DUPONT™ VAMAC® ULTRA DX (VMX2122)

HIGH VISCOSITY, PEROXIDE CURED AEM DIPOLYMER

Introduction

Vamac® ethylene acrylic elastomer, introduced in 1975, has been successfully used for many years in demanding automotive applications, where excellent resistance to heat, engine and transmission fluids or Blow-By is required. DuPont's latest manufacturing technology allows production of enhanced AEM grades that have significantly improved compared to the existing standard Vamac® elastomers. These grades, designated and sold as Vamac® Ultra, provide a step-change improvement in processability, performance and customer value for targeted applications, including for peroxide cure E/MA dipolymer grade with Vamac® Ultra DX (formerly VMX2122).

Major Performance Properties and Applications

Higher viscosity is the major difference between the standard AEM grades and the Vamac® Ultra family of polymers. Four Terpolymers of the Ultra grades, cured by Diamine curatives, are now commercial. Vamac® Ultra DX is a high viscosity version of Vamac® DP. It provides improved mold release, and is comparable to Vamac® Ultra Terpolymers. Increased green strength of compounds helps to avoid collapse during extrusion processes, and may help in applying reinforcement layers without cutting the inner tube by filaments. The optimized polymer structure ensures gains in physical properties, resulting in improved performance of rubber parts such as cables, seals, gaskets or extruded hoses.

Best physical properties of Vamac® Ultra DX are obtained in rubber parts having a hardness range between 50 and 90 Shore A.

Handling Precautions

Because Vamac® Ultra DX contains small amounts of residual methyl acrylate monomer, adequate ventilation should be provided during storage and processing to prevent worker exposure to methyl acrylate vapor. Additional information may be found in the Vamac® Ultra DX Safety Data Sheet (SDS), and DuPont bulletin, Safe Handling and Processing of Vamac® (VME-A10628), available on the DuPont website.

Like every other grade of Vamac®, Ultra DX is halogen-free.

DuPont™ Vamac® Ultra DX - Typical Product Properties

Property	Target Values	Test Method
Mooney Viscosity, ML 1+4 at 100 °C	26	ASTM D1646
Volatiles, wt%	≤0.4	Internal DuPont Test
Form, mm (in)	Bale size is nominally: 560 x 370 x 165 (22 x 15 x 7)	Visual Inspection
Color	Clear to light yellow translucent	Visual Inspection

Mixing

Vamac® Ultra DX has higher viscosity than Vamac® DP which permits better and faster dispersion of fillers and other compounding ingredients. Due to the general good scorch safety of peroxide cured compounds, changes in mixing cycle due to higher viscosity are not considered necessary.

Compounding and Physical Properties- Wire & Cable

Table 1 shows a comparison of Vamac® Ultra DX to Vamac® DP in identical formulations, which can be used as a starting point for halogen-free, flame retardant Wire & Cable applications.

Table 1 - Compound Properties, HFFR W&C Compound

Compound No.	**1**	**2**
Vamac® DP	100	
Vamac® Ultra DX (formerly VMX2122)		100
Naugard® 445	1	1
Armeen®18 D	0.5	0.5
Stearic Acid	1.5	1.5
Martinal® OL-111 LE	160	160
Dynasylan® 6490	1	1
Perkadox® 14-40B-GR	4.5	4.5
Rubber chem HVA-2	1	1
Total PHR	269	269
Mooney Viscosity ML 1+4, 100°C [MU] - Polymer	22	28
Mooney Viscosity ML 1+4, 100°C [MU] - Compound	41	51
MDR, 0.5°arc, 12 minutes at 180°C		
ML [dNm]	0.44	0.48
MH [dNm]	16.3	17.6
Ts2 [min]	0.48	0.49
T10 [min]	0.45	0.47
T50 [min]	1.36	1.34
T90 [min]	4.41	4.26
Press-Cure 15 minutes at 180°C		
Hardness Shore A (1 s)	76	79
Tensile Strength [MPa]	9.8	11.5
Elongation at break [%]	261	267
Modulus at 100% [MPa]	6.6	7.0
Tear Die C at 23°C [N/mm]	39	38
Trouser Tear Die A at 23°C [N/mm]	5.5	6.5
Tg by DSC [°C]	-29	-28

