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Mercedes-Benz

GTR head restraints
Backset measuring method
Analyses of H-point and R-point method

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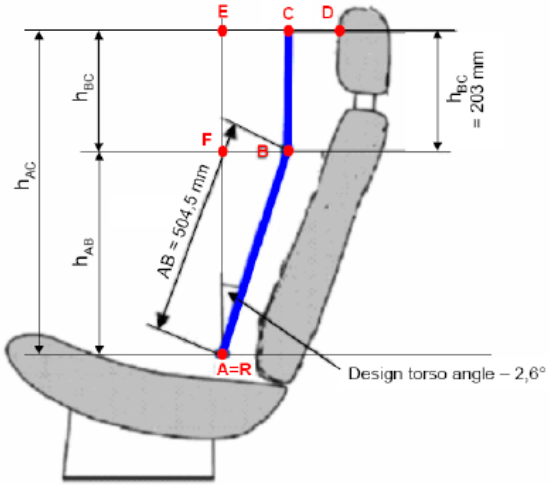
Backset measuring methods

H-point method

- Seat in design position
- Use of SAE 3D-manikin and head restraint measuring device (HRMD), positioned in H-point
- Measuring of backset value with HRMD scale

R-point method

- Seat in design position
- Use of straight edges, representing geometry of 3D-manikin and HRMD (can be replaced by calculation) and positioned in R-point
- Measuring of backset value with straight edged (can be replaced by calculation)



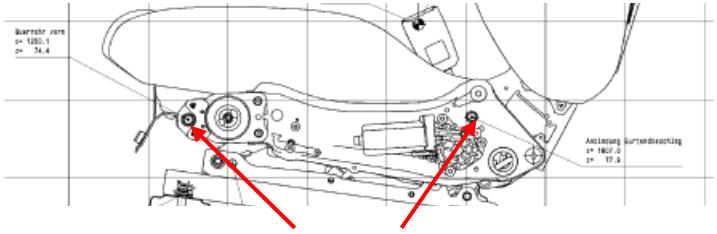
Seats used for measurements

C-Class driver seats in standard version

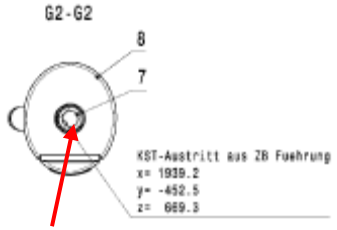
- mechanical fore/aft and head restraint height adjustment, crash active head restraint
- el. powered seat height, seat back and cushion angular adjustment
- lumber support (in rearmost position)
- fabric upholstery
- 10 identical, new and un-used seats from one production batch

Seat adjustment

- seat adjustment in design position, according to manufacturer‘s data
- adjustment of reference points on seat structure (seat base and seat back) according to CAD coordinates



reference points on seat base
for fore/aft, inclination adjustment



reference point on head rest rod
for seat back adjustment

Procedure of measurements

Seat 1:

1. Adjustment of seat in design position (manufacturer data of reference points, ECE method)
2. Person A: Measuring of H-point, torso angle and backset with 3D-manikin and HRMD
3. Measuring of point D at head restraint (X coorinate for R-point backset method)
4. Person B: Measuring of H-point, torso angle and backset with 3D-manikin an HRMD
5. Seat back re-adjustment to 25° design torso angle, measured with 3D-manikin
6. Person A: Measuring of H-point and backset with 3D-manikin and HRMD

Seat 2:

1. Adjustment of seat in ...
2. ...

Seat ...

(sequence of persons changed some times to prevent sequence influences in statistics)

