Mixing procedures

Procedure	Denomination / Instrument Producer	For[1]	Description	Standard
Internal mixer 90l (intermeshing)	GK 90 E	C	Mixing including batch-off finishing	In-house procedure
Internal mixer 5l (intermeshing)	GK 5 E	C	Mixing	
Internal mixer 1.5l (intermeshing)	GK 1.5 E	C	Mixing	
Internal mixer 350 ml	Brabender	C	Mixing	
Internal mixer 85 ml	Brabender	C	Mixing	
Pressmixer 1.4l	HPM 10/Gl	C	Mixing of low viscosity compounds	
Microcompounder 15ml	DSM	C	Twin screw mixing and sample preparation	
Mill	Various sizes	C	Mixing	
Mill shrinkage		C	Mixing	
Vulcanization	Various vulcanization presses, steam- or electrically heated	C	Curing of slabs and samples	
UV crosslinking	UVA-Cube 2000	C		

[1]**Polymers (P),Compounds (C), Vulcanisates (V), Solutions (S)**

Procedure	Denomination / Instrument Producer	For[1]	Description	Standard
90 mm vacuum extruder	Berstorff L/D = 20	C	Continuous extrusion of hoses and profiles (incl.vulcanization in microwave channel or liquid salt bath)	In-house procedure
45mm extruder, with gear pump	Rubicon	C		
Gel test (KEL method)		P		
19mm extruder	Brabender	C		
Twin screw extruder	Leistritz ZSE 27-48 MAXX	C	Twin screw compounding	
Film blowing / Die casting	Eurexma 3-Layer Film Equipment	C	Production of films with up to 3 layers	
Granulation	Wanner Grinder	P, C	Granulation of rubber, powdering	
Granule solid mixer		P, C	Powdering, coating and mixing of granules	
Extrusion test (various dies, e.g. Garvey)	19mm, L/D = 10	C	Processability of rubber compounds	
Extrusion test (various dies)	45mm, L/D = 10	C	Processability of rubber compounds	
Injection molding test	DESMA	C	Characterization of mold fouling and injection faults	

[1]**Polymers (P),Compounds (C), Vulcanisates (V), Solutions (S)**

Aging and swelling tests

Procedure	Denomination / Instrument Producer	For[1]	Description	Standard
Aging in liquids		V	Aging/swelling open vessel	DIN ISO 1817 ASTM D471
Aging in liquids		V	Aging/swelling pressure vessel	
Aging in steam		V	Steam aging	
Aging in hot air		V	Hot air aging	DIN 53508 ISO 188 ASTM D573
Post-cure		V		

[1]**Polymers (P),Compounds (C), Vulcanisates (V), Solutions (S)**

Procedure	Denomination / Instrument Producer	For[1]	Description	Standard
Stress relaxation in compression (CSR)	Elastocon	V	Decay of stress under constant compression	In-house procedure
Compression set (CS)	ARLANXEO	V	Remaining deformation after a period of compression	DIN ISO 815 ASTM D395
Shore hardness	Barreis	V	Resistance against indention of a defined cone	DIN ISO 7619 ISO 48-4 ASTM D2240
Hardness (IRHD)	Barreis	V	Resistance against indention of a ball with a specific force	DIN ISO 48 ISO 48-2 ASTM D1415
Microhardness (μ–IRHD)	Barreis	V	Resistance against indention of a ball with a specific force	DIN ISO 48 ISO 48-2 ASTM D1415
Crystallization	Barreis	P, C, V	Change of hardness over time by crystallization	DIN 53541 ISO 3384
TR test (temperature retraction)	Gibitre	V	Rectraction of strained elastomer samples with temperature	ISO 2921 ASTM D1329
Stress relaxation in tension	-			
Adhesion to fabric	Zwick	V	Adhesion between fabric and elastomer layers	DIN 53530
Cord adhesion test	Zwick	V	Separation force between cord and rubber	ASTM D2229 In-house procedure
Tear test	Zwick	V	Resistance of various sample shapes against tear	DIN ISO 34 ASTM D624
Tension set	Zwick	V	Remaining deformation after storage under constant elongation	DIN ISO 2285 ASTM D412