Heat ageing 168 hours at 160°C		
Hardness Shore A (1 s)	82	82
Delta Hardness [pts.]	7	4
Tensile Strength [MPa]	11.4	12.3
Delta TS [%]	16	7
Elongation at break [%]	209	241
Delta Elong. [%]	-20	-10
Modulus at 100 % [MPa]	8.3	8.6
Delta 100% [%]	26	23
Heat ageing 168 hours at 175°C		
Hardness Shore A (1 s)	82	83
Delta Hardness [pts.]	6	5
Tensile Strength [MPa]	10.8	11.7
Delta TS [%]	10	2
Elongation at break [%]	170	184
Delta Elongation [%]	-35	-31
Modulus at 100 % [MPa]	9.2	9.4
Delta 100% [%]	39	34
Fluid ageing 168 h at 150°C in IRM 903		
Hardness Shore A (1 s)	62	65
Delta Hardness [pts.]	-14	-13
Tensile Strength [MPa]	10.3	11.8
Delta TS [%]	5	3
Elongation at break [%]	163	181
Delta Elong. [%]	-38	-32
Modulus at 100 % [MPa]	7.1	7.2
Delta 100% [%]	8	3
Volume change [%]	29	27
Weight change [%]	17	16

Polymer and Compound Mooney are higher for Vamac® Ultra DX. The tighter crosslink network and faster cure lead to slightly higher Hardness, with higher Tensile Strength, and still slightly higher Elongation at Break. After Heat Ageing, Vamac® Ultra DX maintains its properties better than Vamac® DP

For more information regarding Vamac® for Wire & Cable applications please refer to the Technical Data Sheet "DuPont™ Vamac® for Halogen Free Flame Retardant (HFFR) Applications".

Compounding and Physical Properties – Carbon Black Filled Compounds

The major difference between compounds based on diamine cured Vamac® Terpolymers and peroxide cured Dipolymers is that process aids and plasticizers levels, that are needed for good low temperature performance and good mold release, should be kept to a minimum in Dipolymers, as they significantly impact the cure speed and crosslink density of peroxide cure systems. However, the addition of small amounts of Vanfre® VAM process aid showed positive impact on heat ageing in our lab tests.

As Carbon Black filled compounds shows in **Table 2**, Vamac® Ultra DX showed slightly faster cure, higher MH, along with significant better combination of tensile and Elongation and Break compared to Vamac® DP, whilst Compression Set was slightly inferior for Vamac® Ultra DX.

Table 2 - Compound Properties, 70 Shore A Carbon Black Filled Compounds

Compound No.	**3**	**4**	**5**	**6**
Vamac® DP	100			
Vamac® Ultra DX (formerly VMX2122)		100	100	100
Vanfre® VAM	0.75	0.75	0.75	0.75
Naugard® 445	1	1	1	1
Stearic Acid Reagent (95%)	0.5	0.5	0.5	0.5
Spheron® SOA (N 550)	50	50	50	50
Luperox® DC 40 P	8	8	8	8
Rubber chem HVA 2				3
Sartomer® SR 350 (TRIM)	3	3		
Diak™ No. 7 (TAIC)			3	
Mooney Viscosity ML 1+4, 100°C [MU]	30	38	43	46
MDR, 0.5°arc, 15 minutes at 180°C				
ML [dNm]	0.44	0.52	0.55	0.66
MH [dNm]	10.16	10.74	16.47	12.79
Ts2 [min]	0.94	0.93	0.91	0.36
T10 [min]	0.68	0.68	0.83	0.32
T50 [min]	1.54	1.55	1.91	0.61
T90 [min]	3.29	3.19	4.23	1.97
Press-Cure 10 minutes at 185°C				
Hardness Shore A (1 s)	67	66	71	68
Tensile Strength [MPa]	15.9	17.8	19.3	14.4
Elongation at break [%]	337	371	185	207
Modulus at 100% [MPa]	4.0	3.7	8.5	5.3
C. set, 70 h at 150°C [%], ISO 815	24	29	17	22
C. set, 168 h at 150°C [%], ISO 815	32	36	28	32
C. set, 94 h at 150°C [%], ASTM D 1414 (o'ring size AS-214)	24	31	11	29
C. set, 22 h at 150°C [%], VW PV 3307 (5 sec)	84	86	48	80
Tensile properties (type 2) at 150°C				
Tensile Strength [MPa]	5.0	5.0	4.2	3.5
Elongation at break [%]	142	148	75	90

Replacing TRIM as coagent by TAIC or HVA-2 will result in much higher MH and better Compression Set. However, properties measured at room temperature and 150°C are low, which may result in problems during molding or in the final application.

