



Viton[®] fluoroelastomer

From DuPont Performance Elastomers

A-601C

Introduction

Viton[®] A-601C* fluoroelastomer is a new generation incorporated cure “A-family” dipolymer designed for compression molding of sealing devices that must meet major fluoroelastomer specifications. In addition to the chemical and heat resistance characteristics typical of fluoroelastomers, Viton[®] A-601C offers significant improvements in processing and rheology. Viton[®] A-601C can be blended with similar Viton[®] types to provide variations in processing, properties, and physical properties.

Viton[®] A-601C features:

- Fully precompounded, O-ring curative levels
- Improved processing for a high viscosity polymer
 - improved mold flow
 - easier mold release
 - less mold fouling
- Excellent scorch safety
- Excellent physical properties
 - improved compression set resistance

Applications

- Compression molding of O-rings, gaskets, and other sealing devices.
- Applications where a higher polymer viscosity is needed for molding operations. Can be used to modify viscosity of other types of Viton[®].
- Can be formulated to meet FKM specifications Mil-R-83248C and AMS 7276E.

Use of Viton[®] A-601C

Table 1 compares compounds of Viton[®] A-601C, A-201C, A-401C, and B-601C. *Table 2* compares the effects of carbon black levels in A-601C, and *Table 3* compares the use of mineral fillers in A-601C. *Table 4* lists the performance of A-601C to AMS 7276E and Mil-R-83248C specifications.

Safety and Handling 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])	60

Before handling or processing Viton[®] A-601C, read and follow the recommendations in DuPont Performance Elastomers bulletin “Handling Precautions for Viton[®] and Related Chemicals.”

Viton[®] A-601C should be handled like other types of Viton[®]. For the safe handling of other compounding ingredients, please refer to the respective manufacturers' information.

*Viton A-601C was formerly VTR-6806.

Table 1
The Performance of Viton® A-601C in Typical Compounds

	A Viton® A-601C	B Viton® A-401C	C Viton® A-201C	D Viton® B-601C
Viton® A-601C	100	—	—	—
Viton® A-401C	—	100	—	—
Viton® A-201C	—	—	100	—
Viton® B-601C	—	—	—	100
High Activity Magnesium Oxide	3	3	3	3
Calcium Hydroxide	6	6	6	6
Carnauba Wax	1	1	1	1
MT Black (N990)	30	30	30	30
Stock Properties				
Viscosity, ML 1+10, 121°C (250°F)				
Units	100	70	47	103
Mooney Scorch, MS at 121°C (250°F)				
Minimum (in-lb)	100	69	48	55
2-pt rise (min.)	12.1	15.7	>30	16.2
5-pt rise (min.)	>30	>30	—	>30
ODR at 177°C (350°F), Microdie, 3° Arc, 15 min				
ML (in-lb)	24	16	9	22
Ts 2 (min.)	2.1	2.1	2.6	2.7
Tc 90 (min.)	3.8	3.7	4.3	6.1
Mc 90 (in-lb)	129	122	106	106
MH (in-lb)	140	133	117	115
ROSAND Capillary Rheometer at 100°C (212°F), 1.5 mm Die, L/D=0/1				
Piston Speeds	Shear Rate	Pressure, MPa*		
12.7 mm/min	113 s ⁻¹	8.7	6.9	5.6
50.8 mm/min	452 s ⁻¹	13.3	10.0	7.9
127 mm/min	1130 s ⁻¹	34.7	17.1	11.7
Vulcanizate Properties				
Slabs cured: 10'/177°C (350°F)				
Post-cured: 24 hr/232°C (450°F)				
Stress/Strain at 23°C (73°F)—Original, Post-Cured				
100% Modulus, MPa	7.9	7.0	6.5	6.7
(psi)	(1140)	(1010)	(940)	(975)
Tensile Strength, MPa	16.0	13.8	12.1	14.0
(psi)	(2320)	(1925)	(1750)	(2030)
Elongation at Break, %	187	175	170	203
Hardness, Durometer A, pts	77	78	78	76
Stress/Strain at 23°C (73°F)—After aging 70 hr/200°C (392°F)				
100% Modulus, MPa	7.8	6.9	7.2	6.6
(% change)	-1.3	-1.4	10.8	-1.5
Tensile Strength, MPa	14.7	13.3	12.3	13.7
(% change)	-8.1	-3.6	1.7	-2.1
Elongation at Break, %	183	194	169	213
(% change)	-2.1	10.9	-0.6	4.9
Hardness, Durometer A, pts	77	78	77	75

