3M™ Dynamar™

Elastomer Additive FC 2172

Typical Properties (Data not for specification purposes)	
Specific Gravity [3M 14.10 .C]	1.80
Color	Creamy white, light tan
Solubility	Ketones and Esters

Introduction

Dynamar FC 2172 is a cure accelerator masterbatch for use with all incorporated cure fluoropolymers. FC 2172 in fluoroelastomer formulations provides:

- Fast cure rates at reduced molding temperatures of 150-165 °C (300-325 °F).
- Slightly accelerated cure rates at normal molding temperatures of 180-190 °C (360-375 °F).
- A way to adjust cure speeds of fluoroelastomer compounds that contain fillers which tend to have a “retarding” effect.

Recommended Processing Procedures

FC 2172 is normally used at a 0.5 to 3 phr level depending on compound ingredients, desired cycle times and mold temperature being used. It can be incorporated into the formulation during mill or internal mixing. Generally, lower levels (0.5 to 1.5 phr) are recommended when internal mixing.

Product Form

FC 2172 is packaged in slab form. It is available in 25 kg (44 lb.) boxes.

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Use of Dynamar FC 2172 in O-Ring Compounds

(Data not for specification purposes)
Table 1 shows the effect on scorch safety, cure rate and ultimate physical properties of 1, 2 and 3 parts of FC 2172 in Dyneon™ fluoroelastomer O-ring compounds. Increasing levels of FC 2172 causes a significant increase in cure rate @ 150 °C (302 °F) without reducing scorch safety at typical preforming and processing temperatures, 90-120 °C (200-250 °F). The cure rate is also accelerated to a lesser extent at standard molding temperatures of 180-190 °C (350-375 °F). Physical properties are essentially unchanged, except for the trend towards poorer long-term compression set resistance.

Use of Dynamar FC 2172 with 3M™ Dyneon™ Fluoroelastomer FC 2174

Table 1

Compound				
FC 2174	100	100	100	100
N-990	30	30	30	30
$Ca(OH)_2$	6	6	6	6
MgO	3	3	3	3
FC 2172	–	1	2	3

Typical Rheological Properties

Mooney Scorch, MS @ 121 °C (250 °F) for 30 min.

Minimum Viscosity (MU)	40	41	41	41
Time to a 10 point rise - minutes	>30	>30	>30	28
Point Rise in 30 min (MU)	2	2	3	15

Monsanto Moving Die Rheometer (MDR 2000)

12 minutes at 177 °C (350 °F) 100 cpm, 0.5° Arc, [3M 2.19.1.C]

Minimum Torque, dNm (inch-lbs.)	2.3 (2)	2.3 (2)	2.3 (2)	2.3 (2)
ts2, Time to 2 inch-pound rise from minimum, minutes	1.1	0.8	0.7	0.6
t50, Time to 50% cure, minutes	1.4	1.1	0.9	0.8
t90, Time to 90% cure, minutes	1.9	1.4	1.1	1
Maximum Torque, dNm (inch-lbs.)	30.5 (27)	29.4 (26)	29.4 (26)	28.3 (25)

Monsanto Moving Die Rheometer (MDR 2000)

24 minutes at 149 °C (300 °F) 100 cpm, 0.5° Arc, [3M 2.19.1.C]

Minimum Torque, dNm (inch-lbs.)	2.3 (2)	2.3 (2)	2.3 (2)	2.3 (2)
ts2, Time to 2 inch-pound rise from minimum, minutes	8.1	5.3	3.6	2.7
t50, Time to 50% cure, minutes	11.4	7.5	5.1	3.9
t90, Time to 90% cure, minutes	15.2	10.3	7	5.4
Maximum Torque, dNm (inch-lbs.)	31.6 (28)	32.8 (29)	32.8 (29)	31.6 (28)

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Typical Physical Properties

Press Cure 10 minutes @ 177 °C (350 °F)
Post Cure 16 hours @ 232 °C (450 °F)

Tensile, MPa (psi)	16.6 (2405)	16.1(2335)	15.2 (2205)	16.1 (2330)
Elongation, %	195	185	180	190
100% Modulus, MPa (psi)	6.4 (930)	6.7 (970)	6.6 (955)	6.8 (980)
Hardness, Shore A [ASTM D 2240]	76	77	77	77

Air Aged 70 hours @ 270 °C (518 °F)