Optimization of Properties and Compression Set

To obtain a good combination of Compression Set resistance and physical properties, **Table 3** shows possibilities with combinations of coagents and alternative peroxide with higher decomposition temperature.

Table 3 – Optimizing Compression Set and Physical Properties – Coagent Level and Type

Compound No.	7	8	9	10
Vamac® Ultra DX (formerly VMX2122)	100	100	100	100
Naugard® 445	1	1	1	1
Stearic acid	0.5	0.5	0.5	0.5
Vanfre® VAM	0.5	0.5	0.5	0.5
Spheron® SOA N550	50	50	50	50
Rubber chem HVA 2	3	1.5		3
Sartomer® SR 350 (TRIM)			1.5	
Diak™ No. 7 (TAIC)		1.5	1.5	
Luperox® 101 XL 45				8
Luperox® DC 40 P	8	8	8	
MDR, 0.5°arc, 15 minutes at 180°C				
ML [dNm]	0.45	0.53	0.48	0.57
MH [dNm]	12.32	14.35	13.31	13.25
Ts2 [min]	0.38	0.42	0.74	0.37
T10 [min]	0.34	0.37	0.61	0.34
T50 [min]	0.68	1.18	1.57	0.79
T90 [min]	2.07	3.09	3.66	3.41
Press-Cure 5 minutes at 185°C				
Hardness Shore A (1 s)	68	69	68	68
Tensile Strength [MPa]	16.2	17.9	19.1	16.0
Elongation at break [%]	266	228	252	232
Modulus at 100% [MPa]	4.3	5.6	5.2	5.1
C. set, 70 h at 150°C [%], ISO 815	44	28	27	67
Press-Cure 10 minutes at 185°C				
Hardness Shore A (1 s)	67	69	68	67
Tensile Strength [MPa]	15.5	17.6	18.4	15.4
Elongation at break [%]	245	217	248	204
Modulus at 100% [MPa]	4.5	6.1	5.2	5.6
C. set, 70 h at 150°C [%], ISO 815	22	16	16	21

A combination of TAIC with either HVA-2 or TRIM offers good combinations of physical properties and Compression Set, as well as options for reduced cure times. Dicumylperoxide provided better

Compression Set, but results must be taken with care, as active oxygen index at same phr levels are different for both peroxides used.

Another study, shown in **Table 4**, looked at different peroxide levels to those typically used for Vamac® DP

Table 4 – Optimizing Compression Set and Physical Properties – Peroxide Level

Compound No.	11	12	13	14	15
Vamac® DP	100				
Vamac® Ultra DX (formerly VMX2122)		100	100	100	100
Naugard® 445	1	1	1	1	1
Stearic Acid Reagent (95%)	0.5	0.5	0.5	0.5	0.5
Vanfre® VAM	1.25	0.75	0.75	0.75	0.75
Spheron® SOA (N 550)	50	50	50	50	50
Sartomer® SR350 (TRIM)	1.5	1.5	1.5	1.5	1.5
Rubber chem Diak™ no 7	1.5	1.5	1.5	1.5	1.5
Luperox® DC 40 P	8	8	6.5	5	4
Luperox® 230 XL 40 SP					2.5
Mooney Viscosity ML 1+4, 100°C [MU]	34	45	42	44	39
MDR, 0.5°arc, 15 minutes at 180°C					
ML [dNm]	0.43	0.61	0.54	0.56	0.46
MH [dNm]	14.49	15.32	12.39	9.93	11.06
T10 [min]	0.64	0.60	0.63	0.64	0.61
T50 [min]	1.67	1.58	1.72	1.84	1.62
T90 [min]	4.22	3.64	4.05	4.49	4.40
Press-Cure 5 minutes at 185°C					
Hardness Shore A (1 s)	68	70	68	67	67
Tensile Strength [MPa]	17.0	18.2	16.7	15.8	16.1
Elongation at break [%]	225	238	282	370	309
Modulus at 100% [MPa]	6.1	6.3	4.7	3.6	3.8
C. set, 70 h at 150°C [%], ISO 815	26	27	23	31	42

Vamac® Ultra DX provided best Compression Set resistance at levels of about 6.5 phr Dicumylperoxide. This level also provides significant better Elongation at Break.