* 1 MPa is equal to 145 psi

Table 1 (continued)
The Performance of Viton® A-601C in Typical Compounds

	A Viton® A-601C	B Viton® A-401C	C Viton® A-201C	D Viton® B-601C
Stress/Strain at 23°C (73°F)—After aging 168 hr/200°C (392°F)				
100% Modulus, MPa	7.7	7.6	6.7	6.6
(% change)	-2.5	8.6	3.1	-1.5
Tensile Strength, MPa	13.8	13.3	12.0	13.2
(% change)	-13.8	-3.6	-0.8	-5.7
Elongation at Break, %	171	174	179	198
(% change)	-8.6	-0.6	5.3	-2.5
Hardness, Durometer A, pts	77	78	79	77
Stress/Strain at 23°C (73°F)—After aging 70 hr/250°C (482°F)				
100% Modulus, MPa	6.9	6.8	5.8	5.0
(% change)	-12.7	-2.9	-10.8	-25.4
Tensile Strength, MPa	13.9	12.8	10.6	11.7
(% change)	-13.1	-7.2	-12.4	-16.4
Elongation at Break, %	174	172	173	208
(% change)	-7.0	-1.7	1.8	2.5
Hardness, Durometer A, pts	77	78	79	75
Stress/Strain at 23°C (73°F)—After aging 70 hr/275°C (527°F)				
100% Modulus, MPa	5.6	5.0	4.9	3.2
(% change)	-29.1	-28.6	-24.6	-52.2
Tensile Strength, MPa	10.6	10.7	9.0	8.6
(% change)	-33.8	-22.5	-25.6	-38.6
Elongation at Break, %	184	218	190	283
(% change)	-1.6	24.6	11.8	39.4
Hardness, Durometer A, pts	77	76	77	72
Compression Set, Method B, O-Rings, %				
70 hr/23°C (73°F)	6	7	9	11
22 hr/175°C (347°F)	6	9	6	11
22 hr/200°C (392°F)	11	14	14	14
70 hr/200°C (392°F)	20	20	21	24
168 hr/200°C (392°F)	29	30	36	37
70 hr/232°C (450°F)	36	44	47	50

Table 2
The Effect of Carbon Black Levels in Viton® A-601C

	F	G	H	I	J	K
	60 phr	45 phr	30 phr	15 phr	5 phr	5 phr
Viton® A-601C	100	100	100	100	100	100
High Activity Magnesium Oxide	3	3	3	3	3	3
Calcium Hydroxide	6	6	6	6	6	3
MT Black (N990)	60	45	30	15	5	5
Stock Properties						
Viscosity, ML 1+10, 121°C (250°F)						
Units	144	124	103	90	84	79
Mooney Scorch, MS at 121°C (250°F)						
Minimum (in-lb)	79	67	56	48	45	41
2-pt rise (min.)	28.3	23.1	18.8	>30	>30	>30
5-pt rise (min.)	>30	>30	>30	—	—	—
ODR at 177°C (350°F), Microdie, 3° Arc, 15 min						
ML (in-lb)	28	26	22	20	19	17
Ts 2 (min.)	1.7	1.8	2.0	2.4	2.7	3.1
Tc 90 (min.)	3.7	3.5	3.8	4.3	4.5	5.4
Mc 90 (in-lb)	151	139	124	107	93	91
MH (in-lb)	165	151	136	117	101	99
ROSAND Capillary Rheometer at 100°C (212°F), 1.5 mm Die, L/D=0/1						
Piston Speeds	Shear Rate	Pressure, MPa*				
12.7 mm/min	113 s ⁻¹	9.7	9.3	8.4	7.7	7.6
50.8 mm/min	452 s ⁻¹	13.9	13.8	12.6	11.9	12.2
127 mm/min	1130 s ⁻¹	41.9	37.3	35.6	28.2	22.3
Vulcanizate Properties						
Slabs cured: 10'/177°C (350°F)						
Post-cured: 24 hr/232°C (450°F)						
Stress/Strain at 23°C (73°F)—Original, Post Cured						
100% Modulus, MPa (psi)	11.7 (1700)	9.8 (1420)	6.4 (925)	3.6 (525)	2.1 (300)	1.8 (260)
Tensile Strength, MPa (psi)	16.6 (2400)	16.0 (2320)	15.3 (2225)	12.8 (1850)	10.9 (1575)	9.6 (1395)
Elongation at Break, %	159	175	219	236	265	254
Hardness, Durometer A, pts	89	83	76	64	58	57
Stress/Strain at 23°C (73°F)—After aging 70 hr/200°C (392°F)						
100% Modulus, MPa (% change)	12.4 6.0	9.7 -1.0	6.9 7.8	3.7 2.8	2.1 0.0	1.8 0.0
Tensile Strength, MPa (% change)	16.8 1.2	16.0 0.0	15.8 3.3	12.7 -0.8	10.8 -0.9	9.1 -5.2
Elongation at Break, % (% change)	149 -6.3	174 -0.6	210 -4.1	233 -1.3	269 1.5	250 -1.6
Hardness, Durometer A, pts	88	82	75	65	58	56

