Black building profiles according to DIN 7863 and RAL-GZ 716/1
Alternatives to carbon black: Aktisil VM 56

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Status Quo

- Typical formulations for black window sections and glazing profiles are based on EPDM, carbon black and paraffinic mineral oil. This means the major part of the raw materials is petroleum based.

- According to the crude oil price, the raw material prices are subject to considerable variations. The long term trend is clearly pointing upwards.

- The price of mineral fillers is only marginally affected by the crude oil price; over the long term there will be a slight increase, and this without big variations.

Status Quo

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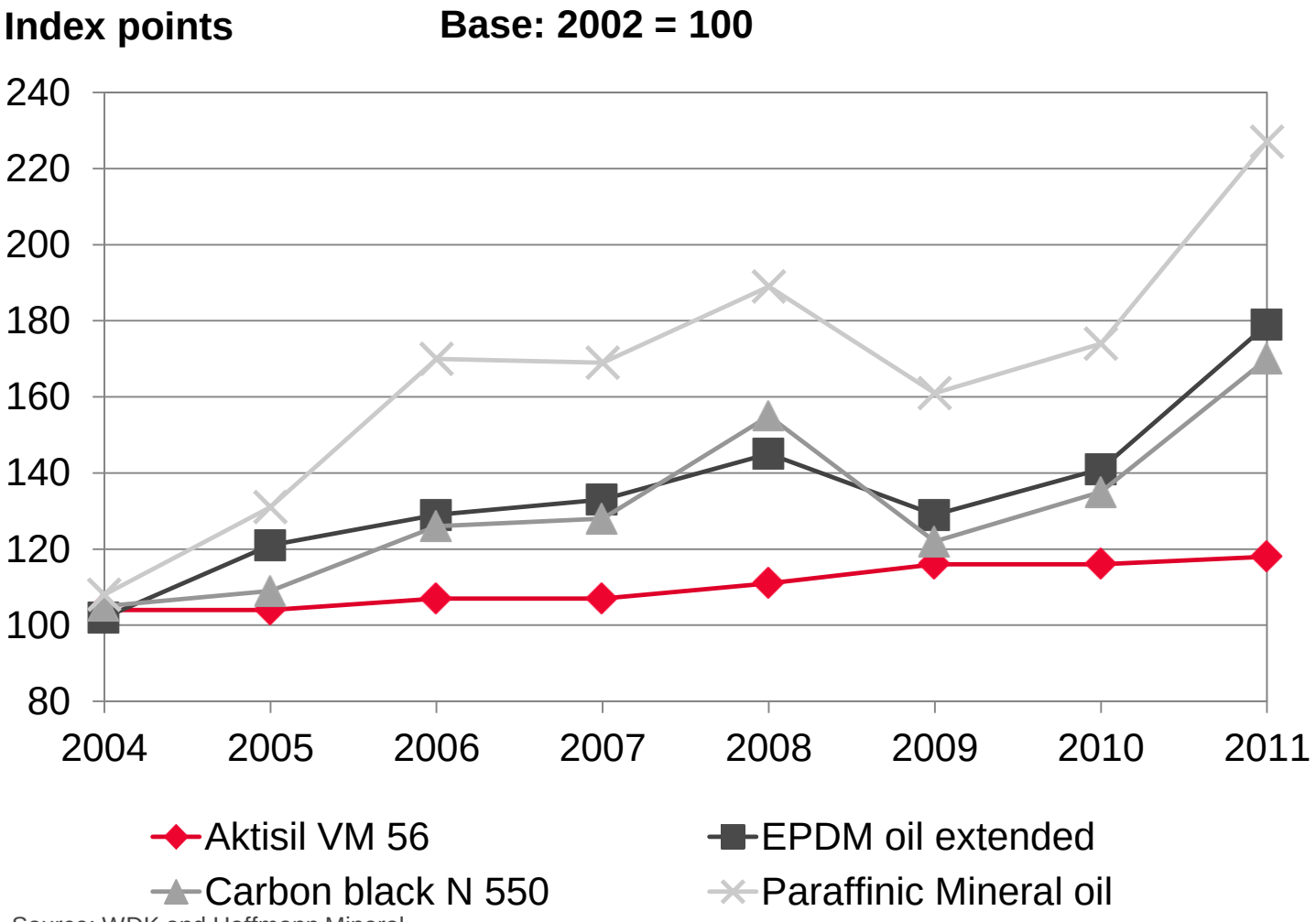
Cost development – Yearly averages



Source: WDK and Hoffmann Mineral

Costs – Carbon black / Plasticizer loading

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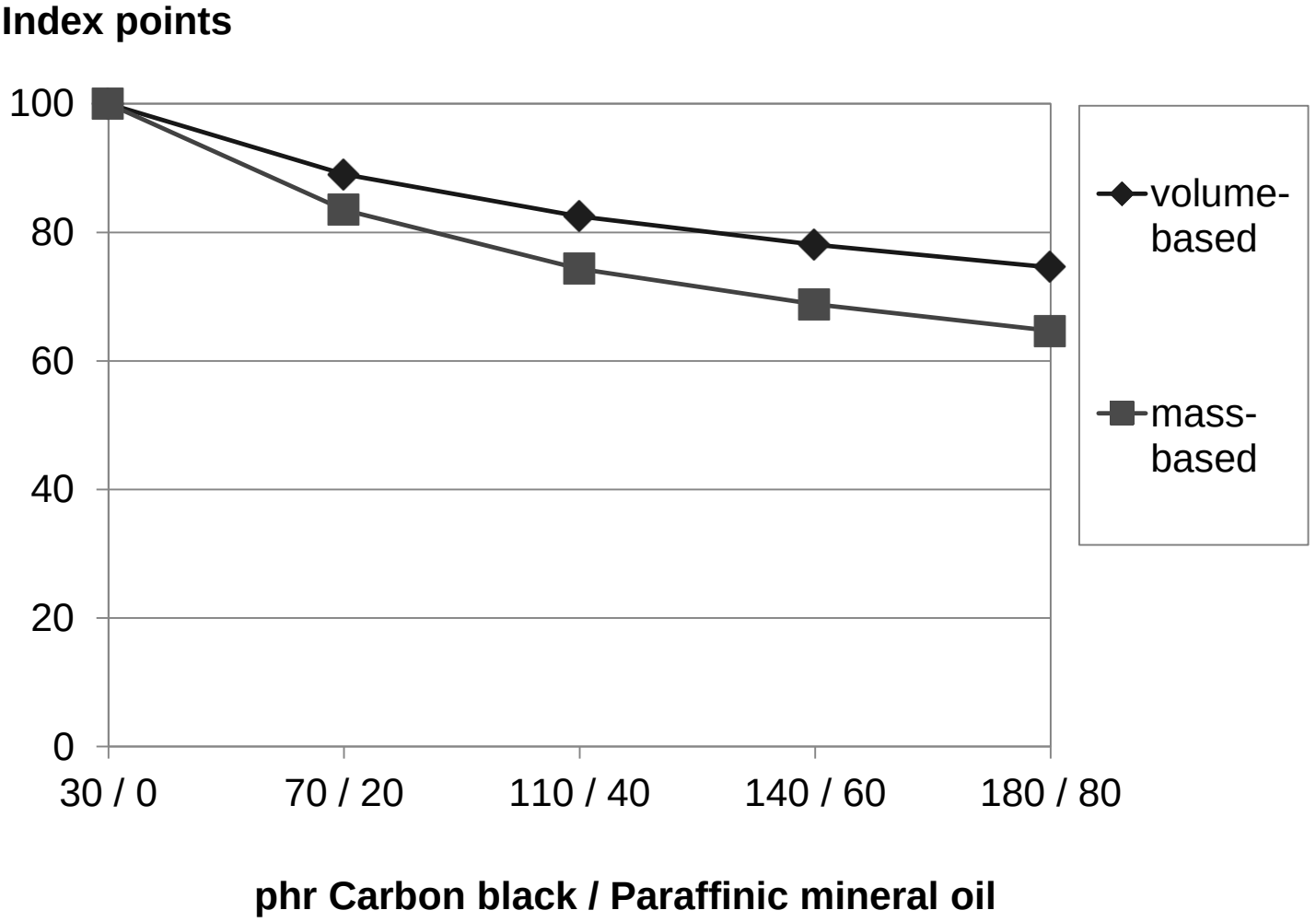
Equivalent hardness about 65 Shore A



Objective

- To demonstrate an alternative formulation approach in order to reduce the petroleum based raw materials.
- As a cost optimized starting point, a formulation with a carbon black / plasticizer loading of 180 / 80 phr was selected.
- As guidelines were the mechanical requirements of the German standard DIN 7863 and RAL-GZ 716/1.
- Calcium carbonate represents the traditional cost reducing filler, but at high loadings it does not impart sufficiently high mechanical properties.
- By contrast, Aktisil VM 56 even at high loadings allows to obtain good mechanical results along with very good processing properties.