Static test procedures

Procedure	Denomination / Instrument Producer	For[1]	Description	Standard
Tensile test, dumbbell Tensile test, dumbbell, temperature chamber Tensile test, ring	Zwick, Instron	V	Stress-strain behavoir,ultimate elongation and maximum stress under elongation	DIN 53504 ISO 37 ASTM D412
Greenstrength Tensile test, dumbbell	Zwick	P, C	Stress-strain behavoir,ultimate elongation and maximum stress under elongation	DIN 53504 ISO 9026 ASTM D 6746
Peel strength	Zwick	V		
Adhesive shear strength	Zwick	V		
Rebound resilience	Zwick	V	Relative rebound height of a pendulum	DIN 53512
Brittleness point	Frank	V	Estimation of the brittleness temperature	DIN ISO 812 ASTM D746
Abrasion	Zwick	V	Resistance against wear on a rotating drum	DIN ISO 4649 ASTM D5963
Akron abrasion	-	V	Resistance to abrasive wear	
Skid resistance	-	V	Coefficient of friction between rubber and other surfaces	In-house procedure

[1]**Polymers (P),Compounds (C), Vulcanisates (V), Solutions (S)**

ARLANXEO Performance Elastomers

Procedure	Denomination / Instrument Producer	For[1]	Description	Standard
Standard Tests				
Mooney (viscosity)	Alpha Technologies	P, C	Viscosity of uncured materials	DIN ISO 289 ASTM D1646
Mooney (scorch)	Alpha Technologies	P, C	Scorch behavior of unvulcanized compounds	DIN ISO 289 ASTM D1646
Rheovulcameter	Göttfert	C	Simulation of injection molding	In-house procedure
Curemeter (MDR)	Alpha Technologies	P, C	Curing behavior	DIN 53529 ISO 6502 ASTM D5289
UV curemeter	MCR - UV system	P, C	Curing behavior due to UV source	In-house procedure
Temperature-dependent modulus and phase angle				
-100°C to 150°C	TA ARES G2	V	Temperature-dependent viscoelastic properties (f, γ = const., sinusoidal mode) other T-ranges on request	In-house procedure similar to DIN ISO 6721
-100°C to 150°C	Mettler DMA/SDTA 861e	V		
-100°C to 150°C	GABO Eplexor	V		
Frequency-dependent modulus and phase angle				
0,01 Hz to 40 Hz	TA RPA Scarabaeus SIS-V50	P, C		In-house procedure
0,01 Hz to 100 Hz	TA ARES G2 Mettler DMA/SDTA 861e	P, C, V	Frequency-dependent viscoelastic properties (T, γ = const., sinusodial mode) other f-ranges on request	In-house procedure
0,1 Hz to 100 Hz	GABO Eplexor	V	Frequency-dependent viscoelastic properties (T, γ = const., sinusodial mode) other f-ranges on request	In-house procedure
0,01 Hz to 100 Hz	Anton Paar MCR 300	P, C, V	Frequency-dependent viscoelastic properties (T, γ = const., sinusodial mode) other f-ranges on request	In-house procedure

Dynamic test procedures

Procedure	Denomination / Instrument Producer	For[1]	Description	Standard
0,1 Hz to 200 Hz	MTS 831 Elastomer test system Metravib	V	Frequency-dependent viscoelastic properties (T, γ = const., sinusoidal mode) other load modes on request	In-house procedure
Master curve construction	-	P, C	Combination of temperature and time-dependent measurements and application of the time-temperature equivalence	In-house procedure
Amplitude-dependent modulus and phase angle				
0 - 1000 %	TA RPA Scarabaeus SIS-V50 (shear)	P, C	Amplitude-dependent viscoelastic properties(T = const., f = const., sinusoidal mode)	In-house procedure
0 - 100 %	MTS 831 (shear, compression, tension)	V		
Lifetime testing				
Goodrich flexometer	-	V	Heat built up, fatigue life and creep under sinusoidal compressive load	DIN 53533 ISO 4666
De Mattia fatigue life	Zwick	V	Fatigue under cyclic bending defomation	DIN ISO 132
Tear analyser	Coesfeld	V	Crack propagation rate under pulsed or sinusoidal elongation	In-house procedure

[1]Polymers (P),Compounds (C), Vulcanisates (V), Solutions (S)

