



Viton[®] fluoroelastomer

From DuPont Performance Elastomers

Technical Information

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Viton[®] A-401C

Introduction

Viton[®] A-401C* fluoroelastomer is an incorporated cure “A-family” dipolymer designed for compression molding of sealing devices that must meet major fluoroelastomer specifications. In addition to the heat and chemical resistance characteristics typical of Viton[®] fluoroelastomers, Viton[®] A-401C offers significant improvements in processing and rheology. Viton[®] A-401C can be blended with similar Viton[®] types to provide variations in processing, properties, and shrinkage.

Compared with Viton[®] E-60C, Viton[®] A-401C features:

- Fully precompounded
 - O-ring curative level
- Improved compression molding
 - increased mold flow
 - easier mold release
 - less mold fouling
- Improved extrusion
- Increased cure rate
- Improved compression set resistance
- Same mold shrinkage as Viton[®] E-60C

Applications

Viton[®] A-401C is highly recommended for O-rings, extruded cord, gaskets, seals, and profiles. Viton[®] A-401C can be formulated to meet fluoroelastomer specifications Mil-R-83248B, AMS 7276D, and AMS 7259A.

Use of Viton[®] A-401C

Table 1 compares compounds of Viton[®] A-401C, Viton[®] A, Viton[®] E-60C, and Viton[®] A-201C. *Table 2* compares the effects of carbon black levels in Viton[®] A-401C, and *Table 3* compares the use of mineral fillers in Viton[®] A-401C. *Table 4* lists the performance of Viton[®] A-401C to fluoroelastomer specifications AMS 7276D and Mil-R-83248B (Amendment I).

Product Description

Chemical Composition	Dipolymer of hexafluoropropylene and vinylidene fluoride, plus cure chemicals
Physical Form	Slab
Color	Off-white
Odor	None
Specific Gravity	1.82
Solubility	Low molecular weight esters and ketones
Storage Stability	Excellent
Mooney Viscosity (ML 1 + 10 at 121°C [250°F])	42

Safety and Handling

Before handling or processing Viton[®] A-401C, read and be guided by the recommendations in the DuPont Performance Elastomers technical bulletin “Handling Precautions for Viton[®] and Related Chemicals.”

Viton[®] A-401C should be handled like other Viton[®] fluoroelastomers. Keep off skin and wash well after handling. For the safe handling of other compounding ingredients, refer to the respective manufacturers’ literature.

*Viton[®] A-401C was formerly VTR-6600.