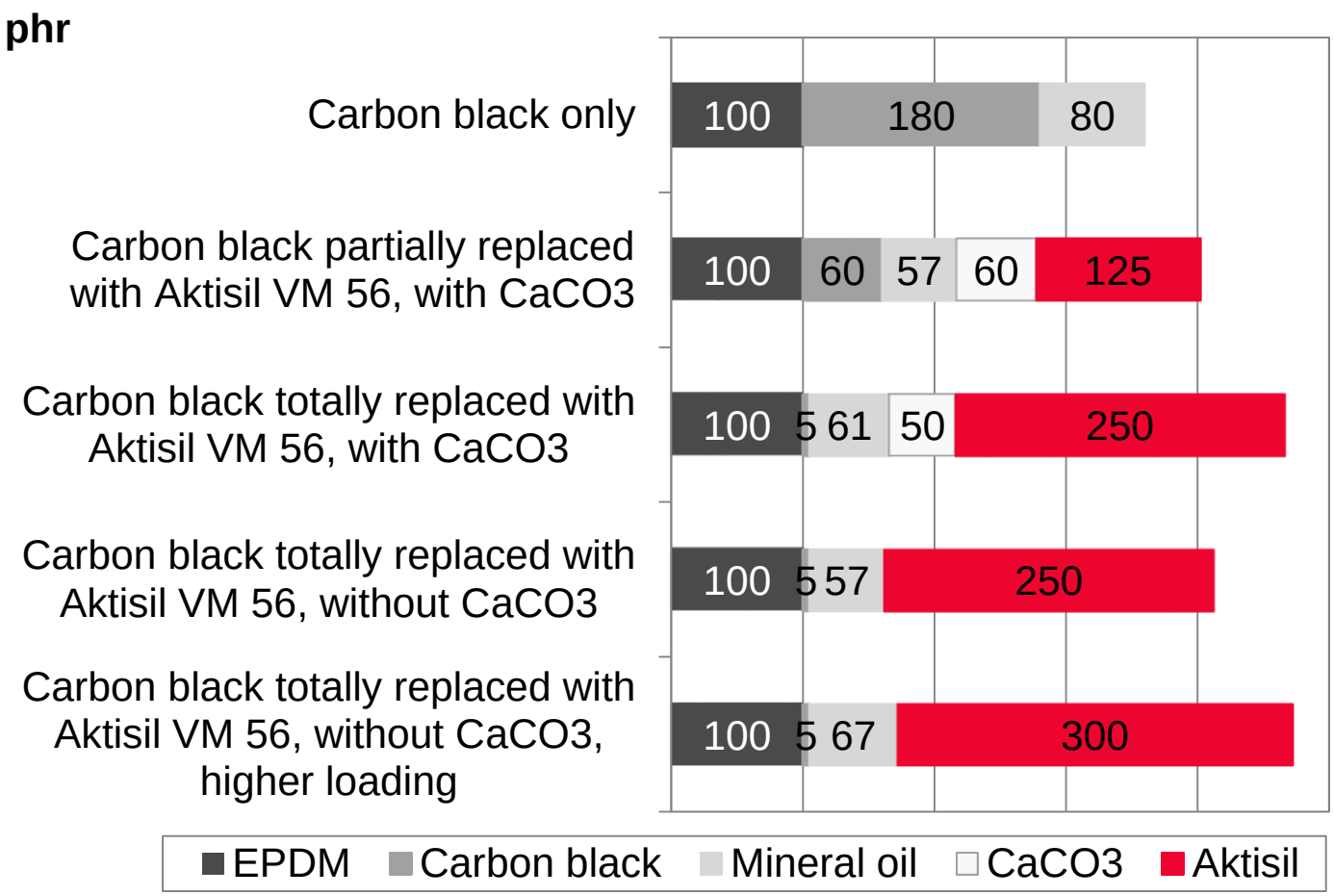
Base Formulation

EPDM – 65 Shore A

	phr
Keltan 8340 A	100.0
PEG 4000	2.0
Processing aid	3.0
Carbon black N 550	180.0
Paraffinic mineral oil, Plasticizer	80.0
Calcium oxide	10.0
TAC GR 50 %	3.0
Perkadox 14/40 pd	8.0
Total	**386.0**

Design of Experiments

Formulation variations in phr



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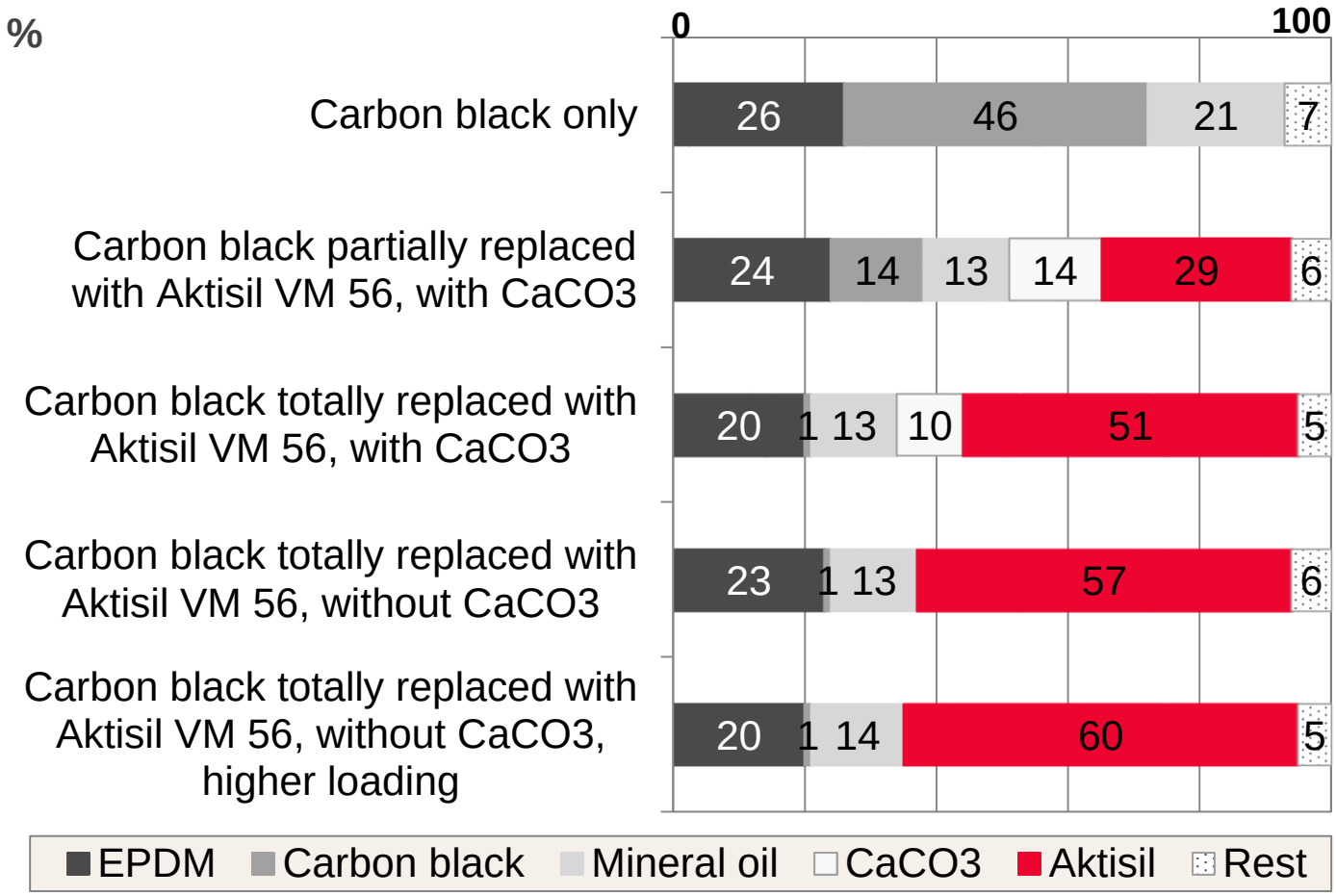
Formulation variations in mass percent