*1 MPa is equal to 145 psi

Table 2 (continued)
The Effect of Carbon Black Levels in Viton® A-601C

	F 60 phr	G 45 phr	H 30 phr	I 15 phr	J 5 phr	K 5 phr
Stress/Strain at 23°C (73°F)—After aging 168 hr/200°C (392°F)						
100% Modulus, MPa	12.4	9.9	6.9	3.8	2.2	1.8
(% change)	6.0	1.0	7.8	5.6	4.8	0.0
Tensile Strength, MPa	16.6	16.6	15.3	13.2	9.9	8.0
(% change)	0.0	3.8	0.0	3.1	-9.2	-16.7
Elongation at Break, %	142	175	201	233	240	233
(% change)	-10.7	0.0	-8.2	-1.3	-9.4	-8.3
Hardness, Durometer A, pts	89	83	75	65	58	56
Stress/Strain at 23°C (73°F)—After aging 70 hr/250°C (482°F)						
100% Modulus, MPa	13.2	9.9	6.0	3.1	1.8	1.4
(% change)	12.8	1.0	-6.3	-13.9	-14.3	-22.2
Tensile Strength, MPa	16.7	15.8	14.3	11.4	11.5	8.9
(% change)	0.6	-1.3	-6.5	-10.9	5.5	-7.3
Elongation at Break, %	127	152	189	218	299	284
(% change)	-20.1	-13.1	-13.7	-7.6	12.8	11.8
Hardness, Durometer A, pts	89	83	74	64	56	53
Stress/Strain at 23°C (73°F)—After aging 70 hr/275°C (527°F)						
100% Modulus, MPa	8.9	6.3	4.3	2.1	1.3	1.0
(% change)	-23.9	-35.7	-32.8	-41.7	-38.1	-44.4
Tensile Strength, MPa	12.3	12.0	11.5	10.4	8.6	7.7
(% change)	-25.9	-25.0	-24.8	-18.8	-21.1	-19.8
Elongation at Break, %	148	196	238	304	333	349
(% change)	-6.9	12.0	8.7	28.8	25.7	37.4
Hardness, Durometer A, pts	88	82	71	59	52	49
Compression Set, Method B, O-Rings, %						
70 hr/23°C (73°F)	9	10	6	6	3	3
22 hr/175°C (347°F)	11	9	6	6	4	4
22 hr/200°C (392°F)	14	11	9	9	7	6
70 hr/200°C (392°F)	20	19	11	11	11	11
168 hr/200°C (392°F)	29	23	21	17	17	17
70 hr/232°C (450°F)	39	33	31	26	23	29

