Viton™ A-HV
Fluoroelastomers

Technical Information

Introduction

Viton™ A-HV is a high viscosity fluoroelastomer dipolymer that provides vulcanizates with high tensile strength and best resistance to compression set compared to other Bisphenol AF curable types.

Features

- Bisphenol AF and Diamine Curable
- High Tensile Strength
- Low Compression Set

Typical applications include compression molded seals, O-rings, gaskets, and oil-field parts, such as packers.

Product Description

Chemical Composition	Dipolymer of hexafluoropropylene, vinylidene fluoride
Physical Form	Sheet
Appearance	White to tan
Odor	Negligible
Mooney Viscosity, ML 1 + 10 at 149 °C (300 °F)	100
Specific Gravity	1.82
Storage Stability	Excellent
Fluorine, %	~66

Curing Systems for Viton™ A-Types

The A-types of Viton™ can be cured with Viton™ Curative Masterbatches (No. 20 and 30), Curative No. 50, or with diamines—Viton™ Curative Nos. 1 (VC-1) or 3 (VC-3). Typical formulations and physical properties for compounds using Curatives No. 20, No. 30, and No. 50 are found in Table 1. A comparison of A-HV to A-500 and A-700 can be found in Table 2. For additional information on curing Viton™, see technical bulletin "Viton™ Curatives No. 20, No. 30, and No. 50."

Processing

Mixing

Perhaps the most important aspect of mixing Viton™ is to use equipment free of contamination from other polymer mixes. Residual oils and sulfur or sulfur-containing chemicals can have ruinous effects on mixing and curing characteristics of Viton™ compounds. Viton™ compounds should be mixed on a mill or in an internal mixer that has adequate cooling capacity; not only to prevent stock scorch, but also to prevent sticking of the mix to rolls or rotors. All powdered ingredients should be premixed—this ensures good dispersion and prevents sticking, which occurs if magnesia is added by itself early in the mix. The use of Viton™ Curative No. 1 (VC-1) results in fairly scorchy compounds. For this reason, VC-1 should be added last when mill mixing and on the drop mill when using an internal mixer.

Depending on the acid acceptor and filler systems used, re-milling compounded stock after a minimum of 24 hr often improves physical properties of vulcanizates.

Extruding

High viscosity A-types like A-HV typically provide a better extrudate surface when processed through a hot die—100–140 °C (212–284 °F). The use of 1–1.5 phr of a process aid, such as VPA No. 2 or carnauba wax, markedly improves the surface and definition of extrudates. When using a process aid, it is best to keep the feed zone cool relative to the die and head areas of the extruder to avoid stock slippage and loss of feed.

Curing

Compounds may be cured at temperatures as low as 160 °C (320 °F); but, when using Curative Masterbatches, 170 °C (338 °F) is a minimum temperature to use if practical cure times are desired. These are guidelines for a simple, compression-molded part; in transfer molding or compression molding, where the stock flows significantly, enough shear heat may

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result to shorten "expected" cure times significantly. To attain maximum physical properties, cured parts of Viton™ must also be oven post-cured for 24 hr at a temperature between 200–260 °C (392–500 °F). In general, property values will reach 80–90% of maximum in 12 hr at 232 °C (450 °F). Parts thicker than 6 mm (0.25 in) should be step post-cured to avoid internal fissuring. Starting at 125 °C (257 °F), the heat can then be increased hourly to the final desired post-cure temperature. For more information, see technical bulletin "Viton™ Fluoroelastomers—Oven Post-Curing of Parts."

Safety and Handling

Before handling or processing Viton™ A-HV, read and be guided by the suggestions in the technical bulletin, "Handling Precautions for Viton™ and Related Chemicals."