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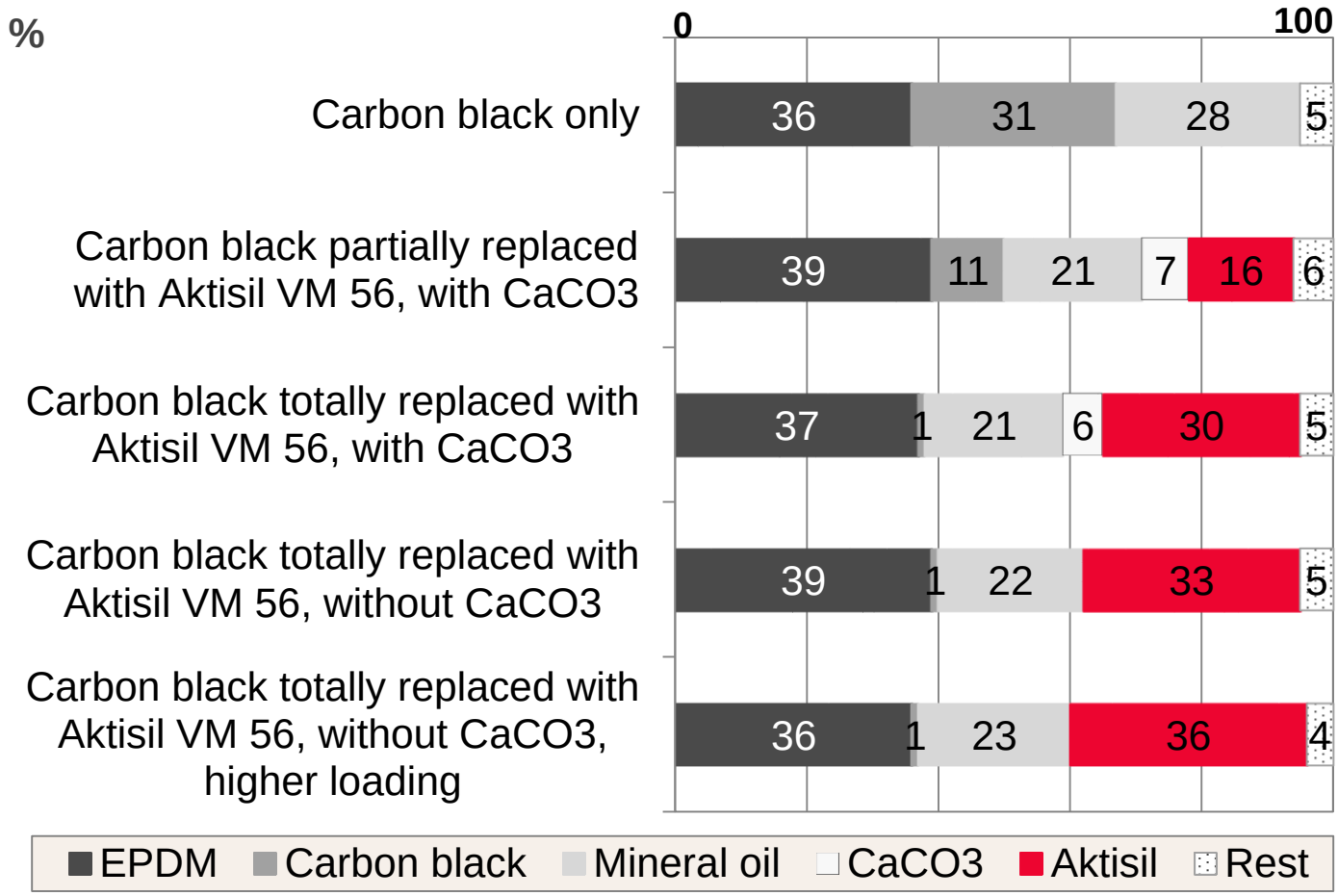
Formulation variations in volume percent



Fillers, Characteristics

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		Carbon black N 550	Calcium-carbonat surface treated	Aktisil VM 56
Density	[g/cm^3]	1.8	2.7	2.6
Particle size d_{50}	[µm]		2.7	2.0
Particle size d_{97}	[µm]		25	9
Sieve residue >40 µm	[mg/kg]	</= 300	14	4
Sieve residue 45 µm (Siev No. 325)	ppm	10		
Oil absorption	[g/100g]		19	50
DBP absorption	[ml/100 g]	121		
Specific surface area BET	[m^2/g]	41	2.1	11
CTAB Surface area	[m^2/g]	42		
Surface treatment		none	Stearate	vinyl functionalized

Preparation and Curing of the Compound

- **Mixing**

  Open mill Ø 150 x 300 mm

  Batch volume: approx. 600 cm³

  Temperature: 50 °C

  Mixing time: approx. 20 min.