Table 3
The Effect of Mineral Fillers in Viton® A-601C

	L	M	N	O	P	Q	
	MT	Albaglos®	Nyad®	Celite®	Blanc	Ti-Pure®	
	Black		400	350	Fixe	R960	
Viton® A-601C	100	100	100	100	100	100	
High Activity Magnesium Oxide	3	3	3	3	3	3	
Calcium Hydroxide	6	6	6	6	6	6	
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, 121°C (250°F)							
Units	103	111	103	131	91	90	
Mooney Scorch, MS at 121°C (250°F)							
Minimum (in-lb)	56	59	55	69	51	49	
2-pt rise (min.)	18.8	>30	>30	>30	>30	>30	
5-pt rise (min.)	>30	—	—	—	—	—	
ODR at 177°C (350°F), Microdie, 3° Arc, 15 min							
ML (in-lb)	22	26	24	27	20	20	
Ts 2 (min.)	2.0	2.3	2.2	2.0	2.4	2.7	
Tc 90 (min.)	3.8	4.1	3.5	3.3	4.1	5.1	
Mc 90 (in-lb)	124	116	112	126	104	98	
MH (in-lb)	136	126	122	137	113	106	
ROSAND Capillary Rheometer at 100°C (212°F), 1.5 mm Die, L/D=0/1							
Piston Speeds	Shear Rate	Pressure, MPa*					
12.7 mm/min	113 s ⁻¹	8.4	7.8	7.3	8.4	7.1	8.0
50.8 mm/min	452 s ⁻¹	12.6	11.8	10.3	12.1	11.6	11.5
127 mm/min	1130 s ⁻¹	35.6	29.3	19.5	24.2	23.9	26.2
Vulcanizate Properties							
Slabs cured: 10'/177°C (350°F)							
Post-cured: 24 hr/232°C (450°F)							
Stress/Strain at 23°C (73°F)—Original, Post-Cured							
100% Modulus, MPa	6.4	5.4	6.0	9.5	3.4	3.8	
(psi)	(925)	(790)	(870)	(1375)	(495)	(555)	
Tensile Strength, MPa	15.3	14.9	11.0	14.8	11.4	13.3	
(psi)	(2225)	(2160)	(1600)	(2145)	(1655)	(1925)	
Elongation at Break, %	219	216	230	188	258	228	
Hardness, Durometer A, pts	76	69	67	76	63	65	

*1 MPa is equal to 145 psi

Table 3 (continued)
The Effect of Mineral Fillers in Viton® A-601C

	L MT Black	M Albaglos®	N Nyad® 400	O Celite® 350	P Blanc Fixe	Q Ti-Pure® R-960
Stress/Strain at 23°C (73°F)—After aging 70 hr/200°C (392°F)						
100% Modulus, MPa	6.9	5.5	7.1	11.4	3.4	4.1
(% change)	7.8	1.9	18.3	20.0	0.0	7.9
Tensile Strength, MPa	15.8	13.8	11.4	15.3	9.3	12.6
(% change)	3.3	-7.4	3.6	3.4	-18.4	-5.3
Elongation at Break, %	210	198	198	143	203	200
(% change)	-4.1	-8.3	-13.9	-23.9	-21.3	-12.3
Hardness, Durometer A, pts	75	69	68	76	64	67
Stress/Strain at 23°C (73°F)—After aging 168 hr/200°C (392°F)						
100% Modulus, MPa	6.9	6.4	6.9	12.9	3.7	4.4
(% change)	7.8	18.5	15.0	35.8	8.8	15.8
Tensile Strength, MPa	15.3	14.0	11.2	16.9	11.4	13.1
(% change)	0.0	-6.0	1.8	14.2	0.0	-1.5
Elongation at Break, %	201	173	173	136	228	190
(% change)	-8.2	-19.9	-24.8	-27.7	-11.6	-16.7
Hardness, Durometer A, pts	75	69	68	77	64	67
Stress/Strain at 23°C (73°F)—After aging 70 hr/250°C (482°F)						
100% Modulus, MPa	6.0	6.3	6.6	9.4	2.9	3.3
(% change)	-6.3	16.7	10.0	-1.1	-14.7	-13.2
Tensile Strength, MPa	14.3	13.8	10.8	14.1	10.1	14.2
(% change)	-6.5	-7.4	-1.8	-4.7	-11.4	6.8
Elongation at Break, %	189	175	196	160	237	258
(% change)	-13.7	-19.0	-14.8	-14.9	-8.1	13.2
Hardness, Durometer A, pts	74	71	66	76	62	67
Stress/Strain at 23°C (73°F)—After aging 70 hr/275°C (527°F)						
100% Modulus, MPa	4.3	7.7	5.4	6.2	2.2	4.1
(% change)	-32.8	42.6	-10.0	-34.7	-35.3	7.9
Tensile Strength, MPa	11.5	12.9	9.0	8.9	9.0	10.5
(% change)	-24.8	-13.4	-18.2	-39.9	-21.1	-21.1
Elongation at Break, %	238	158	207	183	305	215
(% change)	8.7	-26.9	-10.0	-2.7	18.2	-5.7
Hardness, Durometer A, pts	71	74	65	76	59	71
Compression Set, Method B, O-Rings, %						
70 hr/23°C (73°F)	6	6	3	6	4	7
22 hr/175°C (347°F)	6	6	4	4	6	4
22 hr/200°C (392°F)	9	9	6	9	7	9
70 hr/200°C (392°F)	11	17	9	15	11	14
168 hr/200°C (392°F)	21	23	20	25	20	23
70 hr/232°C (450°F)	31	37	29	35	31	27