Results: Measurement data

seat No.	measured by person	design data R-point [mm]			Torso [°]	Backset [mm]	measurements H-point method** H-point [mm]			deviation desired - actual [mm]			Torso [°]*	deviation des-act [°]	Backset (HRMD) [mm]	difference des-act [mm]	measurements R-point method measuring height of point D (absolute)**	Backset coordinate (X) [mm]	Results Backset (R-point)	deviation R-/H-point method
		X	Y	Z			X	Y	Z	X	Y	Z					(calculated)	(measured)	(calculated)	(calculated)
1	A	1540	370	196	25	55	1531,99	373,18	205,38	8,01	-3,18	-9,38	24,0	1,0	55,0	0,0	861,92	1845,71	34,1	-20,9
	B	1540	370	196	25	55	1532,83	372,69	203,15	7,17	-2,69	-7,15	23,5	1,5	56,5	-1,5	861,92			
	X	1540	370	196	25	55	1531,00	372,46	203,15	9	-2,46	-7,15	25,0	0,0	58,0	-3,0	861,92			
2	A	1540	370	196	25	55	1533,79	373,92	202,91	6,21	-3,92	-6,91	23,5	1,5	53,0	2,0	861,92	1848,29	36,7	-16,3
	B	1540	370	196	25	55	1533,70	373,02	201,59	6,3	-3,02	-5,59	23,0	2,0	54,0	1,0	861,92			
	X	1540	370	196	25	55	1531,40	372,94	202,20	8,6	-2,94	-6,2	25,0	0,0	59,0	-4,0	861,92			
3	A	1540	370	196	25	55	1532,04	370,67	199,30	7,96	-0,67	-3,3	23,0	2,0	56,5	-1,5	861,92	1850,17	38,6	-17,9
	B	1540	370	196	25	55	1535,64	372,36	199,05	4,36	-2,36	-3,05	23,5	1,5	53,5	1,5	861,92			
	X	1540	370	196	25	55	1533,50	372,43	199,47	6,5	-2,43	-3,47	25,0	0,0	60,0	-5,0	861,92			
4	A	1540	370	196	25	55	1534,65	374,33	201,45	5,35	-4,33	-5,45	23,5	1,5	56,0	-1,0	861,92	1850,17	38,6	-17,4
	B	1540	370	196	25	55	1539,35	378,52	200,49	0,65	-8,52	-4,49	23,0	2,0	56,0	-1,0	861,92			
	X	1540	370	196	25	55	1537,95	378,42	200,67	2,05	-8,42	-4,67	25,0	0,0	64,0	-9,0	861,92			
5	A	1540	370	196	25	55	1537,36	374,51	202,84	2,64	-4,51	-6,84	23,5	1,5	51,5	3,5	861,92	1847,02	35,5	-16,0
	B	1540	370	196	25	55	1534,85	374,24	201,89	5,15	-4,24	-5,89	23,0	2,0	53,0	2,0	861,92			
	X	1540	370	196	25	55	1534,16	373,97	201,91	5,84	-3,97	-5,91	25,0	0,0	61,0	-6,0	861,92			
6	A	1540	370	196	25	55	1533,34	370,78	199,36	6,66	-0,78	-3,36	23,0	2,0	55,5	-0,5	861,92	1849,66	38,1	-17,4
	B	1540	370	196	25	55	1537,14	373,30	199,15	2,86	-3,3	-3,15	22,5	2,5	56,0	-1,0	861,92			
	X	1540	370	196	25	55	1535,23	373,09	199,19	4,77	-3,09	-3,19	25,0	0,0	62,5	-7,5	861,92			
7	A	1540	370	196	25	55	1534,53	373,39	201,41	5,47	-3,39	-5,41	23,0	2,0	57,5	-2,5	861,92	1850,03	38,5	-19,0
	B	1540	370	196	25	55	1537,18	373,25	199,25	2,82	-3,25	-3,25	22,5	2,5	57,5	-2,5	861,92			
	X	1540	370	196	25	55	1536,31	373,40	199,76	3,69	-3,4	-3,76	25,0	0,0	67,5	-12,5	861,92			
8	A	1540	370	196	25	55	1535,04	372,43	201,54	4,96	-2,43	-5,54	23,5	1,5	54,0	1,0	861,92	1849,33	37,8	-16,2
	B	1540	370	196	25	55	1532,99	372,76	204,46	7,01	-2,76	-8,46	23,5	1,5	52,0	3,0	861,92			
	X	1540	370	196	25	55	1534,07	372,46	201,78	5,93	-2,46	-5,78	25,0	0,0	61,0	-6,0	861,92			
9	A	1540	370	196	25	55	1540,52	374,12	200,53	-0,52	-4,12	-4,53	23,0	2,0	57,2	-2,2	861,92	1850,22	38,7	-18,5
	B	1540	370	196	25	55	1537,97	373,49	201,74	2,03	-3,49	-5,74	23,0	2,0	56,5	-1,5	861,92			
	X	1540	370	196	25	55	1539,57	374,21	200,74	0,43	-4,21	-4,74	25,0	0,0	68,5	-13,5	861,92			
10	A	1540	370	196	25	55	1537,64	372,25	200,11	2,36	-2,25	-4,11	23,0	2,0	57,0	-2,0	861,92	1850,00	38,4	-18,6
	B	1540	370	196	25	55	1537,38	372,23	200,46	2,62	-2,23	-4,46	22,5	2,5	56,5	-1,5	861,92			
	X	1540	370	196	25	55	1536,27	372,37	200,14	3,73	-2,37	-4,14	25,0	0,0	63,0	-8,0	861,92			