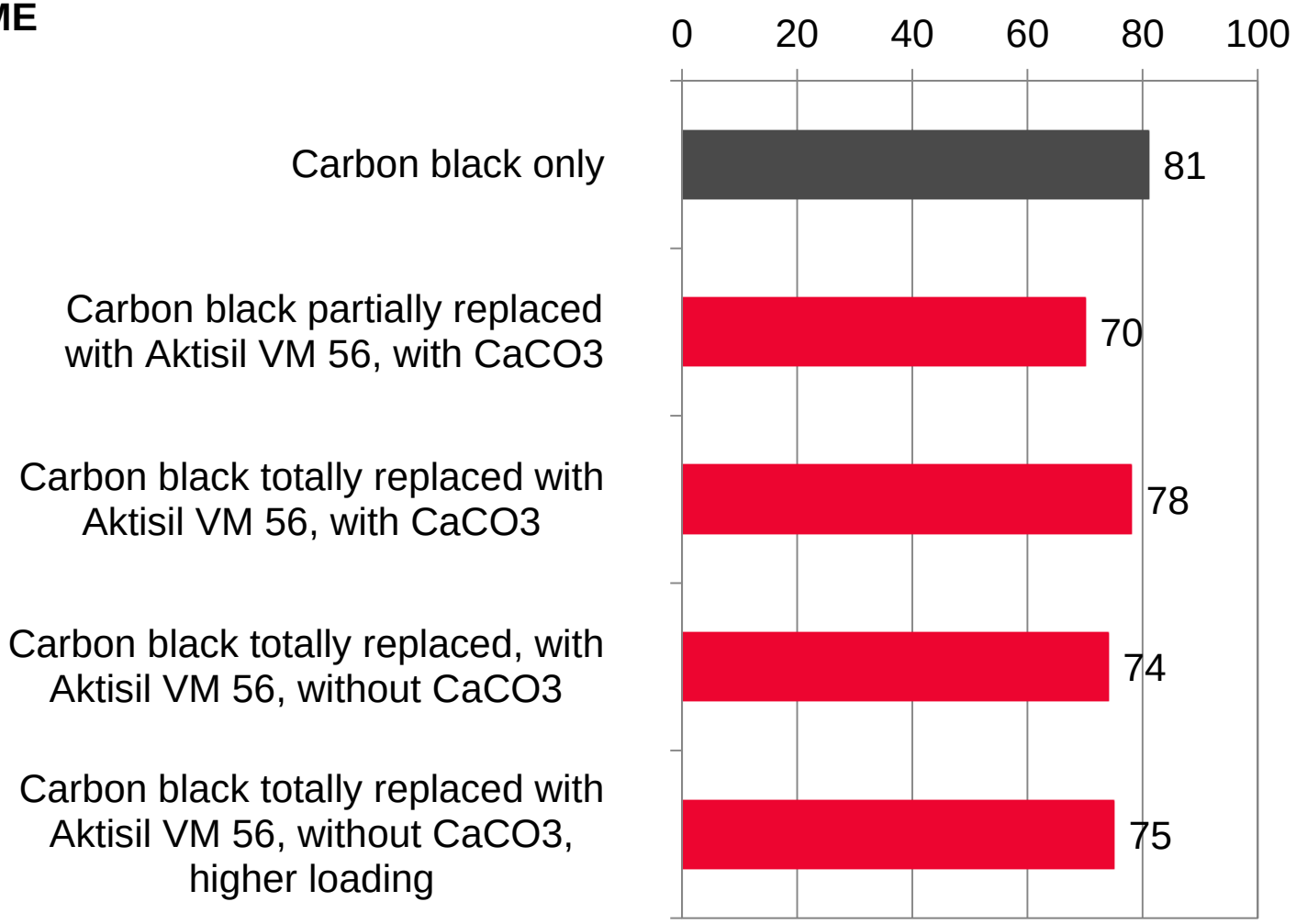
- **Curing**

  Press, 180 °C, t_{90} + 10 %

Mooney Viscosity

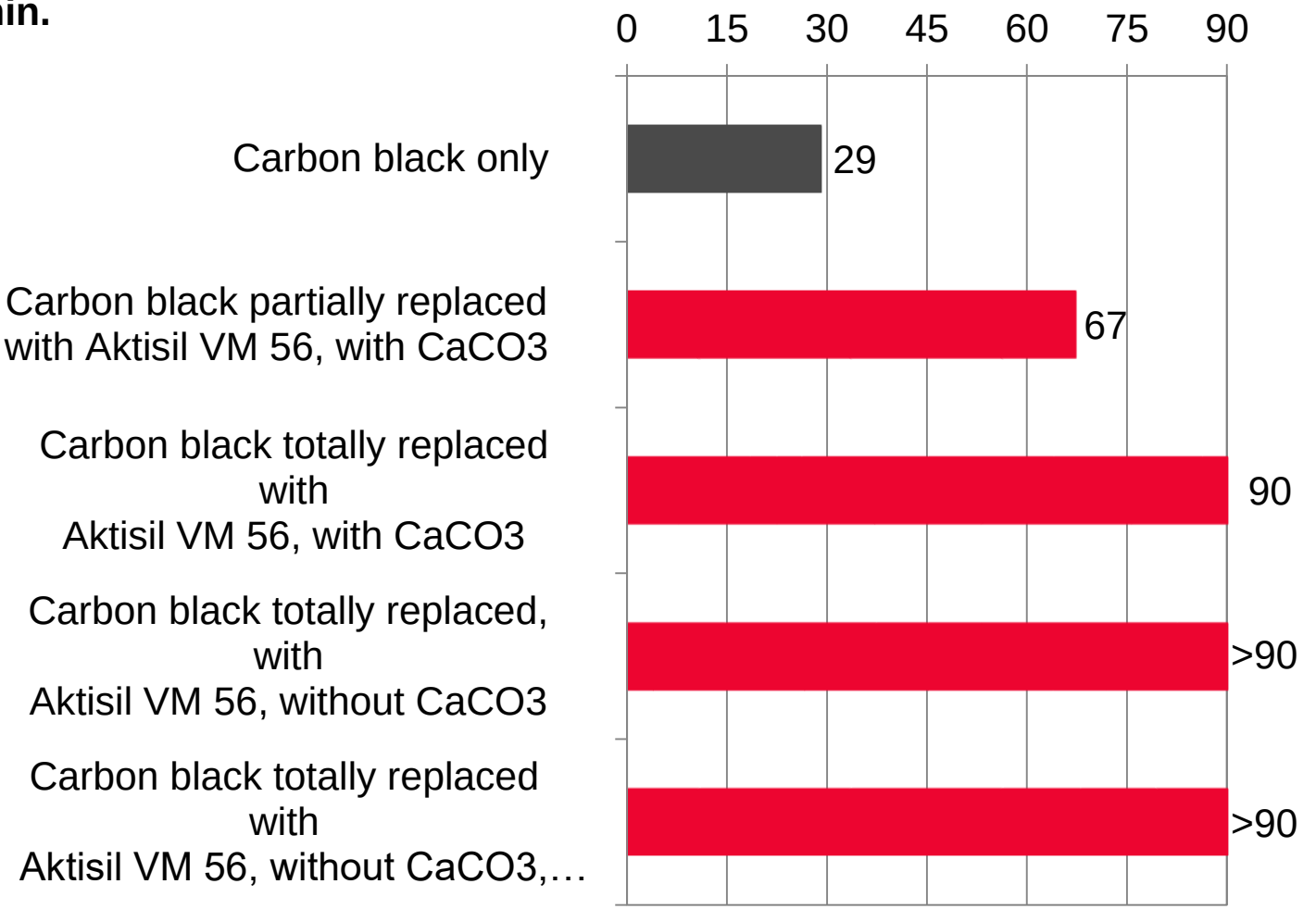
DIN 53 523 Part 3, ML 1+4 100 °C

ME



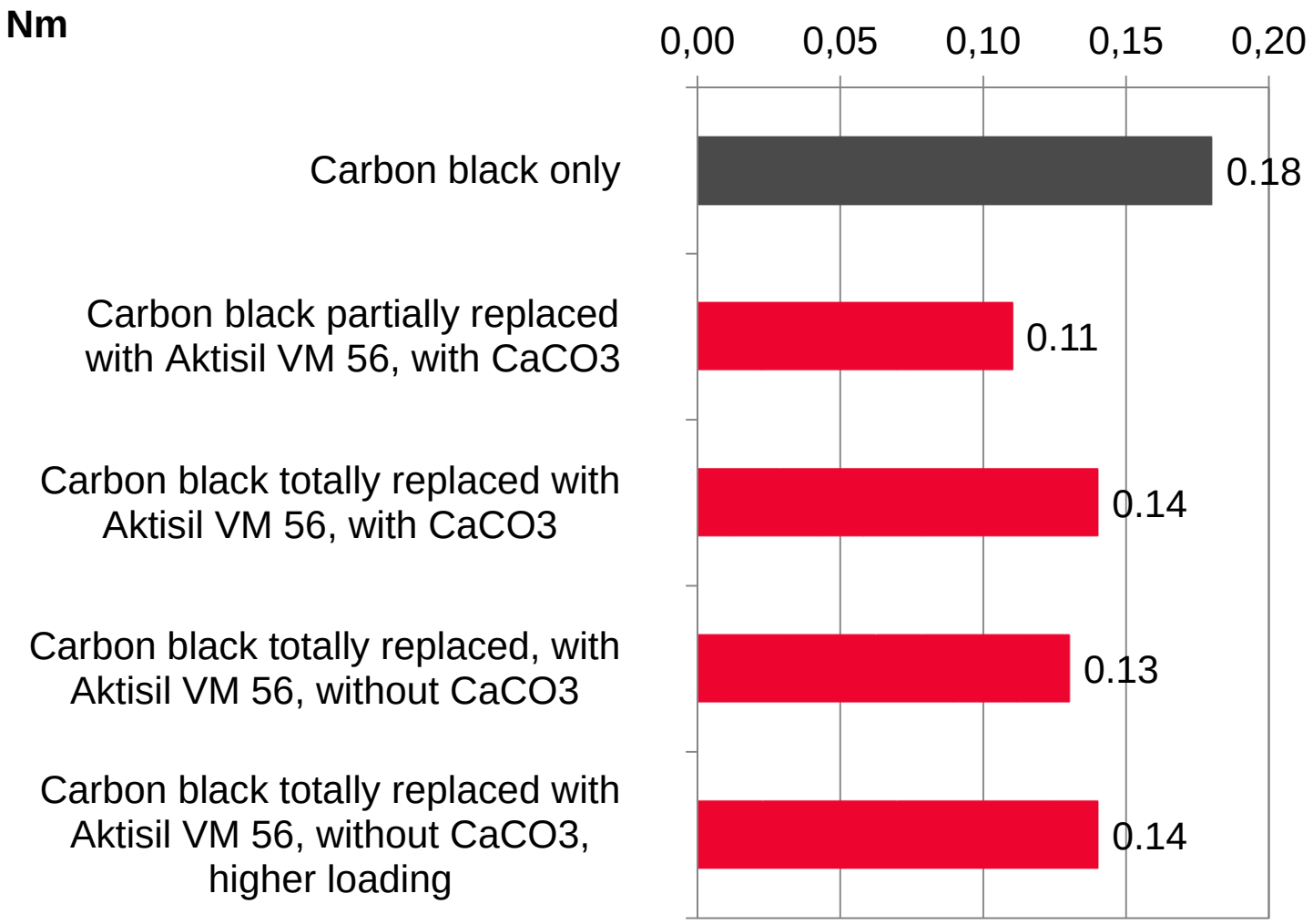
Mooney Scorch Time

DIN 53 523 Part 4, ML +5 120 °C



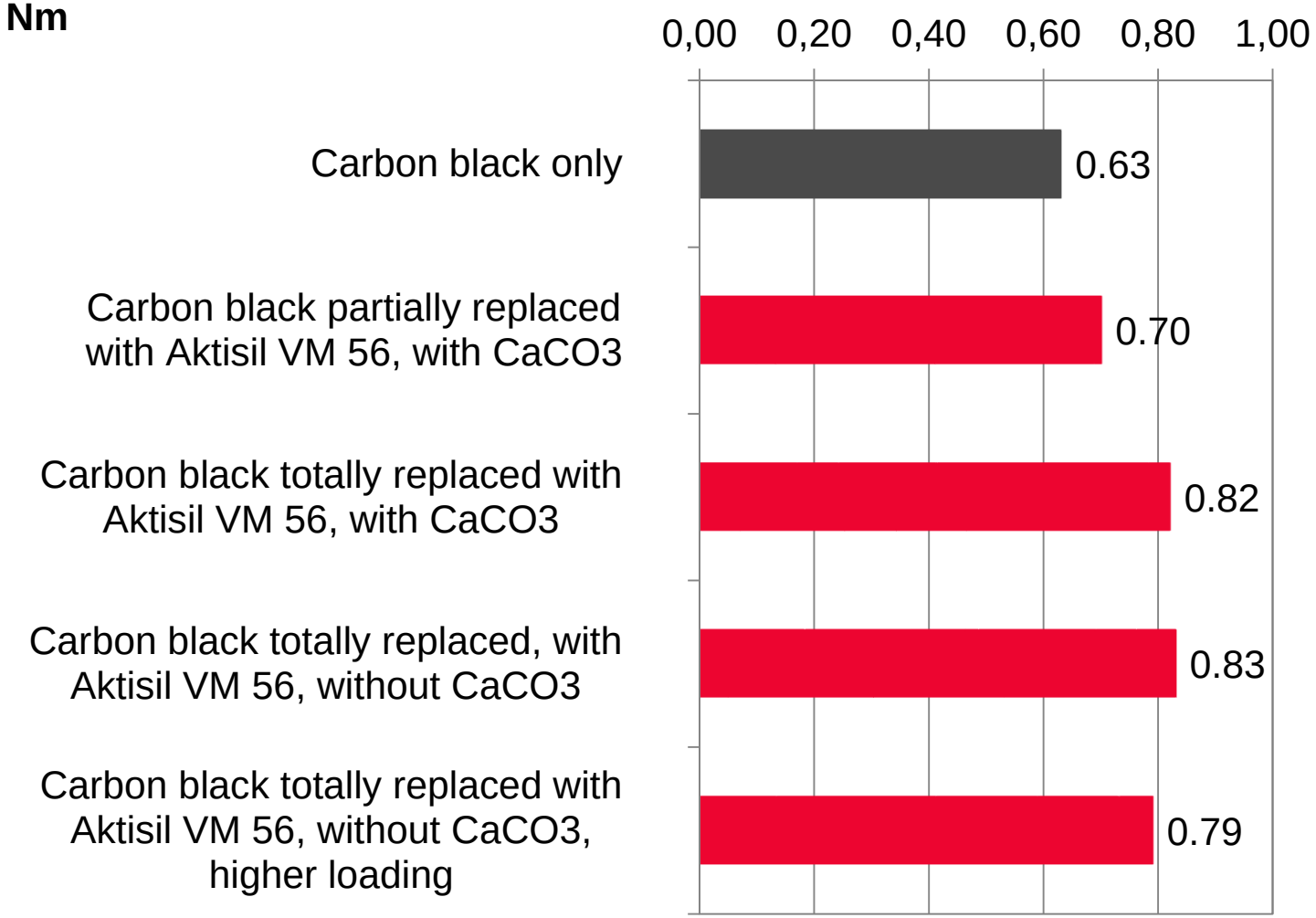