Tensile Change, %	-37	-40	-33	-40
Elongation Change, %	14	16	26	13
Hardness Change, Points	1	2	2	2

Compression Set, %

[ASTM D395 Method B (O-Rings)]

70 hours @ 24 °C (75 °F)	10	10	10	10
70 hours @ 200 °C (392 °F)	14	16	15	16
336 hours @ 200 °C (392 °F)	31	31	34	35

Use of Dynamar FC 2172 in “Molded Goods” Compounds

(Data not for specification purposes)
Tables 2 and 3 demonstrate the effect of FC 2172 in high tear strength, molded goods Dyneon fluoroelastomer compounds. These compounds are more sensitive to high amounts of FC 2172, as seen by Mooney scorch value at 121 °C (250 °F). The cure rates of Dyneon FE 5642Q (Table 2) and FE 5840Q (Table 3) accelerate well at low levels of FC 2172.

Typical physical properties are essentially unchanged, except for the trend to poor long-term compression set resistance.

Use of Dynamar FC 2172 with 3M™ Dyneon™ Fluoroelastomer FE 5642Q

Table 2

Compound				
FE 5642Q	100	100	100	100
N-990	30	30	30	30
$Ca(OH)_2$	6	6	6	6
MgO	3	3	3	3
FC 2172	–	1	2	3

3M™ Dynamar™
Elastomer Additive FC 2172

Typical Rheological Properties

Mooney Scorch, MS @ 121 °C (250 °F) for 30 min.

Minimum Viscosity (MU)	42	41	41	41
Time to a 10 point rise - minutes	>30	>30	>30	19
Point Rise in 30 min (MU)	0	1	8	N/A

Monsanto Moving Die Rheometer (MDR 2000)

12 minutes at 177 °C (350 °F) 100 cpm, 0.5° Arc, [3M 2.19.1.C]

Minimum Torque, dNm (inch-lbs.)	2.3 (2)	2.3 (2)	2.3 (2)	2.3 (2)
ts2, Time to 2 inch-pound rise from minimum, minutes	1.7	1	0.8	0.6
t50, Time to 50% cure, minutes	2.3	1.3	1	0.8
t90, Time to 90% cure, minutes	3.5	1.9	1.3	1
Maximum Torque, dNm (inch-lbs.)	23.7 (21)	24.9 (22)	24.9 (22)	24.9 (22)

Monsanto Moving Die Rheometer (MDR 2000)

24 minutes at 149 °C (300 °F) 100 cpm, 0.5° Arc, [3M 2.19.1.C]

Minimum Torque, dNm (inch-lbs.)	3.4 (3)	3.4 (3)	3.4 (3)	2.3 (2)
ts2, Time to 2 inch-pound rise from minimum, minutes	12.4	5.9	3.5	2.4
t50, Time to 50% cure, minutes	17.6	8.8	5.2	3.6
t90, Time to 90% cure, minutes	21.3	12	7	4.8
Maximum Torque, dNm (inch-lbs.)	22.6 (20)	27.1 (24)	28.3 (25)	27.1 (24)

Typical Physical Properties

Press Cure 10 minutes @ 177 °C (350 °F)
Post Cure 16 hours @ 232 °C (450 °F)

Tensile, MPa (psi)	16.3 (2370)	17.1 (2480)	16.2 (2355)	15.4 (2240)
Elongation, %	255	230	220	210
100% Modulus, MPa (psi)	4.6 (660)	5.0 (720)	5.2 (750)	5.4 (790)
Hardness, Shore A [ASTM D 2240]	72	73	75	75

Air Aged 70 hours @ 270 °C (518 °F)

Tensile Change, %	-39	-48	-45	-43
Elongation Change, %	25	10	1	-4
Hardness Change, Points	2	0	2	3

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Compression Set, %

[ASTM D395 Method B (O-Rings)]

70 hours @ 24 °C (75 °F)	12	11	9	10
70 hours @ 200 °C (392 °F)	16	18	22	23
336 hours @ 200 °C (392 °F)	37	43	46	49

Use of Dynamar FC 2172 with 3M™ Dyneon™ Fluoroelastomer FE 5640Q

Table 3

Compound				
FE 5840Q	100	100	100	100
N-990	30	30	30	30
$Ca(OH)_2$	6	6	6	6
MgO	3	3	3	3
FC 2172	–	1	2	3

Typical Rheological Properties

Mooney Scorch, MS @ 121 °C (250 °F) for 30 min.