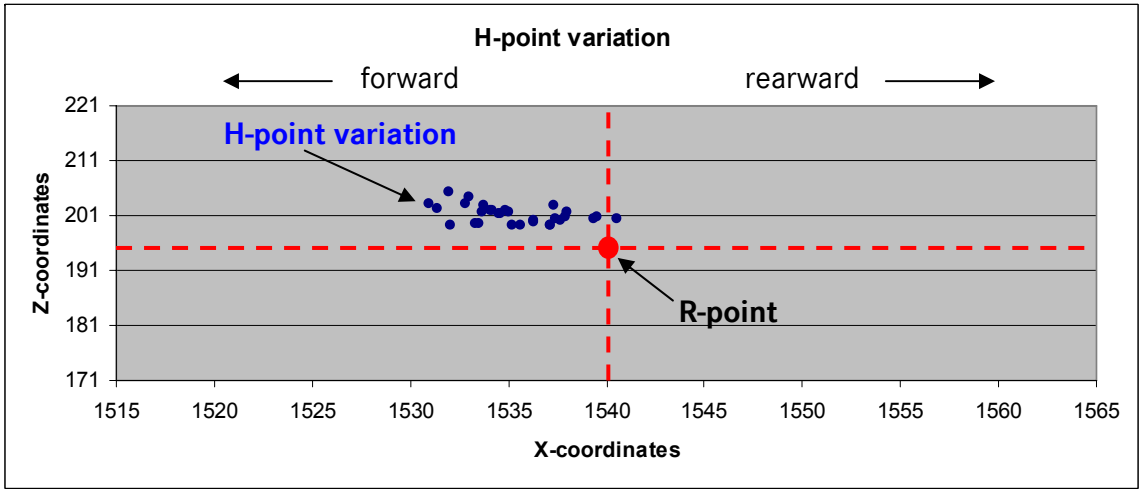
* measured torso angle, which results from seat adjustement according to manufactureres data (design position, ECE R17 method)
for "person X" the torso angle was adjusted to 25° according to the angle measurement of the 3D manikin
** real contact point from HRMD-scale at head restraint is at a height of 839 mm (difference comes from missing head form for R-point method)

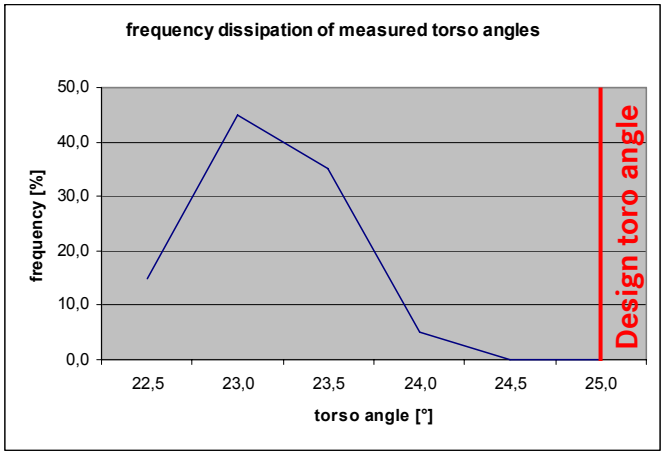
Measurements conducted by	Person A	A. Karyotis	sequence for seat 1-7: first person A, then B
	Person B	P. Horn	sequence for seat 8-10: first person B, then A
	Measurement X	Measurement with torso angle re-adjusted to 25°, as indicated by the 3D-manikin	

Results: Analysis of data

H-point variation

All measured H-points are located in a quadrant „more forward“ and „higher“ (variation of upholstery without influence on head restraint position!).
This results in higher backset values, measured with HRMD-head.