Injection Molding Performance

Vamac® Terpolymers are usually the material of choice for parts that are produced in Injection, Transfer or Compression Molding. In the past, dipolymers were rarely chosen due to the stickiness of peroxide cured AEM compounds. Vamac® Ultra DX showed excellent properties in demolding in lab trials, reaching performance levels comparable to Vamac® Ultra IP.

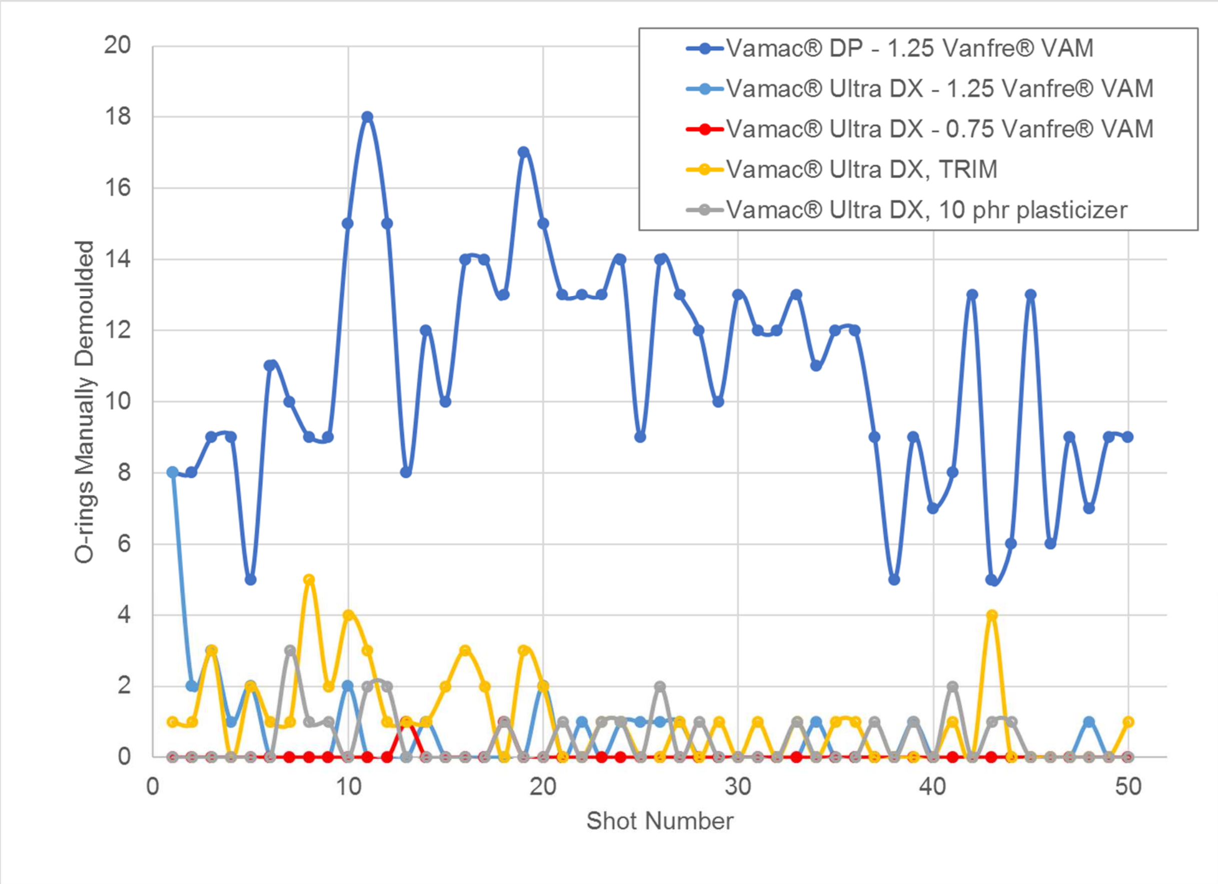
The procedure used in DuPont labs to determine mold release uses a horizontal injection molding machine, and a mold with 40 cavities of O-rings, Size AS-214. Cold runners are used, and central single point injection. The mold is cleaned according to the same procedure before each new compound is tested. Mold temperature has been set at 185°C. Cure time has been set at 30 seconds, where blister-free O-rings have been obtained. After mold opening, a brush is removing most of the O-rings from the mold. The number of O-rings sticking to the mold after brushing is counted.