Table 1
Performance of Viton® A-401C in Typical Compounds

	A Viton® A-401C	B Viton® A	C Viton® E-60C	D Viton® A-201C
Viton® A-401C	100	—	—	—
Viton® A	—	94.35	—	—
Viton® E-60C	—	—	100	—
Viton® A-201C	—	—	—	100
High-activity MgO	3	3	3	3
Calcium Hydroxide	6	6	6	6
MT Black (N990)	30	30	30	30
Viton® Curative #20	—	1.65	—	—
Viton® Curative #30	—	4	—	—
Stock Properties				
Viscosity, ML 1 + 10 at 121°C [250°F]				
Units	80	106	78	42
Mooney Scorch, MS at 121°C [250°F]				
Minimum, in-lb	43	57	41	23
2-pt rise, min	17.9	>30	>30	>30
5-pt rise, min	>30	—	—	—
ODR at 177°C [350°F], Microdie, 3° Arc, 15 min				
M _L , in-lb	15	18	11	9
t _{s2} , min	1.7	2.8	2.2	1.9
t _{c90} , min	3.2	7.0	4.5	3.3
M _{c90} , in-lb	112	127	111	103
M _{Hr} , in-lb	122	139	122	113
Rosand Capillary Rheometer at 100°C [212°F], 1.5 mm Die, L/D = 0/1				
<i>Piston Speeds</i>	<i>Shear Rate</i>	<i>Pressure, MPa</i>		
12.7 mm/min	113 s ⁻¹	7.6	8.7	7.6
50.8 mm/min	452 s ⁻¹	10.7	11.5	12.1
127 mm/min	1130 s ⁻¹	18.7	16.1	28.0
Vulcanizate Properties				
Slabs Cure: 10 min at 177°C [350°F]				
Post Cure: 24 hr at 232°C [450°F]				
Stress/Strain at 23°C [73°F]—Original, no post cure				
100% Modulus, MPa [psi]	4.6 [665]	5.2 [755]	4.2 [610]	4.0 [575]
Tensile Strength, MPa [psi]	9.9 [1,440]	9.6 [1,390]	9.0 [1,305]	8.8 [1,275]
Elongation at Break, %	257	202	266	261
Hardness, durometer A, points	74	75	74	77
Stress/Strain at 23°C [73°F]—Original, post cure				
100% Modulus, MPa [psi]	6.4 [925]	8.5 [1,235]	6.3 [920]	5.9 [855]
Tensile Strength, MPa [psi]	13.4 [1,950]	16.2 [2,345]	12.9 [1,870]	13.0 [1,890]
Elongation at Break, %	199	173	194	211
Hardness, durometer A, points	75	79	76	79
Stress/Strain at 23°C [73°F]—After aging 70 hr at 200°C [392°F]				
100% Modulus, MPa [psi]	6.9 [995]	9.2 [1,340]	6.8 [985]	5.9 [850]
Tensile Strength, MPa [psi]	14.0 [2,035]	16.4 [2,385]	13.5 [1,955]	11.9 [1,725]
Elongation at Break, %	198	168	198	195
Hardness, durometer A, points	78	78	77	83
Stress/Strain at 23°C [73°F]—After aging 168 hr at 200°C [392°F]				
100% Modulus, MPa [psi]	7.0 [1,015]	9.2 [1,340]	7.1 [1,035]	6.2 [900]
Tensile Strength, MPa [psi]	13.9 [2,020]	16.9 [2,455]	13.4 [1,940]	13.0 [1,880]
Elongation at Break, %	187	176	187	200
Hardness, durometer A, points	76	79	77	80
Stress/Strain at 23°C [73°F]—After aging 70 hr at 232°C [450°F]				
100% Modulus, MPa [psi]	7.2 [1,050]	9.4 [1,365]	7.1 [1,030]	6.2 [905]
Tensile Strength, MPa [psi]	14.0 [2,035]	15.9 [2,300]	13.9 [2,010]	12.4 [1,795]
Elongation at Break, %	177	152	183	184
Hardness, durometer A, points	80	79	80	82
Compression Set, Method B, O-Rings, %				
70 hr at 23°C [73°F]	6	7	10	6
70 hr at 200°C [392°F]	15	19	21	16
168 hr at 200°C [392°F]	21	30	29	26
336 hr at 200°C [392°F]	29	—	38	47
70 hr at 232°C [450°F]	37	46	47	38