Torque Minimum

DIN 53 529-A3, 180 °C, 0.2° deflection – Göttfert Elastograph



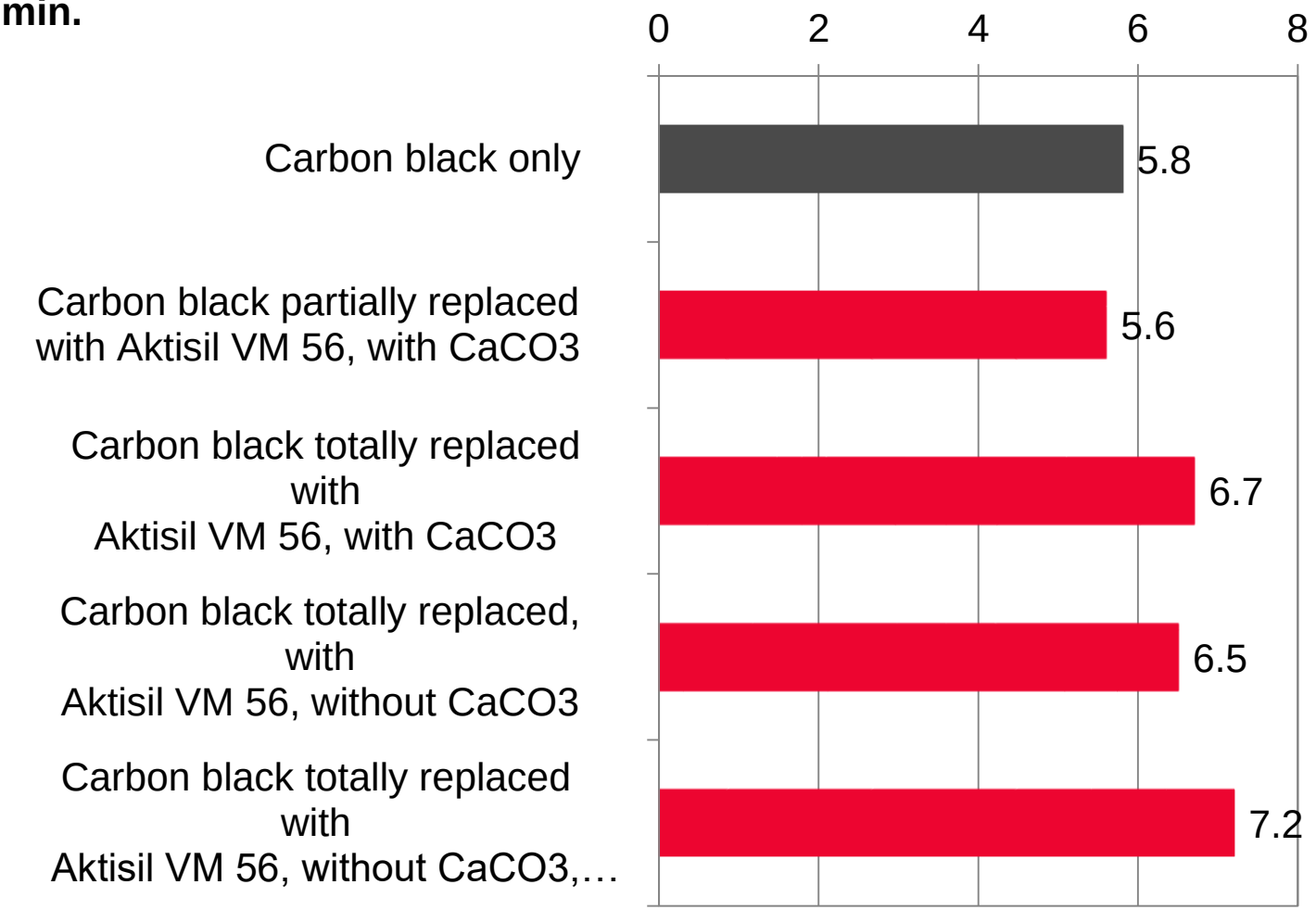
Torque Maximum

DIN 53 529-A3, 180 °C, 0.2° deflection – Göttfert Elastograph



Conversion Time t_{90}

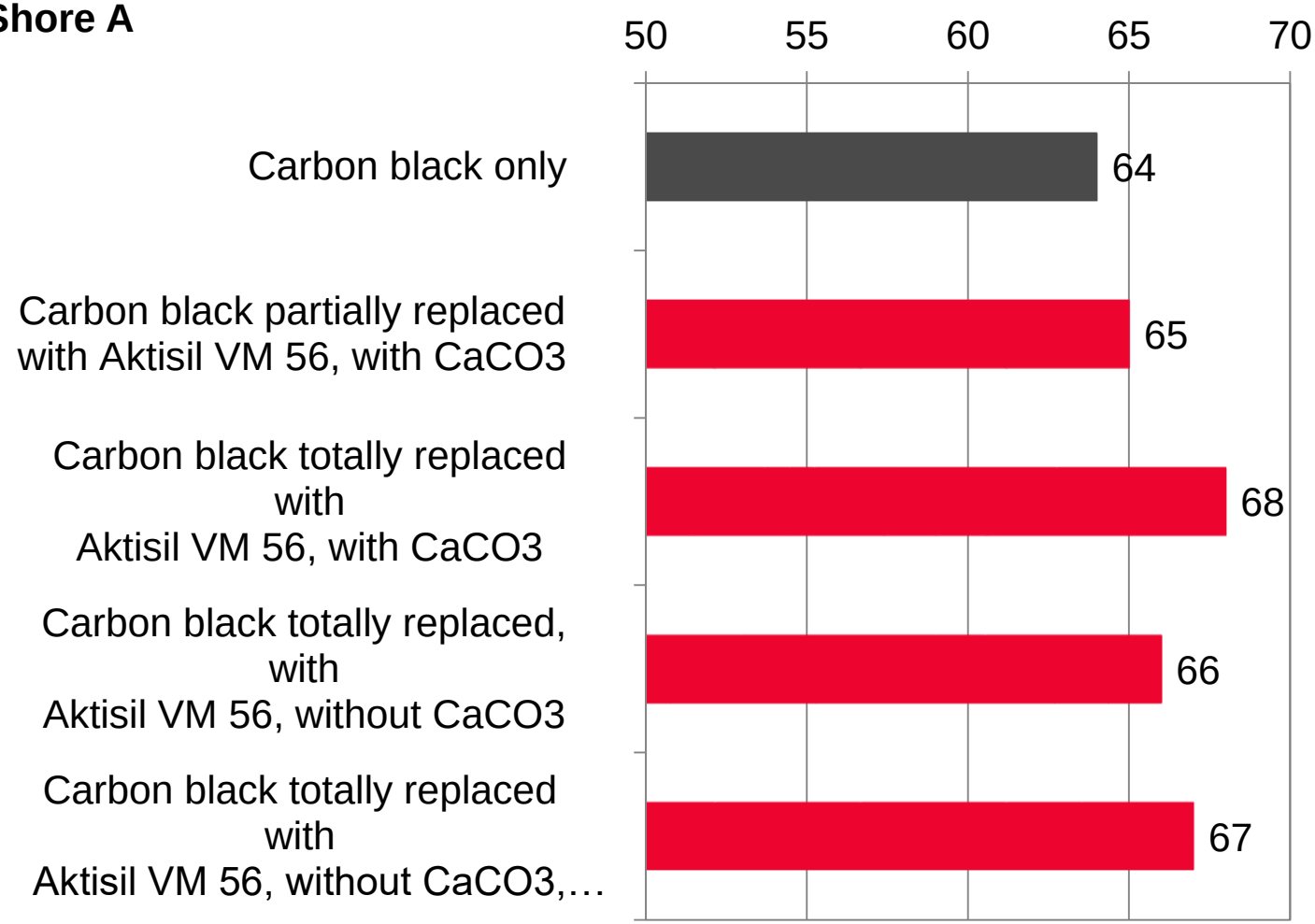
DIN 53 529-A3, 180 °C, 0.2° deflection – Göttfert Elastograph