Minimum Viscosity (MU)	43	43	43	42
Time to a 10 point rise - minutes	>30	>30	27	20
Point Rise in 30 min (MU)	4	6	12	N/A

Monsanto Moving Die Rheometer (MDR 2000)

12 minutes at 177 °C (350 °F) 100 cpm, 0.5° Arc, [3M 2.19.1.C]

Minimum Torque, dNm (inch-lbs.)	1.5 (1.3)	1.5 (1.3)	1.5 (1.3)	1.6 (1.4)
ts2, Time to 2 inch-pound rise from minimum, minutes	1.5	1.2	1	0.8
t50, Time to 50% cure, minutes	2	1.6	1.2	1.1
t90, Time to 90% cure, minutes	2.7	2.2	1.7	1.4
Maximum Torque, dNm (inch-lbs.)	31.6 (28)	30.5 (27)	29.4 (26)	28.3 (25)

Monsanto Moving Die Rheometer (MDR 2000)

24 minutes at 149 °C (300 °F) 100 cpm, 0.5° Arc, [3M 2.19.1.C]

Minimum Torque, dNm (inch-lbs.)	2.3 (2)	2.3 (2)	2.3 (2)	2.3 (2)
ts2, Time to 2 inch-pound rise from minimum, minutes	8.1	6.2	4.6	3.5
t50, Time to 50% cure, minutes	13.3	10	7.2	5.5
t90, Time to 90% cure, minutes	17.1	13	9.5	7.4
Maximum Torque, dNm (inch-lbs.)	36.2 (32)	36.2 (32)	33.9 (30)	33.9 (30)

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Typical Physical Properties

Press Cure 10 minutes @ 177 °C (350 °F)
Post Cure 16 hours @ 232 °C (450 °F)

Tensile, MPa (psi)	14.0 (2030)	14.1 (2045)	15.1 (2190)	14.9 (2155)
Elongation, %	215	220	225	220
100% Modulus, MPa (psi)	5.9 (860)	6.0 (865)	6.1 (885)	6.3 (920)
Hardness, Shore A [ASTM D 2240]	83	84	84	84

Air Aged 70 hours @ 270 °C (518 °F)

Tensile Change, %	-69	-71	-74	-74
Elongation Change, %	84	84	94	99
Hardness Change, Points	0	-1	-3	-2

Compression Set, %

[ASTM D395 Method B (O-Rings)]

70 hours @ 24 °C (75 °F)	16	18	21	21
70 hours @ 200 °C (392 °F)	24	31	31	32
336 hours @ 200 °C (392 °F)	50	53	55	61

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Safety Instructions

Follow the normal precautions observed with all fluoropolymer materials.

Please consult the Material Safety Data Sheet and Product Label for information regarding the safe handling of the material. By following all precautions and safety measures, processing these products poses no known health risks. General handling/processing precautions include: 1) Process only in well-ventilated areas. 2) Do not smoke in areas contaminated with powder/residue from these products. 3) Avoid eye contact. 4) If skin comes into contact with these products during handling, wash with soap and water afterwards. 5) Avoid contact with hot fluoropolymer.

Potential hazards, including release of toxic vapours, can arise if processing occurs under excessively high temperature conditions. Vapour extractor units should be installed above processing equipment. When cleaning processing equipment, do not burn off any of this product with a naked flame or in a furnace.

Important Notice

All information set forth herein is based on our present state of knowledge and is intended to provide general notes regarding products and their uses. It should not therefore be construed as a guarantee of specific properties of the products described or their suitability for a particular application. Because conditions of product use are outside Dyneon's control and vary widely, user must evaluate and determine whether a Dyneon product will be suitable for user's intended application before using it.

The quality of our products is warranted under our General Terms and Conditions of Sale as now are or hereafter may be in force.

Technical information, test data, and advice provided by Dyneon personnel are based on information and tests we believe are reliable and are intended for persons with knowledge and technical skills sufficient to analyze test types and conditions, and to handle and use raw polymers and related compounding ingredients.

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General recommendations on health and safety in processing, on work hygiene and on measures to be taken in the event of accident are detailed in our material safety data sheets.

You will find further notes on the safe handling of fluoropolymers in the brochure „Guide for the safe handling of Fluoropolymers Resins" (download link) by PlasticsEurope, Box 3, B-1160 Brussels, Tel. +32 (2) 676 17 32.

You can also download it with your smartphone using the QR code below.

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