Torso angle variation

All measured torso angles where steeper than the design torso angle (25°), most seats (45%) had a torso angle of 23°.
Seat back structure (including head restraint) was adjusted to design position. Variation of upholstery leads to steeper torso angles (without influence to the head restraint position!), measured with 3D-manikin.
This results in higher backset values, measured with HRMD-head

Correlation H-point and backset

Seat adjustment according to manufacturers data means:

- Adjustment of seat structure (base and seat back) by reference points on seat structure
- Head restraint is fixed to seat back structure

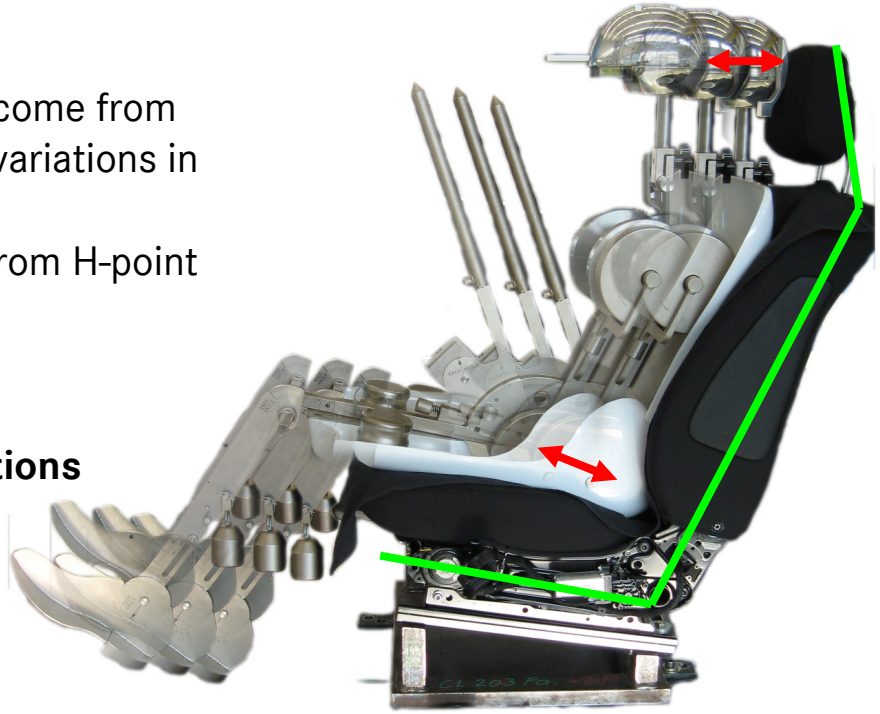
Conclusions:

- Tolerances in H-point (and torso angle) come from tolerances in seat upholstery and from variations in 3D-manikins / HRMDs
- Head restraint position is independent from H-point tolerances (because fixed to structure)