Table 4
The Performance of Viton® A-601C in Fluoroelastomer Specifications

	Viton® A-601C		
Viton® A-601C	100		
High Activity Magnesium Oxide	3		
Calcium Hydroxide	6		
MT Black (N990)	30		
Vulcanizate Properties		Mil-R-83248C	AMS 7276E
Slabs cured: 10'/177°C (350°F)		(Type I, Class I)	
Post-cured: 24 hr/232°C (450°F)			
Stress/Strain at 23°C (73°F)—Original, Post-Cured			
Tensile Strength, MPa (psi)	11.0 (1600)	9.65 (1400)	9.65 (1400)
Elongation at Break, %	175	125	125
Hardness, Durometer A, pts	77	75±5	75±5
TR 10 (max., °C [°F])	-17 (+1)	-15 (+5)	-15 (+5)
Specific Gravity	1.84	—	—
Stress/Strain at 23°C (73°F)—After aging 70 hr/270°C (518°F)			
Tensile Strength, % change (max.)	-25	-35	-35
Elongation at Break, % change (max.)	+10	-15	-15
Hardness, pts change	+1	-5 to +10	-5 to +10
Weight Loss, %	4	10	10
Stress/Strain at 23°C (73°F)—After aging 70 hr/23°C (73°F)/TT-S-735 Type III (ASTM Reference Fuel B)			
Tensile Strength, % change (max.)	-10	-20	-20
Elongation at Break, % change (max.)	-9	-20	-20
Hardness, pts change	-1	±5	±5
Volume Swell, %	+1	+0 to +5	+0 to +5
Stress/Strain at 23°C (73°F)—After aging 70 hr/200°C (392°F)/ARM-200 (AMS 3023)			
Tensile Strength, % change (max.)	-21	-35	-35
Elongation at Break, % change (max.)	-11	-20	-20
Hardness, pts change	-11	0 to -15	0 to -15
Volume Swell, %	+16	+1 to +25	+1 to +25
Compression Set, % (Method B)	4	10	10
Compression Set, Method B, % 25 × 3.5 mm (0.984 × 0.139 in) O-Rings			
22 hr/200°C (392°F)	8	15	15
70 hr/200°C (392°F)	14	—	—
336 hr/200°C (392°F)	28	40	40

Test Procedures
(Test temperature is 24°C [75°F] except where specified otherwise)

Property Measured	Test Procedure
Compression Set	ASTM D395-89, Method B (25% deflection)
Compression Set, O-Rings	ASTM D1414-90 ASTM D1229-79 (low temperature)
Hardness	ASTM D2240-87, Durometer A
Mooney Scorch	ASTM D1646-90, using small rotor. Minimum viscosity and time to a 1-, 2-, 5- and 10-unit rise are reported.
Mooney Viscosity	ASTM D1646-90, ten pass 121°C
ODR (vulcanization characteristics measured with an oscillating disk cure meter)	ASTM D2084-91
Property Change After Oven Heat-aging	ASTM D573-88
Stress/Strain Properties: 100% Modulus Tensile Strength Elongation at Break	ASTM D412-87, pulled at 8.5 mm/s (20 in/min)
Volume Change in Fluids	ASTM D471-79
Temperature Retraction	ASTM D1329-88
Low Temperature Brittleness	ASTM D2137-75

Proprietary Materials

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

Material	Composition	Supplier
Albaglos ^{®1}	Calcium Carbonate (precipitated)	Pfizer, Inc. M.P.M. Division 235 East 42 Street New York, NY 10017
Blanc Fixe	Barium Sulfate (precipitated)	Whittaker, Clark & Daniels (Distributor) 1000 Coolidge Street South Plainfield, NJ 07080
Celite [®] 350	Diatomaceous Silica	Manville Corp. & Subsidiaries Ken-Caryl Ranch P.O. Box 5108 Denver, CO 80217
Nyad [®] 400 ²	Calcium Metasilicate	Interpace Corporation 260 Cherry Hill Road Parsippany, NJ 07054
Ti-Pure [®] R960 ³	Rutile Titanium Oxide	DuPont Company Specialty Chemicals Wilmington, DE 19898

¹Trademark of Pfizer Corp.

²Trademark of Interpace Corp.

³Trademark of DuPont Company

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