Hardness

DIN 53 505-A, piled-up S2 dumbbells

Shore A



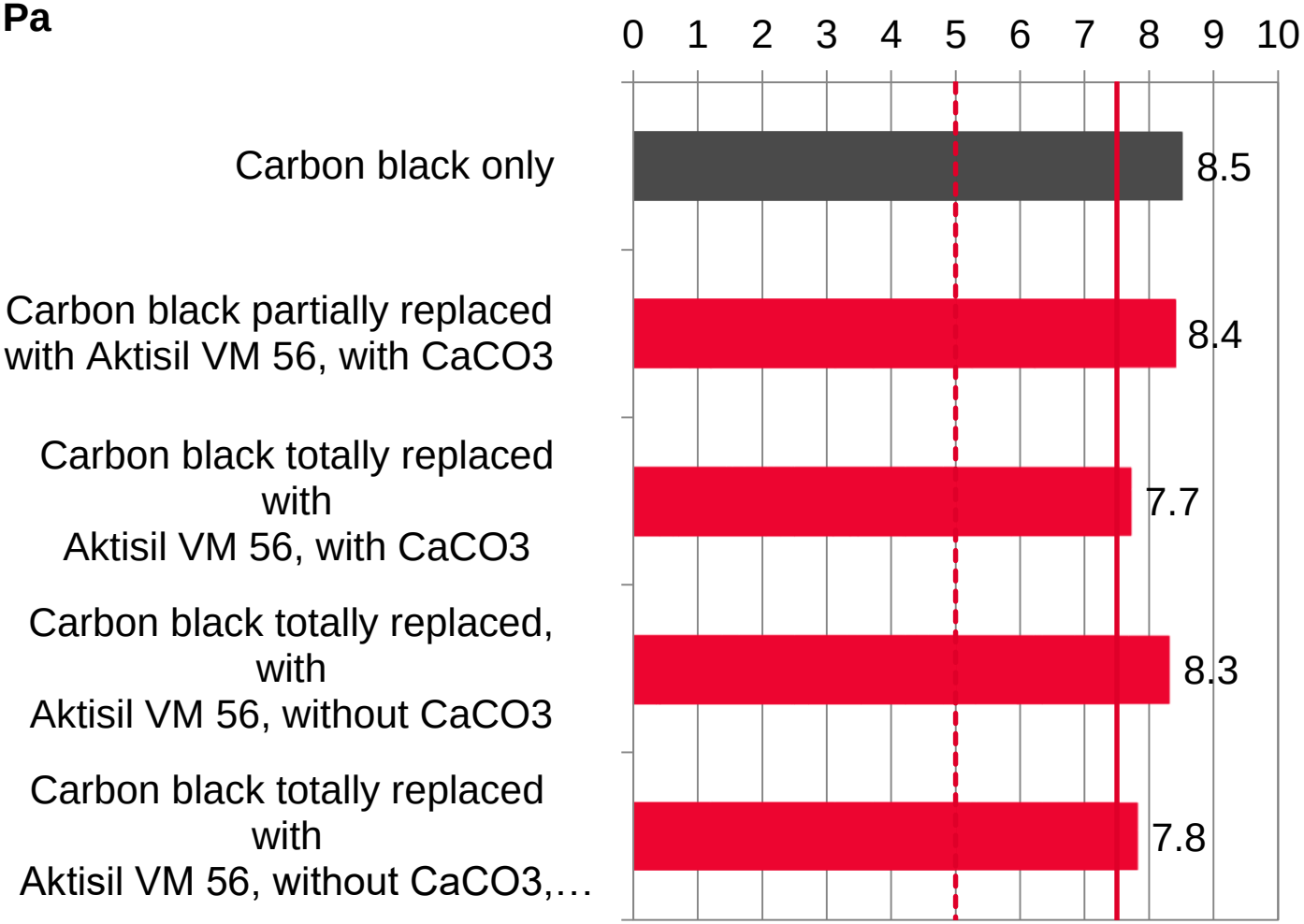
Tensile Strength

DIN 53 504, S2

DIN 7863, Facade + RAL GZ 716/1

DIN 7863, Window

MPa

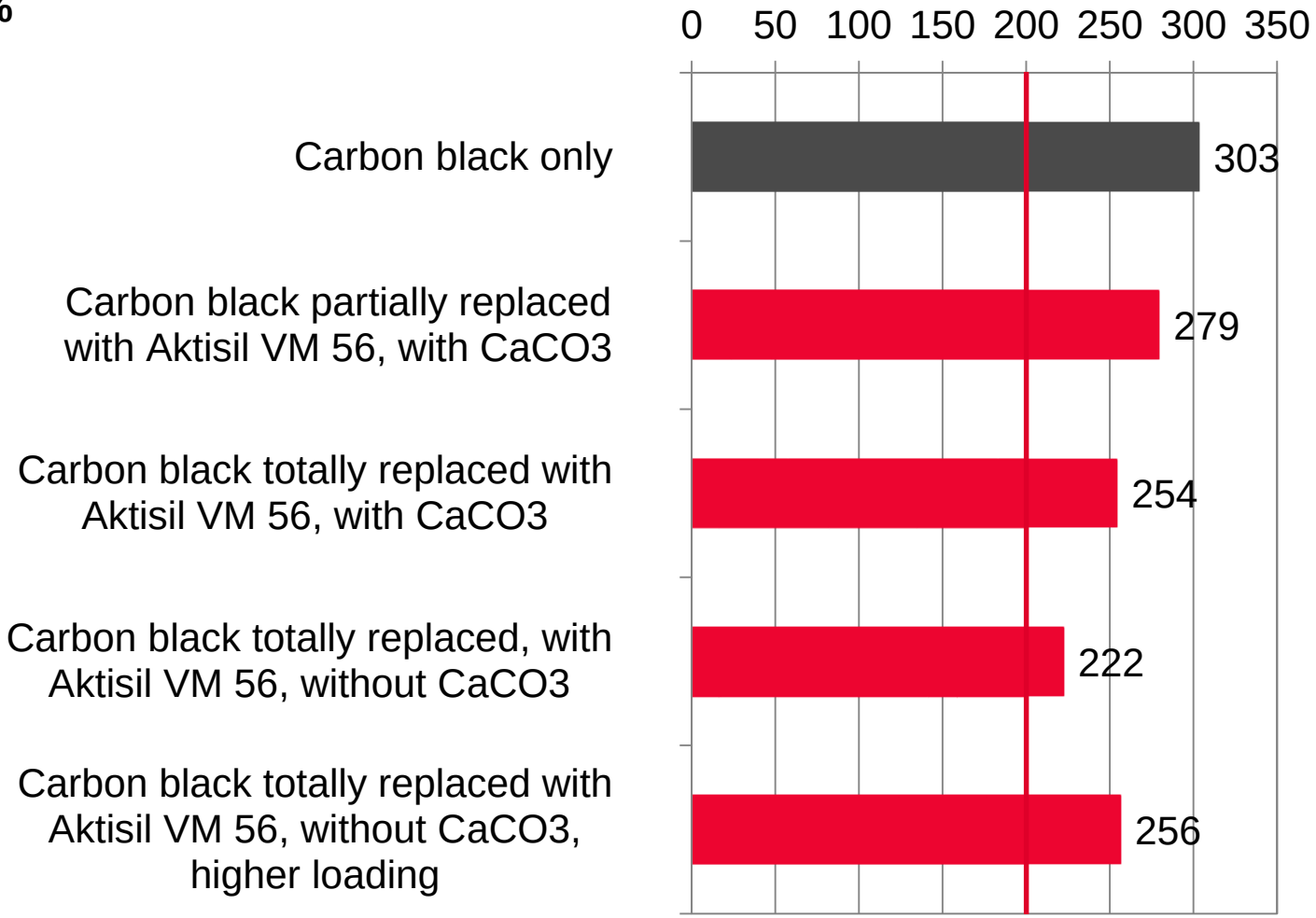


Elongation at Break

DIN 53 504, S2

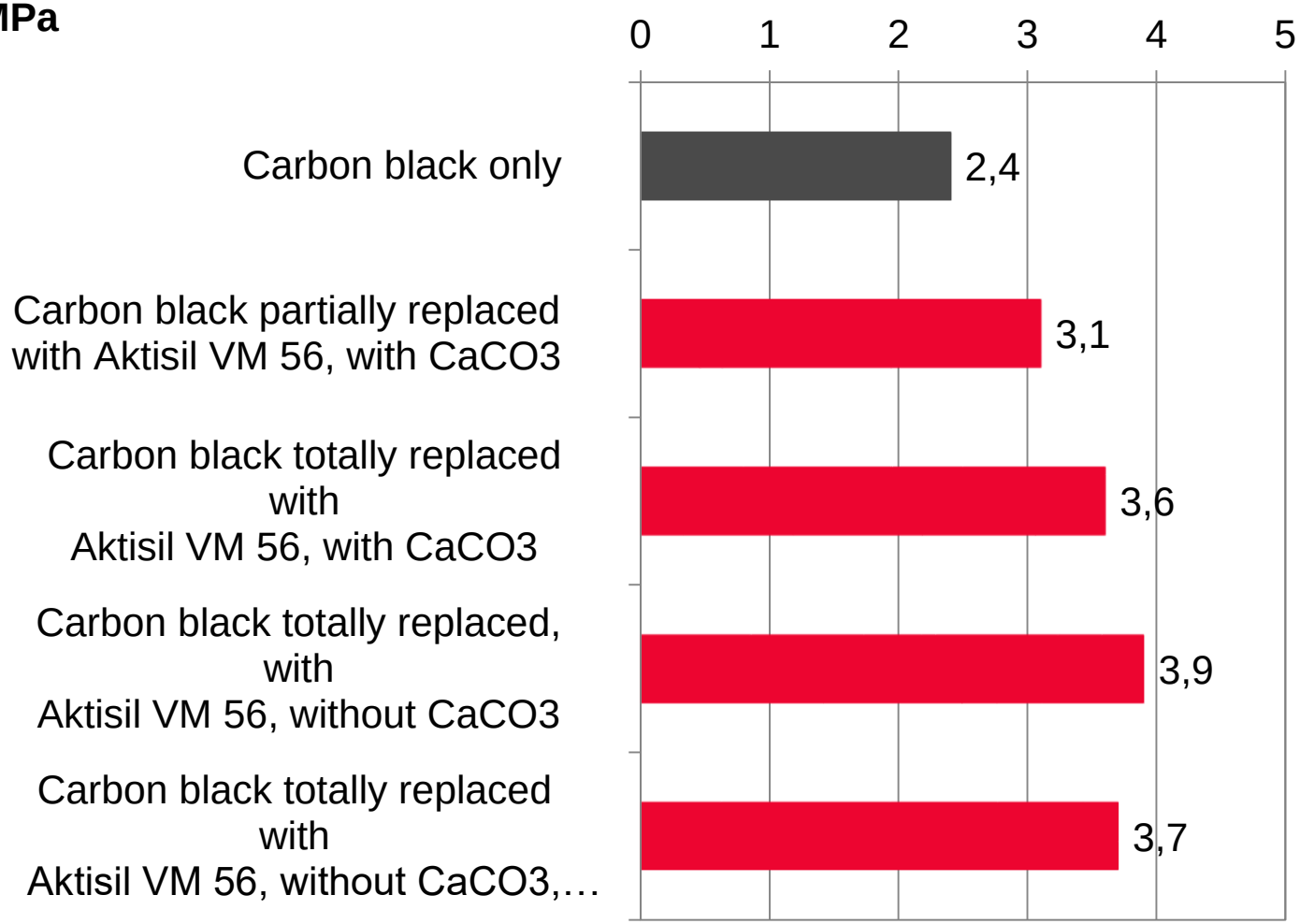
DIN 7863 + RAL GZ 716/1

%



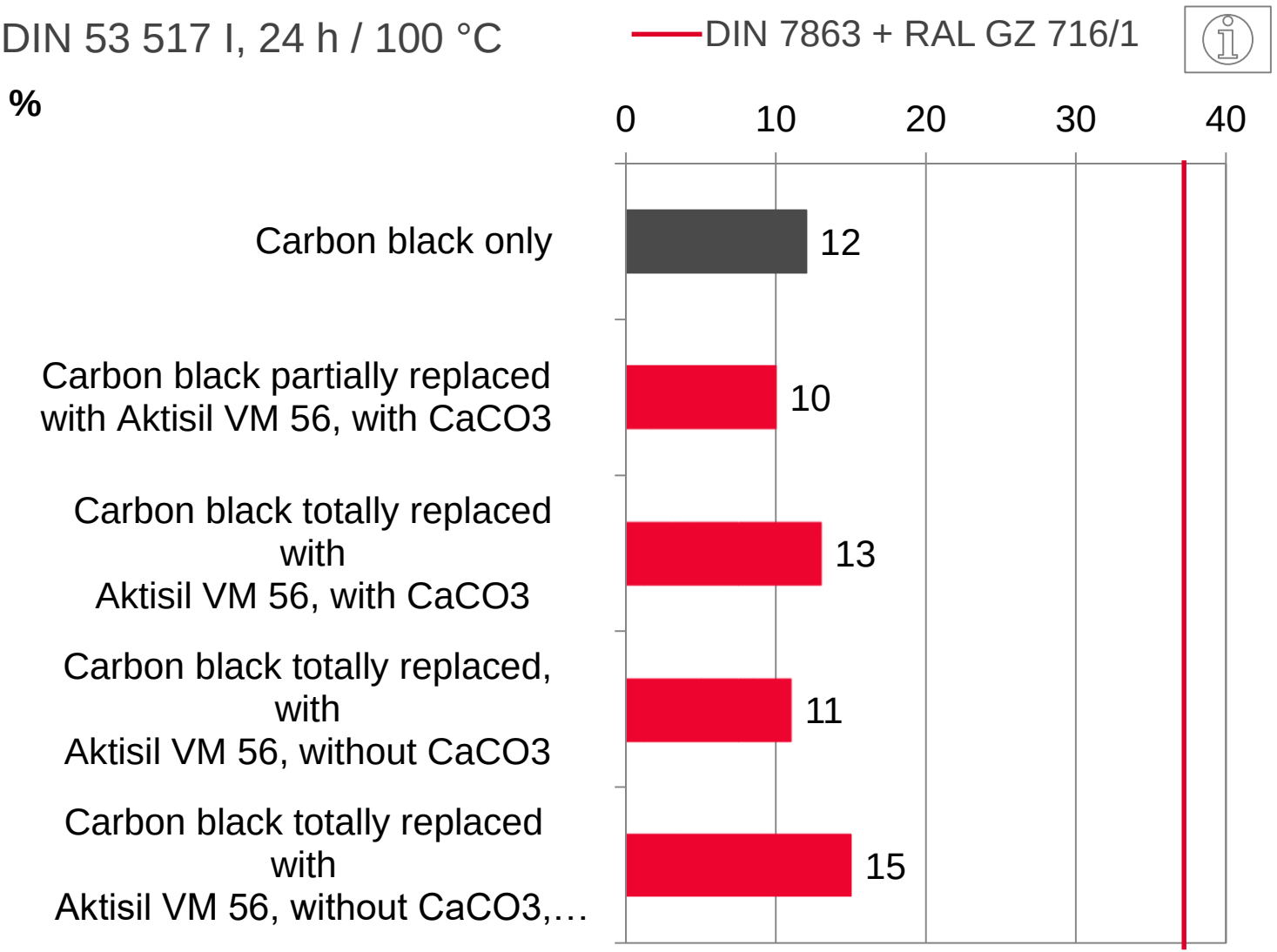
Modulus 100 %

DIN 53 504, S2



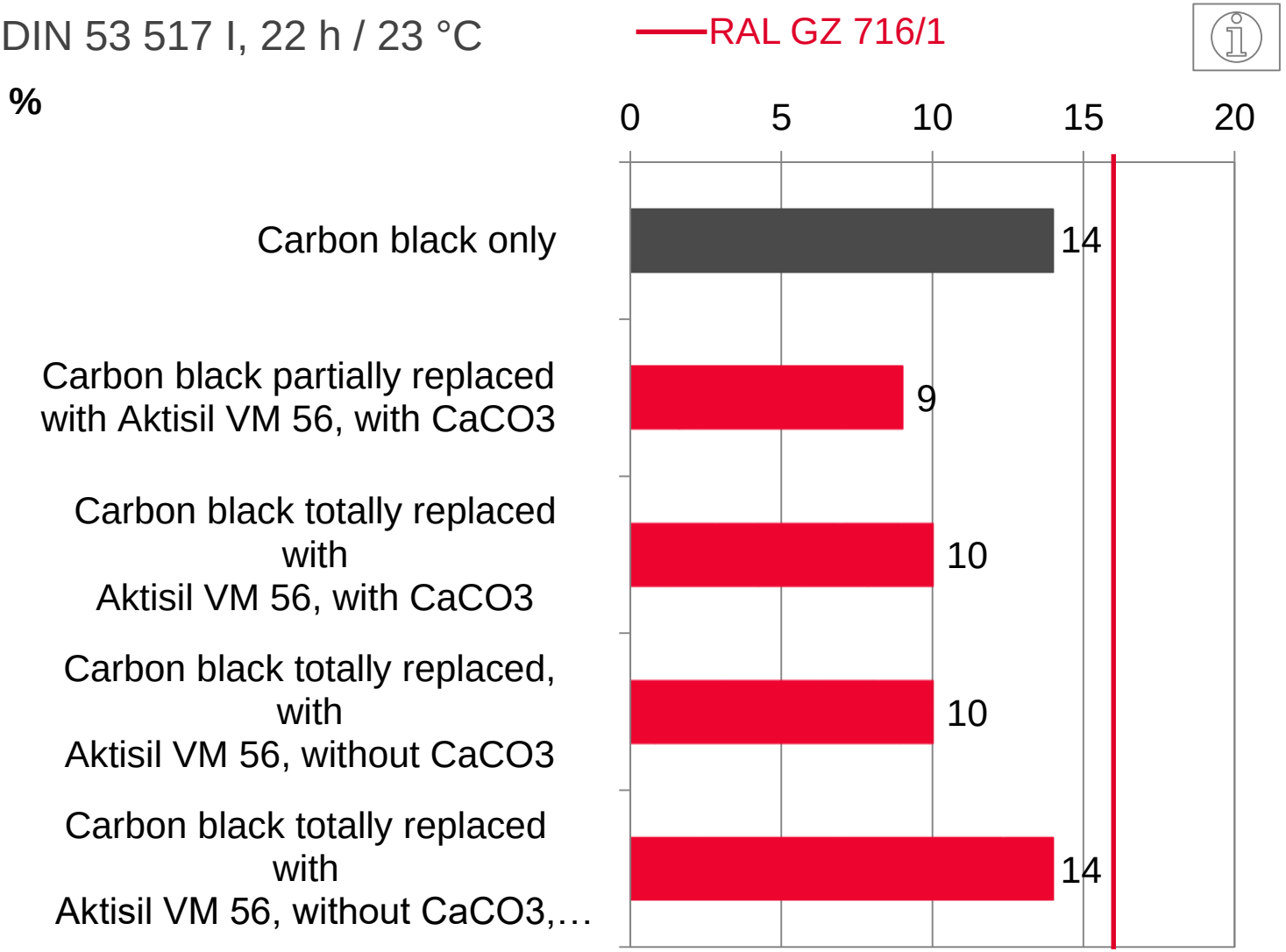
Compression Set