Table 2
Effect of Carbon Black Level in Viton® A-401C

	E 60 phr	F 45 phr	G 30 phr	H 15 phr	I 5 phr	J 2 phr
Viton® A-401C	100	100	100	100	100	100
High-activity MgO	3	3	3	3	3	3
Calcium Hydroxide	6	6	6	6	6	3
MT Black (N990)	60	45	30	15	5	2
Stock Properties						
Viscosity, ML 1 + 10 at 121°C [250°F]						
Units	115	98	80	67	62	57
Mooney Scorch, MS at 121°C [250°F]						
Minimum, in-lb	62	51	43	37	33	29
2-pt rise, min	14.2	13.1	17.9	21.0	>30	>30
5-pt rise, min	29.1	28.7	>30	>30	—	—
10-pt rise, min	>30	>30	—	—	—	—
ODR at 177°C [350°F], Microdie, 3° Arc, 15 min						
M _L , in-lb	23	21	15	17	15	14
t _{s2} , min	1.3	1.5	1.7	1.9	2.1	2.8
t _{c90} , min	2.6	2.8	3.2	3.4	3.6	4.6
M _{c90} , in-lb	150	138	112	108	93	84
M _H , in-lb	164	151	122	118	102	92
Vulcanizate Properties						
Slabs Cure: 10 min at 177°C [350°F]						
Post Cure: 24 hr at 232°C [450°F]						
Stress/Strain at 23°C [73°F]—Original, no post cure						
100% Modulus, MPa [psi]	7.1 [1,030]	6.1 [885]	4.6 [665]	2.9 [425]	1.8 [265]	1.4 [205]
Tensile Strength, MPa [psi]	9.2 [1,340]	9.8 [1,420]	9.9 [1,440]	8.6 [1,250]	7.4 [1,075]	5.6 [810]
Elongation at Break, %	180	223	257	254	269	252
Hardness, durometer A, points	87	81	74	63	57	53
Stress/Strain at 23°C [73°F]—Original, post cure						
100% Modulus, MPa [psi]	11.9 [1,730]	9.4 [1,360]	6.4 [925]	3.7 [535]	2.1 [310]	1.4 [210]
Tensile Strength, MPa [psi]	14.5 [2,105]	13.9 [2,020]	13.4 [1,950]	11.4 [1,660]	9.7 [1,405]	6.5 [945]
Elongation at Break, %	130	156	199	216	240	239
Hardness, durometer A, points	90	84	75	63	57	53
Stress/Strain at 23°C [73°F]—After aging 70 hr at 200°C [392°F]						
100% Modulus, MPa [psi]	12.1 [1,760]	9.8 [1,415]	6.9 [995]	3.7 [530]	2.0 [295]	1.5 [215]
Tensile Strength, MPa [psi]	14.1 [2,050]	14.6 [2,115]	14.0 [2,035]	11.6 [1,675]	9.4 [1,360]	7.4 [1,080]
Elongation at Break, %	124	159	198	220	243	255
Hardness, durometer A, points	93	86	78	67	60	57
Stress/Strain at 23°C [73°F]—After aging 168 hr at 200°C [392°F]						
100% Modulus, MPa [psi]	12.7 [1,840]	10.3 [1,495]	7.0 [1,015]	3.7 [540]	2.2 [315]	1.6 [225]
Tensile Strength, MPa [psi]	14.6 [2,115]	14.2 [2,055]	13.9 [2,020]	12.1 [1,750]	9.6 [1,390]	8.1 [1,170]
Elongation at Break, %	120	144	187	217	234	258
Hardness, durometer A, points	93	87	76	68	61	58
Stress/Strain at 23°C [73°F]—After aging 70 hr at 232°C [450°F]						
100% Modulus, MPa [psi]	13.4 [1,945]	10.9 [1,580]	7.2 [1,050]	3.8 [550]	2.0 [290]	1.5 [220]
Tensile Strength, MPa [psi]	13.8 [2,005]	13.7 [1,980]	14.0 [2,035]	12.7 [1,840]	9.3 [1,345]	7.3 [1,060]
Elongation at Break, %	104	127	177	220	241	249
Hardness, durometer A, points	92	86	80	69	62	57
Compression Set, Method B, O-Rings, %						
70 hr at 23°C [73°F]	15	9	6	6	3	3
70 hr at 200°C [392°F]	21	18	15	13	9	12
168 hr at 200°C [392°F]	29	26	21	19	18	18
336 hr at 200°C [392°F]	38	33	29	25	25	24
70 hr at 232°C [450°F]	46	41	37	35	35	31