Table 5 – Compounds used for Injection Moulding Tests

Compound No.	16	17	18	19	20
	DP	Ultra DX	Ultra DX: Reduced Process Aid	Ultra DX: TRIM	Ultra DX: Plasticizer
Vamac® DP	100				
Vamac® Ultra DX (formerly VMX2122)		100	100	100	100
Naugard® 445	1	1	1	1	1
Stearic Acid Reagent (95%)	0.5	0.5	0.5	0.5	0.5
Vanfre® VAM	1.25	1.25	0.75	0.75	0.75
Spheron® SOA (N 550)	50	50	50	50	60
Alcanplast PO 80					10
Rubber chem HVA 2	2	2	2		2
Sartomer® 350 (SR 350)				3	
Luperox® DC 40 P	8	8	8	8	8

Chart 1 shows the protocol of the injection moulding trials, reporting the number of O-rings that had to be removed from the mold manually throughout the 50 shots that have been made with each of the compounds shown in **Table 5**. Whilst the compound based on Vamac® DP could not be well demolded, nearly all the O-rings based on Vamac® Ultra DX were released either automatically or by brushing, requiring reduced manual demoulding.

Chart 1 – Injection Moulding Trial: Number of O'rings Manually Demoulded



Fluid Resistance, Comparison to AEM Terpolymers

Vamac® terpolymers are known for their excellent sealing capabilities and are extensively used for seals such as cam cover gaskets, oil pan gaskets or transmission seals in harsh automotive environments. Newer oils contain significant levels of additives that may promote additional crosslinking effects of AEM terpolymers during ageing. Vamac® Ultra DX dipolymer shows much less tendency to form such crosslinks during fluid ageing and maintains its original Elongation at Break much better, as shown in **Table 6**. Exxon MB Formula 5W30 is used as first fill oil for truck diesel engines, Fuchs Titan 5W30 as a first fill oil for passenger car gasoline engines by a well-known German OEM. Pentosin® FFL-4 is a lubricant used in automatic transmissions.

Table 6 – Comparison to Vamac® Terpolymers, Engine Oil Ageing

Compound No.	21	22	23	24
Vamac® GLS	100			
Vamac® Ultra LS		100		
Vamac® Ultra IP			100	
Vamac® Ultra DX (formerly VMX2122)				100
Naugard® 445	2	2	2	1
Vanfre® VAM	1	1	1	
Armeen® 18D PRILLS	0.5	0.5	0.5	
Stearic Acid Reagent (95%)	2	2	2	0.5
MT Thermax® Floform N 990	30	30	30	
Spheron® SOA (N 550)				25
Regal® SRF N 772	45	45	45	40
Alcanplast 810 TM	15	15	15	5
Rubber chem Diak™ no 1	1.3	1.3	1.3	
Alcanpoudre DBU-70	3	3	3	
Luperox® DC 40 P				8
Rubber chem HVA 2				2
Press-Cure 5 min / 190°C, Post-cure 4 h / 175°C				
Hardness Shore A (1 s)	64	65	64	70
Tensile Strength [MPa]	14.7	17.1	17.4	14.2
Elongation at break [%]	262	314	310	276
Modulus at 100% [MPa]	4.1	4.2	4.1	4.9
C.set, 24 h at 150°C [%], ISO 815	16.3	13.5	11.4	14.5
C.set, 94 h at 150°C [%], VW PV3307	67.9	56.8	52.2	89.3
C.set, 22 h at 150°C [%], plied, ISO 815-B	26.9	23.0	20.8	46.3
Fluid ageing 1008 h at 150°C in Exxon Mobil, MB Formula 225.18, 5W-30				
Hardness Shore A (1 s)	75	72	65	68
Delta Hardness [pts.]	10	7	2	-3
Tensile Strength [MPa]	7.1	9.6	10.2	12.0
Delta TS [%]	-52	-44	-41	-15
Elongation at break [%]	101	118	136	185
Delta Elong. [%]	-61	-62	-56	-33
Modulus at 100 % [MPa]	7.1	8.0	6.3	5.5
Delta 100% [%]	73	91	55	13
Weight Change [%]	-3	-2	4	6
Volume Change [%]	-4	-2	6	9