Table 1. Viton™ A-HV Compared to E-45

Compound #		CSG0244-10	CSG0244-11	CSG0244-06	CSG0244-07
Viton™ A-HV		97.5	94.2		
Viton™ E-45				97.5	94.2
N-990		30	30	30	30
Calcium Hydroxide		6	6	6	6
Magnesium Oxide		3	3	3	3
Viton™ Curative No. 50		2.5		2.5	
Viton™ Curative No. 30			4		4
Viton™ Curative No. 20			1.8		1.8
		139	139	139	139
Compound Mooney Viscosity, ML1+10, 121 °C (250 °F)					
Init	(MU)	221	217	124	131
ML(1+10)	(MU)	182	182	64	65
Mooney Scorch, Small Rotor, 121 °C (250 °F), 30 min Test					
ML	(MU)	99	98	34	36
T2	(min)	1.22	0.39	>30	>30
T5	(min)	>30	1.22	>30	>30
MDR at 177 °C (351 °F), 10 min, 0.5° Arc					
ML	(dNm)	5.29	5.29	1.13	1.23
MH	(dNm)	34.7	34.2	28.7	26.0
ts2	(min)	0.95	0.88	1.11	1.01
T'50	(min)	1.52	1.45	1.45	1.39
T'90	(min)	2.10	2.07	2.31	2.30
T'95	(min)	2.53	2.50	2.90	2.84
Vulcanizate Properties					
Press-Cured 10 min at 177 °C (351 °F), Oven Post-Cured 24 hr at 232 °C (418 °F)					
Original Properties at 23 °C (73 °F)—No Post-Cure					
Hardness	(Shore A)	73	74	74	74
10% Modulus	(MPa)	1.06	1.04	1.15	1.01
25% Modulus	(MPa)	1.82	1.87	1.88	1.78
50% Modulus	(MPa)	3.03	3.19	2.77	2.79
100% Modulus	(MPa)	6.06	6.14	4.73	5.01
Tensile at Break	(MPa)	12.3	12.2	9.5	10.6
Elongation at Break	(%)	216	208	234	251
Die B Tear	(kN/m)	40.5	42.1	41.8	40.4
Die C Tear	(kN/m)	18.3	19.2	19.8	19.9

continued

Table 1. Viton™ A-HV Compared to E-45 (continued)

Compound #		CSG0244-10	CSG0244-11	CSG0244-06	CSG0244-07
Original Properties at 23 °C (73 °F)—Post-Cured					
Hardness	(Shore A)	77	76	79	77
10% Modulus	(MPa)	1.11	1.12	1.34	1.14
25% Modulus	(MPa)	2.02	2.08	2.19	2.01
50% Modulus	(MPa)	3.52	3.72	3.43	3.35
100% Modulus	(MPa)	8.05	8.44	6.86	7.06
Tensile at Break	(MPa)	16.6	16.1	11.1	14.1
Elongation at Break	(%)	187	175	152	183
Die B Tear	(kN/m)	46.4	46.3	47.4	47.8
Die C Tear	(kN/m)	19.7	20.0	20.8	20.4
Hot Air Aged 72 hr at 275 °C (527 °F)					
Hardness	(Shore A)	74	76	80	79
Hardness	(Pt. Change)	−2	0	1	2
100% Modulus	(MPa)	5.5	5.7	4.4	5.1
100% Modulus	(% Change)	−32	−33	−36	−28
Tensile at Break	(MPa)	12.2	11.8	10.7	10.5
Tensile at Break	(% Change)	−26	−27	−4	−26
Elongation at Break	(%)	211	216	243	229
Elongation at Break	(% Change)	13	23	60	25
Hot Air Aged 168 hr at 275 °C (527 °F)					
Hardness	(Shore A)	78	80	84	84
Hardness	(Pt. Change)	2	4	5	7
100% Modulus	(MPa)	4.5	5.3	4.8	5.3
100% Modulus	(% Change)	−44	−37	−31	−25
Tensile at Break	(MPa)	8.8	8.2	7.8	7.8
Tensile at Break	(% Change)	−47	−49	−30	−45
Elongation at Break	(%)	216	189	192	178
Elongation at Break	(% Change)	16	8	27	−2
Hot Air Aged 504 hr at 250 °C (482 °F)					
Hardness	(Shore A)	79	80	84	84
Hardness	(Pt. Change)	2	5	6	7
100% Modulus	(MPa)	5.9	6.5	5.2	6.0
100% Modulus	(% Change)	−27	−24	−24	−16
Tensile at Break	(MPa)	11.1	10.6	9.9	9.9
Tensile at Break	(% Change)	−33	−34	−11	−30
Elongation at Break	(%)	198	190	209	198
Elongation at Break	(% Change)	6	9	37	9
Compression Set, Pellet, Method B, No Post-Cure					
70 hr at 150 °C (302 °F)	(%)	46	53	56	65
70 hr at 200 °C (392 °F)	(%)	64	71	72	80
Compression Set, Pellet, Method B, Post-Cured					
70 hr at 200 °C (392 °F)	(%)	16	16	18	19
70 hr at 230 °C (446 °F)	(%)	32	34	40	40