Table 3
Effect of Mineral Fillers on Viton® A-401C

	K MT Black	L Albaglos®	M Nyad® 400	N Celite® 350	O Blanc Fixe	P Ti-Pure® R960
Viton® A-401C	100	100	100	100	100	100
High-activity MgO	3	3	3	3	3	3
Calcium Hydroxide	6	6	6	6	6	3
MT Black (N990)	30	—	—	—	—	—
Albaglos®	—	30	—	—	—	—
Nyad® 400	—	—	30	—	—	—
Celite® 350	—	—	—	30	—	—
Blanc Fixe	—	—	—	—	30	—
Ti-Pure® R960	—	—	—	—	—	30
Stock Properties						
Viscosity, ML 1 + 10 at 121°C [250°F]						
Units	80	87	80	107	75	78
Mooney Scorch, MS at 121°C [250°F]						
Minimum, in-lb	43	46	42	56	39	40
2-pt rise, min	17.9	>30	>30	>30	>30	>30
5-pt rise, min	>30	—	—	—	—	—
ODR at 177°C [350°F], Microdie, 3° Arc, 15 min						
M _L , in-lb	15	22	20	24	19	19
t _{s2} , min	1.7	1.7	1.9	1.7	2.0	1.9
t _{c90} , min	3.2	3.6	3.0	2.9	3.5	4.1
M _{c90} , in-lb	112	114	112	122	104	98
M _{Hr} , in-lb	122	124	122	132	113	106
Vulcanizate Properties						
Slabs Cure: 10 min at 177°C [350°F]						
Post Cure: 24 hr at 232°C [450°F]						
Stress/Strain at 23°C [73°F]—Original, no post cure						
100% Modulus, MPa [psi]	4.6[665]	3.9[565]	4.1[600]	5.9[850]	2.7[395]	2.7[395]
Tensile Strength, MPa [psi]	9.9[1,440]	8.8[1,270]	7.4[1,075]	9.8[1,420]	7.0[1,010]	8.9[1,295]
Elongation at Break, %	257	225	248	240	250	307
Hardness, durometer A, points	74	67	67	76	61	64
Stress/Strain at 23°C [73°F]—Original, post cure						
100% Modulus, MPa [psi]	6.4[925]	6.5[945]	8.4[1,225]	14.4[2,090]	3.4[490]	4.1[600]
Tensile Strength, MPa [psi]	13.4[1,950]	12.8[1,860]	11.4[1,660]	15.8[2,290]	9.9[1,435]	11.0[1,595]
Elongation at Break, %	199	153	154	110	211	176
Hardness, durometer A, points	75	67	67	79	63	66
Stress/Strain at 23°C [73°F]—After aging 70 hr at 200°C [392°F]						
100% Modulus, MPa [psi]	6.9[995]	6.7[975]	8.4[1,225]	14.9[2,160]	3.7[535]	4.2[605]
Tensile Strength, MPa [psi]	14.0[2,035]	13.7[1,990]	11.1[1,615]	16.4[2,375]	10.6[1,540]	12.0[1,745]
Elongation at Break, %	198	159	146	111	215	188
Hardness, durometer A, points	78	69	68	80	64	66
Stress/Strain at 23°C [73°F]—After aging 168 hr at 200°C [392°F]						
100% Modulus, MPa [psi]	7.0[1,015]	6.1[880]	7.2[1,050]	12.2[1,775]	3.2[470]	3.8[545]
Tensile Strength, MPa [psi]	13.9[2,020]	13.1[1,905]	10.7[1,555]	14.9[2,165]	9.6[1,390]	12.0[1,745]
Elongation at Break, %	187	187	203	129	242	214
Hardness, durometer A, points	76	70	69	79	64	67
Stress/Strain at 23°C [73°F]—After aging 70 hr at 232°C [450°F]						
100% Modulus, MPa [psi]	7.2[1,050]	6.3[915]	7.5[1,090]	12.7[1,840]	3.2[460]	3.8[545]
Tensile Strength, MPa [psi]	14.0[2,035]	13.2[1,920]	10.8[1,565]	15.1[2,190]	9.7[1,410]	12.8[1,860]
Elongation at Break, %	177	179	189	125	245	220
Hardness, durometer A, points	80	70	69	78	63	66
Compression Set, Method B, O-Rings, %						
70 hr at 23°C [73°F]	6	3	4	6	6	6
70 hr at 200°C [392°F]	15	18	13	18	12	12
168 hr at 200°C [392°F]	21	28	24	25	21	21
336 hr at 200°C [392°F]	29	41	29	32	29	26
70 hr at 232°C [450°F]	37	41	35	38	34	31

