Assembly Parts	PNGV-Class Results (kg)
Mounting Brackets Rear (Fixed Hood)	0.680
Latches	0.470
Spray Nozzels	0.040
Total	1.190

Table 16.2.1-5 PNGV-Class decklid assembly parts

Decklid Assembly Parts	PNGV-Class Results (kg)
Hinges	1.100
Gas Struts & Attachment	0.700
Latch & Striker	0.520
Handle, incl. License Plate Lights	0.250
Misc. Bolts & Clips	0.040
Total	2.610

Table 16.2.1-6 PNGV-Class Closure Summary

	Target PNGV-Class (kg)	PNGV-Class Results (kg)
Structure Closures	79.0	60.762
Assembly Parts	25.0	20.908
Total	104.0	81.670

16.2.2. C-Class Closures

Table 16.2.2-1 C-Class closure structure

Closure Structure C-Class	Target C-Class (kg)	C-Class Results (kg)	Target C-Class Normalized Mass (kg)	C-Class Normalized Mass Results (kg)
Doors Front	26.0	21.592	15.50	13.328
Hood	16.0	9.534	8.00	7.910
Liftgate	10.0	8.564	14.00	11.180
Fenders	4.0	3.216	NA	NA
Total	56.0	42.906		

Table 16.2.2-2 C-Class closure assembly parts

Closure Assembly Parts	Target C-Class (kg)	C-Class Results (kg)
Doors Front	8.0	5.134
Hood	1.0	1.190
Liftgate	2.5	2.150
Electric Window Regulator	4.0	3.820
Total	15.5	12.294

Table 16.2.2-3 C-Class front doors (carry over parts ULSAC)

Component Name	Target C-Class Front Doors Assembly Parts (kg)	C-Class Front Doors Assembly Parts Results (kg)
Check Strap (2x)	NA	0.820
Hinges Upper & Lower (2x)	NA	1.478
Latch (2x)	NA	0.740
Door Outside Handles (2x)	NA	0.940
Outer Belt Seal (2x)	NA	0.280
Mirror Flag Seal (2x)	NA	0.280
Boot Harness (2x)	NA	0.080
Interior Trim Brackets (4)	NA	0.016
Rearview Camera System, incl. Mirror Flag Patch (2)	NA	0.500
Total	8.000	5.134

Table 16.2.4-4 C-Class liftgate assembly parts

Component Name	Target C-Class Liftgate Assembly Parts (kg)	C-Class Liftgate Assembly Parts Results (kg)
Hinge (2x), incl. 4 Bolts	NA	0.640
Latch & Striker	NA	0.520
Gas Struts & Attachments (2x)	NA	0.700
Handle, incl. License Plate Lights	NA	0.250
Misc. Bolts & Nuts	NA	0.040
Total	2.500	2.150

Table 16.2.4-5 C-Class closure summary

	Target C-Class (kg)	C-Class Results (kg)
Structure Closures	56.0	42.906
Assembly Parts	15.5	12.294
Total	71.5	55.200


16.3. Glazing

Table 16.3-1 Glazing

Component Name	Target C-Class (kg)	Target PNGV-Class (kg)	C-Class Results (kg)	PNGV-Class Results (kg)
Front	12.3	12.3	9.695	9.695
Side 2 Door	15.0	NA	10.374	NA
Side 4 Door	NA	14.7	NA	11.458
Rear	4.8	5.8	3.806	5.298
Total	32.1	32.8	23.875	26.451

16.4. Chassis / Suspension

Table 16.4-1 Chassis / Suspension Mass

Component Name	Target C-Class and PNGV-Class (kg)	C-Class and PNGV-Class Results (kg)	Remarks
Front Suspension incl.. Subframe	50.0	44.236	
Rear Suspension incl. Subframe	42.0	25.761	
Pedals		6.720	Adjustable pedal system
Main Brake Cylinder	5.7	NA	
Parking Brake		2.113	
Gear Shift		NA	
Wheels (4)	20.0	16.208	Wheel size 5x14 including bolts 
Tires (4)	26.2	26.000	175/65 R14
Steering incl. Power System	16.0	23.150	
Brake System hydraulic/ABS	8.5	36.865	electrohydraulic brake system w/ steel disc brakes
Front Brake System	15.5		
Rear Brake System	14.5		
Tire fit kit		1.000	Replacement for spare wheel tire
Total *	198.5	182.053	