Fluid ageing 1008 h at 150°C in Fuchs Titan, EM 225.16 (HTHS 3,5), 5W-30				
Hardness Shore A (1 s)	73	71	63	67
Delta Hardness [pts.]	9	6	-1	-3
Tensile Strength [MPa]	9.4	13.2	16.0	12.6
Delta TS [%]	-36	-23	-8	-11
Elongation at break [%]	120	169	235	208
Delta Elong. [%]	-54	-46	-24	-25
Modulus at 100 % [MPa]	8.0	6.3	5.0	5.0
Delta 100% [%]	95	50	23	3
Weight Change [%]	-3	-3	2	5
Volume Change [%]	-4	-3	4	8
Fluid ageing 1008 h at 150°C in Pentosin® FFL-4				
Hardness Shore A (1 s)	76	75	66	70
Delta Hardness [pts.]	12	9	3	0
Tensile Strength [MPa]	13.6	15.4	16.7	13.4
Delta TS [%]	-8	-10	-4	-6
Elongation at break [%]	124	166	193	176
Delta Elong. [%]	-53	-47	-38	-36
Modulus at 100 % [MPa]	10.1	8.1	5.8	6.4
Delta 100% [%]	146	93	43	31
Weight Change [%]	-1	-1	4	7
Volume Change [%]	-2	-1	6	10

Continuous Vulcanization without external Pressure (UHF, Salt Bath)

Vamac® Terpolymers are used as standard material for hoses, due to their good physical properties and excellent green strength of compounds for extrusion. Dipolymer compounds typically have had lower green strength. Vamac® Ultra DX offers higher green strength and better properties compared to Vamac® DP and can meet existing AEM specifications.

Straight tubes can be cured in pressure less, continuous systems like UHF ovens or salt baths. Suitable compounds need Calcium Oxide (CaO) as absorbent for moisture which is always present in any rubber compounds. CaO would react with the acidic cure sites of Vamac® Terpolymers, for which reason these polymers cannot be used for such cost-effective continuous vulcanization processes. Vamac® Dipolymers can be used along with CaO, and some compounding possibilities have been developed in the past to produce compounds fit for use in pressure less cure processes. Vamac® Ultra DX has shown improvements over Vamac® DP in lab trials. Optimization, including use of a combination of two peroxides with lower and higher decomposition temperatures may be employed, but was not used in this study. **Table 7** gives some indications of the range of pressure less cure. More information can be provided on request.

These compounds were extruded through a Garvey Die and then cured in a standard heat ageing oven without pressure. Compounds 25 and 27 of Table 7 showed significant blistering, with Vamac® Ultra DX being significantly better. The blends with 15 phr of Vamac® Ultra LS were significantly lower in blistering, whereas the blend with 25 phr of Vamac® Ultra LS along with Vamac® Ultra DX was principally free of blisters. The compound with lower reinforcing N990 carbon black resulted in higher blistering, and lower hardness.

Table 7 – Compounds for Pressureless Cure Processes

Compound No.	25	26	27	28	29	30
Vamac® DP	**100**	**85**				
Vamac® Ultra LS		15		15	25	25
Vamac® Ultra DX (formerly VMX2122)			100	85	75	75
Naugard® 445	1	1	1	1	1	1
Armeen® 18D PRILLS	0.5	0.5	0.5	0.5	0.5	0.5
Stearic Acid Reagent (95%)	1	1	1	1	1	1
Struktol® WS 180	0.5	0.5	0.5	0.5	0.5	0.5
Kezadol GR (CaO desiccant)	10	10	10	10	10	10
Spheron® SOA (N 550)	65	65	65	65	65	20
MT Thermax® Floform N 990						80
Luperox® DC 40 P	8	8	8	8	8	8
Sartomer® SR350 (TRIM)	2	2	2	2	2	2
Mooney Viscosity ML 1+4, 100°C, MU	54	65	69	84	92	62
MDR, 0.5°arc, 12 minutes at 190°C						
ML [dNm]	0.78	1.13	1.02	1.27	1.61	0.76
MH [dNm]	12.40	13.39	13.21	14.27	15.01	10.18
Ts1 [min]	0.45	0.45	0.43	0.41	0.39	0.45
T50 [min]	0.87	0.88	0.82	0.82	0.80	0.77
T90 [min]	1.81	1.90	1.60	1.72	1.74	1.78
Tan delta at MH	0.094	0.115	0.098	0.138	0.154	0.133
Peak rate [dNm/min]	14	15	16	16	17	14
Cure Time: 5 minutes at 190°C						
Hardness Shore A (1 s)	72	75	75	79	80	71
Tensile Strength [MPa]	12.4	14.0	13.9	14.3	15.8	12.3
Elongation at break [%]	283	258	312	275	278	306
Modulus at 100 % [MPa]	4.7	6.6	5.4	7.0	8.2	4.7
Trouser Tear, Type A , ISO 34-1, N/mm	7.4	6.1	8.6	6.9	9.9	7.8
C.set 70 h at 150°C (%) - ISO 815 type B	53	68	52	71	82	81
C.set 70 h at 150°C (%) - ISO 815 type B plied	46	64	49	68	78	72
Fluid ageing 168 h at 150°C in Lubrizol® OS 206304						
Hardness Shore A (1 s)	59	63	63	69	69	62
Delta Hardness [pts.]	-13	-12	-13	-10	-11	-9
Tensile Strength [MPa]	10.2	11.8	10.9	12.7	13.2	11.2
Delta TS [%]	-18	-16	-22	-11	-16	-9
Elongation at break [%]	261	242	302	274	243	271
Delta Elong. [%]	-8	-6	-3	0	-13	-11
Modulus at 100 % [MPa]	4.0	5.4	4.3	5.6	6.4	4.3
Delta 100% [%]	-15	-18	-20	-20	-22	-9
Weight Change [%]	11	10	10	9	9	8
Volume change [%]	11	16	12	14	9	14