Table 4
Performance of Viton® A-401C in Fluoroelastomer Specifications

Q Viton® A-401C			
Viton® A-401C	100		
High-activity MgO	3		
Calcium Hydroxide	6		
MT Black (N990)	30		
Vulcanizate Properties		Mil-R-83248B (Amendment I)	AMS 7276D
		Slabs Cure: 10 min at 177°C [350°F] Post Cure: 24 hr at 232°C [450°F]	
Stress/Strain at 23°C [73°F]—Original, post cure			
Tensile Strength, MPa [psi]	13.7 [1,985]	9.65 [1,400]	9.65 [1,400]
Elongation at Break, %	191	125	125
Hardness, durometer A, points	76	75 ± 5	75 ± 5
TR ₁₀ (max., °C [°F])	-15 [+5]	-15 [+5]	-15 [+5]
Specific Gravity	1.84	—	—
Stress/Strain at 23°C [73°F]—After aging 70 hr at 275°C [527°F]			
Tensile Strength, % change (max.)	-23	-35	-35
Elongation at Break, % change (max.)	+21	-15	-15
Hardness, pts change	0	-5 to +10	0 to +10
Weight Loss, %	4	10	10
Stress/Strain at 23°C [73°F]—After aging 70 hr at 23°C [73°F] in TT-S-735 type III (ASTM Reference Fuel B)			
Tensile Strength, % change (max.)	-8	-20	-15
Elongation at Break, % change (max.)	-3	-20	-15
Hardness, pts change	-1	-5 to +5	-5 to +5
Volume Swell, %	+1	+1 to +10	0 to +5
Stress/Strain at 23°C [73°F]—After aging 70 hr at 175°C [347°F] in AMS 3021 (Stauffer 7700 Blend)			
Tensile Strength, % change (max.)	-15	-30	-30
Elongation at Break, % change (max.)	-7	-20	-20
Hardness, pts change	-10	0 to -15	-15 to +5
Volume Swell, %	+15	+1 to +20	0 to +20
Compression Set, Method B, %, O-Rings 25 × 3.5 mm (0.984 × 0.139 in)			
70 hr at 23°C [73°F]	6	15	—
166 hr at 175°C [347°F]	16	20	—
22 hr at 200°C [392°F]	9	20	—
70 hr at 200°C [392°F]	16	—	20
336 hr at 200°C [392°F]	30	—	40

Test Procedures

Property Measured	Test Procedure
Compression Set	ASTM D395, Method B (25% deflection)
Compression Set, O-Rings	ASTMD1414
Hardness	ASTM D2240, durometer A
Mooney Scorch	ASTM D1646, using small rotor. Minimum viscosity and time to a 1-, 2-, 5-, and 10-unit rise are reported.
Mooney Viscosity	ASTM D1646, ten pass, 121°C [250°F]
ODR (vulcanization characteristics measured with an oscillating disk cure meter)	ASTMD2084
Property Change After Oven Heat-Aging	ASTMD573
Stress/Strain Properties 100% Modulus Tensile Strength Elongation at Break	ASTM D412, pulled at 8.5 mm/sec (20 in/min)
Volume Change in Fluids	ASTMD471
Temperature Retraction	ASTMD1329

Note: Test temperature is 24°C [75°F], except where specified otherwise.

Proprietary Materials

Sources of compounding ingredients used in developing the information in this bulletin are listed below. This is not to imply that comparable ingredients from other sources might not be equally usable.

Material	Composition	Supplier
Albaglos®	Calcium Carbonate (precipitated)	Pfizer, Inc. M.P.M. Division New York, NY 10017
Blanc Fixe	Barium Sulfate (precipitated)	Whittaker, Clark & Daniels (Distributor) South Plainfield, NJ 07080
Celite® 350	Diatomaceous Silica	Manville Corp. & Subsidiaries Denver, CO 80217
Nyad® 400	Calcium Metasilicate	Interpace Corporation Parsippany, NJ 07054
Ti-Pure® R960	Rutile Titanium Oxide	DuPont Company Wilmington, DE 19898

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