* Total mass does not include drive shafts

16.5. Engine

Table 16.5-1 Engine

Component Name	Target C-Class (kg)	Target PNGV-Class (kg)	C-Class		PNGV-Class	
			Diesel Results (kg)	Gasoline Results (kg)	Diesel Results (kg)	Gasoline Results (kg)
Engine Gasoline	100.0	100.0	113	83	113	83
Engine Diesel	135.00	(135.0)				
Cooling System	8.0	8.0	7.315	6.115	7.315	6.115
Fuel Pump	2.6	2.6	0.815	0.815	0.815	0.815
Fuel Tank incl. Filler	10.0	10.0	5.426	5.426	5.426	5.426
Fuel System incl. Fuel lines and Air Filter	3.5	3.5	4.035	4.035	4.035	4.035
Exhaust System incl. Catalytic Converter	15.0	16.0				
Exhaust System Diesel	20.0	21.0	10.910	13.310	12.510	14.910
Active Carbon Filter	0.75	0.8	0.700	0.700	0.700	0.700
Heat Shield Exhaust System	2.5	2.5	3.500	3.500	3.500	3.500
Dry Sump Oil Tank incl. Hoses	NA	NA	1.750	1.750	1.750	1.750
Engine Electrical Control Unit	1.0	1.0	0.850	0.850	0.850	0.850
Engine Mounts	NA	NA	2.595	2.595	2.595	2.595
Total Gasoline	143.5	144.5		122.096		123.696
Total Diesel	183.5	184.5	150.896		152.496	

16.6. Transmission

Table 16.6-1 Transmission

Component Name	Target C-Class and PNGV-Class (kg)	C-Class		PNGV-Class	
		Diesel Results (kg)	Gasoline Results (kg)	Diesel Results (kg)	Gasoline Results (kg)
Transmission incl. Electrical Actuator	40.00	36.000	36.000	36.000	36.000
Drive Shafts	10.00	8.064	7.064	8.064	7.064
Total	50.00	44.064	43.064	44.064	43.064

16.7. Interior

Table 16.7-1 Interior

Component Name	Target C-Class (kg)	Target PNGV-Class (kg)	C-Class		PNGV-Class	
			Diesel Results (kg)	Gasoline Results (kg)	Diesel Results (kg)	Gasoline Results (kg)
Carpets Instrument Panel Restraint system Interior Panels	65.0	73.0	64.825	64.825	72.175	72.175
Seat system F & R	63.0	69.0	47.260	47.260	47.260	47.260
Heating & Ventilation	14.0	14.0	9.160	9.160	9.160	9.160
Sound Damping	16.6	20.0	19.180	19.180	19.740	19.740
Air Conditioning	16.2	16.2	12.080	12.080	12.080	12.080
Total	174.8	192.2	152.505	152.505	160.415	160.415

16.8. Exterior

Table 16.8-1 Exterior

Exterior	Target C-Class (kg)	Target PNGV-Class (kg)	C-Class		PNGV-Class	
			Diesel Results (kg)	Gasoline Results (kg)	Diesel Results (kg)	Gasoline Results (kg)
Applique Side Roof Rails	NA	NA	2.580	2.580	2.860	2.860
Applique B-pillar with seal	NA	NA	1.500	1.500	1.500	1.500
Fuel Filler lid with hinge	NA	NA	0.130	0.130	0.130	0.130
Total	4.5	6.5	4.210	4.210	4.490	4.490