List of Compound Ingredients

Material	Chemical Composition	Supplier
Polymers		
Vamac® DP	Ethylene Acrylic Elastomer	DuPont
Vamac® Ultra DX (VMX2122)	Ethylene Acrylic Elastomer	DuPont
Vamac® GLS	Ethylene Acrylic Elastomer	DuPont
Vamac® Ultra LS	Ethylene Acrylic Elastomer	DuPont
Vamac® Ultra IP	Ethylene Acrylic Elastomer	DuPont

Release Aids		
Armeen® 18D	Octadecyl Amine	Akzo Nobel
Vanfre® VAM	Complex Organic Phosphate Ester	Vanderbilt Chemicals
Stearic Acid		

Anti-Oxidant		
Naugard® 445	Diphenyl Amine	Addivant

Plasticizers		
Alcanplast PO 80	Mixed Ether/Ester Plasticizer	Safic-Alcan

Fillers		
Spheron® SO N550	Carbon Black	Cabot Corporation
Regal® SRF N 772	Carbon Black	Cabot Corporation
MT Thermax® Floform N 990	Carbon Black	Cancarb
Martinal® OL-111 LE	Al(OH)3	Martinswerk
Dynasylan® 6490	Coupling Agent	Evonik Degussa
Kezadol GR	CaO Desiccant	Kettlitz

Curatives		
Diak™ No. 1	Hexamethylene Diamine Carbamate	Chemours
Perkadox® 14-40B-GR	Di(tert-butylperoxyisopropyl)benzene	Akzo Nobel
Luperox® DC 40 P	Dicumylperoxide	Arkema

Accelerators		
Alcanpoudre DBU-70	DBU accelerator	Safic-Alcan
Rubber chem HVA-2	N,N'-phenylene bismaleimide	Chemours
Sartomer® SR 350	Trimethylolpropane Trimethacrylate	Arkema
Diak™ No. 7	Triallylisocyanurate	Chemours

Test Fluids		
IRM-903	Reference Fluid	
Pentosin® FFL-4	Transmission Fluid	Deutsche Pentosin-Werke
Fuchs Titan EM225.1 5W30	Engine Oil	Fuchs
Mobil MB Formula 5W30	Engine Oil	Exxon Mobil

Test Method	
Rheology	
Mooney Viscosity	ISO 289-1
Mooney Scorch	ISO 289-2
MDR	ISO 6502
Physical Properties	
Hardness	ISO 868
Tensile Strength, Elongation, Modulus	ISO 37
Compression Set	ISO 815
Compression Set	Volkswagen PV3307
Compressive Stress Relaxation (CSR)	ISO 3384
Aging in Air Oven	ISO 188
Fluid Aging	ISO 1817
Tg by DSC	ISO 22768
Tear Strength Die C	ISO 34-1

Visit us at vamac.dupont.com

Contact DuPont at the following regional locations:

North America
+1-800-853-5515

Latin America
+0800 17 17 15

Europe, Middle East, Africa
+41 22 717 51 11

Greater China
+86-400-8851-888

Japan
+81-3-5521-8600

ASEAN
+65 6586 3688