DIN 53 517 I, 24 h / 100 °C



Compression Set

DIN 53 517 I, 22 h / 23 °C

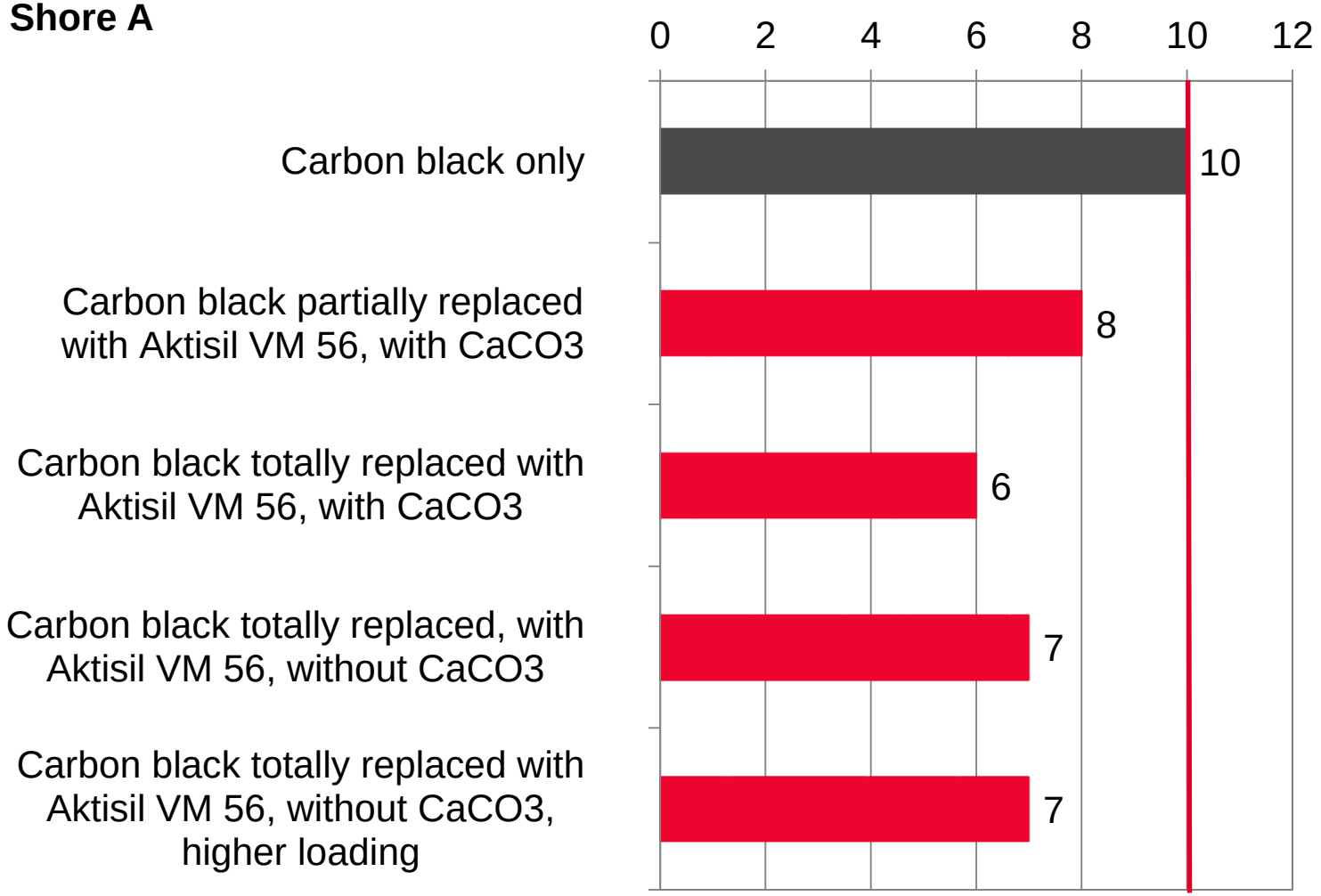


Low Temperature Exposure
Change of Hardness

22 h / -10 °C

DIN 7863 + RAL GZ 716/1

Shore A



Summary

- Aktisil VM 56 allows to meet the essential requirements of the DIN 7863 and RAL-GZ 716/1.
- According to the circumstances, a refining optimization approach such as a reduction of the peroxide concentration, can be useful.
- This way, it is possible to considerably decrease the portion of petroleum based raw materials in the compound, which leads to more safety in planning of the raw material costs.
- On the technical side, according to the formulation used the following results can be attained:
  - lower viscosity
  - increased scorch safety
  - increased tensile moduli
  - improved compression set
  - lower change of hardness at -10 °C

Wir geben Stoff für gute Ideen!

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