=> Backset is depending on H-point (and torso angle) tolerances / variations

Seat structure is basis of adjustment

Backset depending on H-point variation

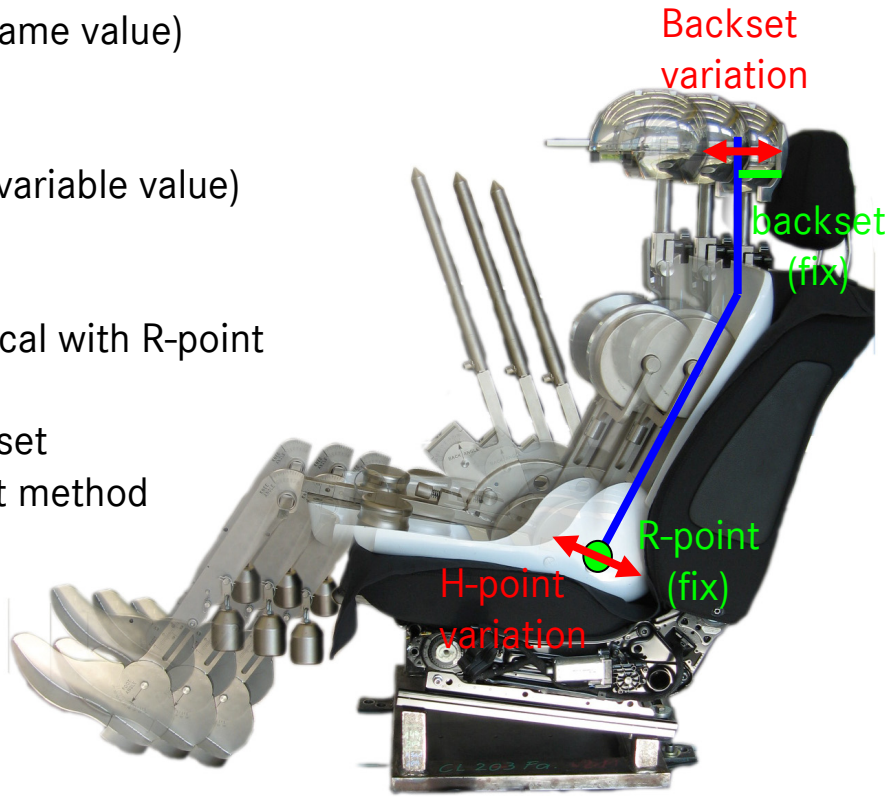


Correlation H-/R-point, backset and measuring methods

R-point method:
- straight edges based on R-point, results in backset value independent of H-point tolerances (always same value)

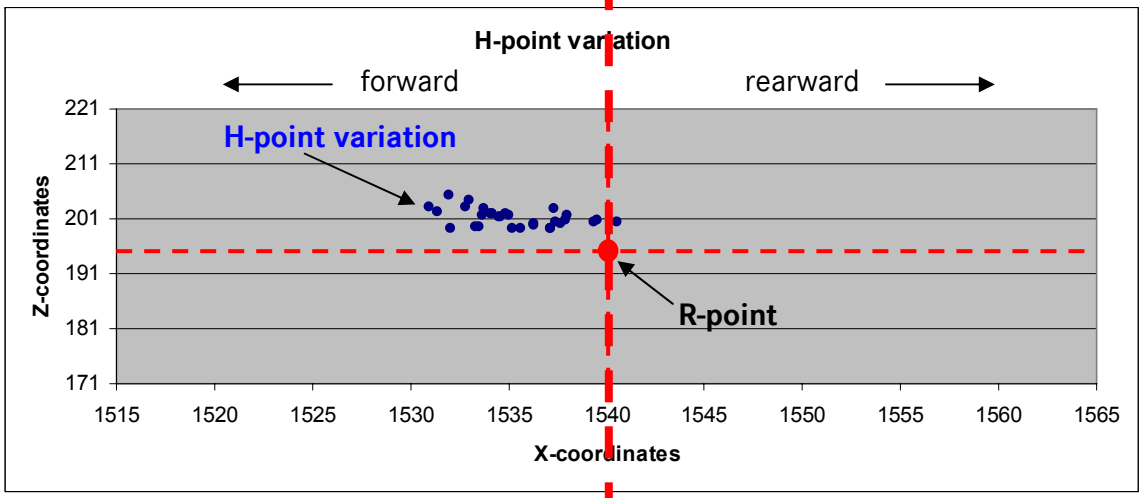
H-point method:
- backset value depends on H-point location (variable value)

Correlation H-point / R-point method:
- Identical backset values when H-point identical with R-point (by geometrical definition)
- H-point in front of R-point will increase backset value for H-point method, but not for R-point method (see measurements before)
- H-point behind R-point will decrease backset value for H-point method, but not for R-point method



Correlation measuring methods

Seats with H-point in front of R-point show lower backset values for R-point method



Seats with H-point behind R-point will show higher backset values for R-point method

Conclusions* (1)

Determined measurement results ...
... showed smaller backset values for R-point method compared to H-point method
... showed a single-sided dissipation of H-points (more forward and higher as R-point)

Variation in H-point location ...
... directly effects backset values for H-point method
... does not influence backset values for R-point method

Backset values of H-point method ...
... are higher than R-point values, if H-point is more forward than R-point
... are equal with R-point values, if H-point is identical with R-point (by definition)
... are smaller than R-point values, if H-point is more rearward than R-point

=> Backset limit should be the same for both methods (H-/R-point method)

** Note: Measurements conducted by other manufacturers / suppliers (BMW, Hyundai, VW, Faurecia, Johnson Controls) confirm the above analysis.*

Conclusions (2)

Repeatability of HRMD:

- The apparently acceptable repeatabilty of the HRMD measurement method is due to the fact that all measurements were conducted in the same lab and with the same 3D manikin / HRMD.
- Measurements conducted with different manikins /HRMDs could not be conducted but are expected to show a much higher variation.

=> Backset measuring method with R-point to be preferred