16.9. Electrics

Table 16.9-1 Electrics

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

16.10. Automotive Fluids

Table 16.10-1 Automotive fluids

Component Name	Target C-Class (kg)	Target PNGV-Class (kg)	C-Class Results (kg)	PNGV-Class Results (kg)
Oil	5.0	5.0	5.0	5.0
Cooling Water	5.0	5.0	5.0	5.0
36 L Gasoline*	27.0	27.0	27.0	27.0
36 L Diesel*	30.0	30.0	30.0	30.0
Gear Oil	2.5	2.5	1.4	1.4
Washing Water	1.5	1.5	1.5	1.5
Total Gasoline	41.0	41.0	39.9	39.9
Total Diesel	44.0	44.0	42.9	42.9

Specific average mass of gasoline = 0.75 kg/L Specific average mass of Diesel = 0.84 kg/L

16.11. Other Concept Related Components

Table 16.11-1 Other concept related components

Other Concept Related Components	C-Class		PNGV-Class	
	Diesel Results (kg)	Gasoline Results (kg)	Diesel Results (kg)	Gasoline Results (kg)
Front End Module	20.087	19.587	20.087	19.587
Engine cover with service box	9.524	9.524	9.524	9.524
Service lid with hinge and lock	0.548	0.548	0.548	0.548
Wheelhouse covers rear	1.100	1.100	1.100	1.100
Bumper with fascia rear	9.853	9.853	11.479	11.479
Total	41.112	40.612	42.738	42.238

16.12. Main Component Summary

Table 16.12-1 Main Component Summary

Component Name	Target C-Class		C-Class Results		Target PNGV-Class		PNGV-Class Results	
	Diesel (kg)	Gasoline (kg)	Diesel (kg)	Gasoline (kg)	Diesel (kg)	Gasoline (kg)	Diesel (kg)	Gasoline (kg)
Body Structure		183 (+25)	201.776	201.776		203 (+25)	218.124	218.124
Closures Structure incl. Fenders		71.5	55.200	55.200		104.0	81.670	81.670
Glazing		32.1	23.875	23.875		32.8	26.451	26.451
Chassis		198.5	182.053	182.053		198.5	182.053	182.053
Engine incl. mounting brackets and bearings	183.5	143.5	150.896	122.096	184.5	144.5	152.496	123.696
Gear Box		50.0	44.064	43.064		50.0	44.064	43.064
Interior		173.0	152.505	152.505		192.0	160.415	160.415
Exterior		4.5	4.200	4.200		6.5	4.490	4.490
Electrics		41.7	36.682	36.682		41.5	35.492	35.492
Automotive Fluid	44.0	41.0	42.900	39.900	44.0	41.0	42.900	39.900
Other Concept Related	NA	NA	41.112	40.612	NA	NA	42.738	42.238
Paint		16.0	16.000	16.000		20.0	20.000	20.000
Brackets and Undercover, aerodynamic devices			15.00	15.00			20.00	20.00
Total	998 (+25)*	955 (+25)*	966.263	932.963	1077 (+25)*	1034 (+25)*	1030.893	997.593

* estimated mass increase to ULSAB body structure due to more severe crash events

16.13. Vehicle Dimensions

Table 16.13-1 Vehicle Dimensions

ECIE Index	SAE Index	Exterior	C-Class Target	PNGV-Class Target	C-Class Result	PNGV-Class Result
L103	L103	Overall Length [mm]	4100 +100	4750	4179	4744
W103	W103	Overall Width [mm]	1750 +50	1822 +50	1766	1765
H100	H100	Overall Height [mm]	1400 +50	1374	1455	1455
W101	W101	Track - Front [mm]	1530 +20	1529 +20	1540	1540
W102	W102	Track - Rear [mm]	1530 +20	1529 +20	1540	1540
L101	L101	Wheelbase [mm]	TBD	> 2743	2950	3035
--	--	Frontal Area [m2]	< 2.0	<2.0	2.02	2.02
W3	W3	Shoulder Room Front [mm]	1402	1402	1448	1448
W4	W4	Shoulder Room Rear [mm]	>1350	1389	1402	1402
--	--	Interior Volume [m3]	> VW Golf IV	2.7	> VW Golf	NA
--	--	Luggage Compartment Volume [m3]	> VW Golf IV	0.44	2.98/1186	0.57
		Passenger Capacity	5	5	5	5
		Turning Circle	<11	TBD	10.7	10.9