Procedure	Denomination / Instrument Producer	For[1]	Description	Standard
Viscosity measurements: melts and compounds				In-house procedure
High-pressure capillary rheometer	Göttfert Rheotester 2000	P, C	Viscosity as function of shear rate	ISO 11443
log eta test	ARLANXEO	P	Zero viscosity determinated by a squeeze flow	In-house procedure
DMA	TA ARES G2 Anton Paar MCR	P, C	Viscosity as function of shear rate (several geometries)	In-house procedure
Strain viscosity	SER II-tool	P, C	Strain viscosity as function of time	In-house procedure
DMA	various	P, C	Viscosity as function of shear rate generated by frequency dependent tests (Cox-Merz)	In-house procedure
Viscosity measurements: solutions				
Kinematic viscosity	Ubbelohde	P, S	Kinematic viscosity determined from gravity driven outflow behaviour (Newtonian fluids)	DIN 51562
Stabinger viscometer	Anton Paar SVM 3000	S	Viscosity at constant shear rate (volatile solvents)	ASTM D7042
DMA	TA ARES G2 Anton Paar MCR	S	Viscosity as function of shear rate (P-P or Couette geometry)	In-house procedure
Solution viscosity (pressure cell)	pressure cell, Anton Paar MCR	S	Viscosity as function of shear rate (Couette geometry in a pressure cell, volatile solvents)	In-house procedure
Solution viscosity, mastercurve (pressure cell)	pressure cell, Anton Paar MCR	S	As above, including construction of mastercurve by use of a suitable temperature sweep	In-house procedure
MRV (Mini rotary viscosimeter)	CMRV4300	S	Low temperature flow behaviour of polymer additive solutions	ASTM D4684
CCS (Cold crank simulator)	Cannon CCS-2B	S	Low temperature flow behaviour of polymer additive solutions	ASTM D5293
Further measurements of flow behaviour				

Procedure	Denomination / Instrument Producer	For[1]	Description	Standard
Melt flow index	Göttfert	P, C	Flowability of polymers at defined temperature and pressure	DIN ISO 1133
Rheovulcameter	Göttfert	C	Simulation of injection molding	In-house procedure
Cold flow test	ARLANXEO	P	Polymer flow in orifice at 50°C	In-house procedure

[1]Polymers (P),Compounds (C), Vulcanisates (V), Solutions (S)

Procedure	Denomination / Instrument Producer	For[1]	Description	Standard
Density	Brabender Elatest	P, C	Density measurememt by compression with a piston	In-house procedure
	Archimedes	P,C,V	Weighing of specimens in air and water	
Filler dispersion	Dispergrader	C, V	Optical (magnification x100) evaluation and comparsion of cut surfaces with reference pictures	ISO 11345 ASTM D7723
Microscopy	Zeiss	C, V	Photo by microscope	
Humidity	-	P	Mass loss during storage in exsiccator over drying agent	In-house procedure
Volatile matter	-	P	Content (mass %) of volatile ingredients in rubber sheets	Similar to DIN 53526
Moisture in granulates	Aboni Hydro Tracer	P	Moisture content, range 0.0005% - 5%	Manufacturer´s instructions
Gas permeation	In-house, Lab Think VAC-V2	V	Permeation coefficients as a function of temperature and test gas	DIN 53536 ISO 15105
Cold bending test	-	V	Embrittlement of elastomers/bending test around a rod (-70° C to 10 °C)	In-house procedure
Fuel permeability	-	V	Amount of fuel migrating through a rubber membrane as a function of time	DIN EN ISO 6179
Solubility	-	P, C	Check for undissolved particles after shaking in a suitable solvent	In-house procedure
Ozone crack test	Argentox	V	Crack development on the surface of strained elastomers when statically stored in ozonized air	DIN ISO 1431
Xenon light restistance	Heraeus	V	Treatment with light, with a spectral energy distribution similar to sunlight	DIN ISO 4892
UL 94	-	V	Flammability test	
Limiting oxygen index (LOI)	-	V	Oxygen concentration required for burning	DIN 22117 ISO 4589
DSC	TA Instruments	P, C, V	Differentical Scanning calometry	DIN EN ISO 11357
TGA	TA Instruments	P, C, V	Thermogravimetric analysis	DIN 51006 DIN EN ISO 11358

Additional test procedures

Procedure	Denomination / Instrument Producer	For[1]	Description	Standard
ECD		V	Electo-chemical degradation	In-house procedure
Röhm test		V	Crack formation on PMMA surface under tension	

[1]Polymers (P),Compounds (C), Vulcanisates (V), Solutions (S)