Table 2. Viton™ A-HV Compared to A-700 and A-500

	A-HV	A-700	A-500
Viton™ A-HV	97.5	—	—
Viton™ A-700	—	97.5	—
Viton™ A-500	—	—	97.5
MT Black (N-990)	30	30	30
Maglite® D	3	3	3
Calcium Hydroxide	6	6	6
Viton™ Curative No. 50	2.5	2.5	2.5
Mooney Scorch, MS at 121 °C (250 °F)			
Minimum Viscosity, units	96	64	48
Time to 1 pt rise, min	16	13	12
Time to 2 pt rise, min	26	—	—
Time to 5 pt rise, min	—	—	—
Time to 10 pt rise, min	—	—	—
Pts rise to 30 min			
MDR at 177 °C (351 °F), 0.5° Arc, 6 min Motor			
Minimum Viscosity, ML, N·m	0.6	0.3	0.2
Scorch Time, ts2, min	0.7	0.8	0.9
Maximum Torque, MH, N·m	3.8	3.2	3.1
50% Cure, M50, N·m	2.2	1.7	1.6
Time to 50% Cure, t'50, min	1.4	1.3	1.3
90% Cure, M90, N·m	3.5	2.9	2.8
Time to 90% Cure, t'90, min	2.2	1.9	2
Slabs Cured 10 min at 177 °C (351 °F) and Post-Cured 24 hr at 232 °C (450 °F)			
Stress/Strain—Original at 23 °C (73 °F)			
100% Modulus, MPa	7.7	6.6	6.4
Tensile Strength at Break, MPa	15.8	13.6	13.9
Elongation at Break, %	195	210	220
Hardness, Durometer A	72	73	73
Original, ASTM, Die C Tear, Tested at 23 °C (73 °F)			
kN·m, pli	21.4	23.7	22
Stress/Strain at 23 °C (73 °F)—After Aging 70 hr at 200 °C (392 °F)			
100% Modulus, MPa	8.1	7.3	6.8
Tensile Strength at Break, MPa	15.4	15.2	14.9
Elongation at Break, %	185	200	220
Hardness, Durometer A	76	74	76
Stress/Strain at 23 °C (73 °F)—After Aging 168 hr at 200 °C (392 °F)			
100% Modulus, MPa	7.3	7.0	6.3
Tensile Strength at Break, MPa	13.8	13.6	14.1
Elongation at Break, %	175	190	220
Hardness, Durometer A	73	73	75

continued

Table 2. Viton™ A-HV Compared to A-700 and A-500 (continued)

	A-HV	A-700	A-500
Stress/Strain at 23 °C (73 °F)—After Aging 70 hr at 250 °C (482 °F)			
100% Modulus, MPa	8.5	7.4	7.1
Tensile Strength at Break, MPa	15.9	15.2	15
Elongation at Break, %	180	195	210
Hardness, Durometer A	75	75	77
Stress/Strain at 23 °C (73 °F)—After Aging 168 hr at 250 °C (482 °F)			
100% Modulus, MPa	8.3	7.4	7.1
Tensile Strength at Break, MPa	16.4	14.1	15.6
Elongation at Break, %	175	175	210
Hardness, Durometer A	75	74	78
Stress/Strain at 23 °C (73 °F)—After Aging 70 hr at 200 °C (392 °F) in IRM-902 Oil			
100% Modulus, MPa	7.8	6.7	6.3
Tensile Strength at Break, MPa	15.1	13.3	12.7
Elongation at Break, %	205	195	210
Hardness, Durometer A	72	73	74
% Change in Volume	2	2	4
Stress/Strain at 23 °C (73 °F)—After Aging 168 hr at 23 °C (73 °F) in 85% Reg. Fuel °C/15% Methanol			
100% Modulus, MPa	5.6	4.8	4.5
Tensile Strength at Break, MPa	8	7.1	7.1
Elongation at Break, %	140	150	160
Hardness, Durometer A	64	62	62
% Change in Volume	28	29	29
Compression Set, Method B, O-Rings, %			
70 hr at 150 °C (302 °F)	5	8	5
70 hr at 200 °C (392 °F)	11	11	11
168 hr at 200 °C (392 °F)	15	18	19
22 hr at 232 °C (450 °F)	7	12	11
Temperature Retraction			
TR-10, °C (°F)	–14 (6.8)	–16 (3.2)	–16 (3.2)

Test Procedures

Property Measured	Test Procedure
Compression Set	ASTM D395, Method B (25% deflection)
Compression Set, O-Rings	ASTM D1414
Hardness	ASTM D2240-91, durometer A
MDR (moving die rheometer)	ASTM D5289
Mooney Scorch	ASTM D1646, small rotor at 121 °C (250 °F)
Mooney Viscosity	ASTM D1646, large rotor at 121 °C (250 °F)
Property Change After Heat Aging	ASTM D573
Stress/Strain Properties 100% Modulus Tensile Strength (T-B) Elongation (E-B)	ASTM D412, pulled at 8.5 mm/sec (20 in/min)
Tear Die B and Tear Die C	ASTM D624
Temperature Retraction	ASTM D1329
Volume Change in Fluids	ASTM D471

Note: Test temperature is 23 °C (73 °F), except where specified otherwise.

For more information, visit Viton.com

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