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XIAMETER® *from* DOW CORNING

Fluid Resistance Guide

Performance Profiles for XIAMETER® brand Silicone Rubber

Contents

Introduction

This guide is intended to give you an idea of the performance profile of various classes of silicone rubbers when immersed in different fluids. It's our hope that the information will save you the time and cost of preliminary screening and feasibility tests. We recommend that you test specific materials prior to use. Keep in mind that service conditions are usually less severe than immersion tests. For instance, in actual service the rubber is often only partly exposed or is subjected only to spills or splashing. This means that a rubber that shows only fair results in a prolonged total immersion test will often perform quite adequately under actual conditions.

Types of XIAMETER® brand Silicone Rubbers

Immersion test results refer to types of silicone rubber by their ASTM designation. The polymer classification described in ASTM D 1418 is based on the organic group side chains attached to the silicon-oxygen chain. If other groups are present, their initials are listed prior to the MQ designation: MQ indicates methyl groups, V indicates phenyl groups. Where several types of rubber have been tested for resistance to one fluid, they are listed in this order in the tables:

XIAMETER brand Silicone Rubbers

MQ, VMQ } General purpose stocks

PMQ, PVMQ } Extremely low-temperature stocks

XIAMETER® brand Fluorosilicone Rubbers

FVMQ Fuel-, oil-and solvent-resistant stocks

Effects of Immersion

If a fluid affects a silicone rubber at all, after prolonged immersion and usually at elevated temperatures, the changes are evidenced as increases or decreases of several physical properties: hardness, tensile strength, elongation, and volume. The values that appear in the tables have been calculated as prescribed in ASTM D 471. The figures have been rounded and represent typical values. The effects that have been tabulated often go hand in hand, but there is no quantitative correlation. For example, a silicone rubber in one fluid may swell 10 percent and lose 15 percent in tensile strength, whereas in another fluid the same rubber may also swell 10 percent but lose 30 percent in tensile strength.

The effects of solvent or fuel immersion often proceed until they reach a limit and then increase no more. This limit corresponds to the maximum amount of solvent or fuel that the rubber structure can absorb at the test temperature. While a fluid may produce little effect at room temperature, it may cause a noticeable change at 204°C (400°F).

Swelling caused by fluid penetration of rubber is usually the most obvious effect. However, this swelling does not necessarily indicate permanent deterioration. The rubber often regains most of its original properties after the fluid has evaporated.
Hardness changes are tabulated in durometer points on the Shore A-2 scale. Changes in tensile strength and elongation are expressed as percentages of the original values. These changes are usually losses that appear as negative values. Volume changes due to penetration of fluids between silicone polymer chains appear as positive values, that is, swelling. Negative volume changes indicate chemical degradation, such as the tables show for 20 percent sulfuric acid at 83˚C (180˚F) for seven days.

Service Considerations
Duration of exposure may be very important in some applications. In the case of silicone rubber used as electrical insulation, this may mean that no permanent harm will result from short exposures to washing or rinsing, even with powerful solvents. After prolonged periods at high temperatures, hydrocarbon oils may slowly decompose. The breakdown products may have an entirely different solvent effect than that of the original oil. On the other hand, heating may sometimes have the favorable result of driving off volatile components of oils. Contamination in service may also produce changes in lubricating oils and their effect as immersion media. Swelling may be a limiting factor in service, even though a small amount may be desirable for certain applications. For example, o-rings often work better if they swell slightly in the fluid they seal; but if they swell too much, they may push themselves out of position and lose effectiveness. Also, swelling may produce tears in tightly restricted parts.

Selection Recommendations
1. XIAMETER brand fluorosilicone rubber shows superior resistance to many fluids; however, other types of rubber offer better resistance to acetone, certain other ketones, and some esters. The fluorosilicone polymer can be blended with other silicone polymers to obtain resistance intermediate between the two types.
2. The higher the aromatic or phenyl content of oils and fuels, the greater is their effect on most types of silicone rubber except fluorosilicone rubber. The stocks most affected are usually the types with ASTM designations including P (phenyl groups). This follows the common principle of organic to solvents that “like dissolves like.”
3. For high-temperature applications, parts should generally be cured at temperatures higher than anticipated service temperatures, no matter whether the parts will contact liquid or air. Property changes are usually less for fully cured parts than for as-vulcanized or partially cured parts.

Test Conditions
The immersion tests tabulated were conducted according to ASTM D 471. Specimens were cut from slabs that were molded and oven-cured in accordance with recommended procedures for the individual stocks.

Many fluids were tested only for their effects on volume and hardness because these values are usually the most critical.

In regard to the limited correlation between test conditions and service conditions, the most widely used test, ASTM D 471, states:

“Owing to the wide variations often present in service conditions, no direct correlation between this accelerated test and service performance may be given or implied. However, the method yields comparative data on which to base judgment (as to service quality and is especially useful in research and development work).”

Test results refer to types of silicone rubber products by ASTM designation. Because tests were conducted over a period of several years, the specific products used may no longer be available. Test results, therefore, can be used to project general performance only. If more specific information is required, refer to individual data sheets or conduct new tests.

Fluids Index

Classification of Immersion Media

Fluids for testing have often been submitted with only a trade name for identification. It has been difficult to classify some of these fluids for the tabular sections of this guide. The overall classification has been designed for easy reference by users in different industries.

ASTM and IRM Oils, Fuels and Fluids

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
ASTM No. 1 Oil	VMQ PVMQ	3 days/25°C (77°F)	nil -5	- -	- -	nil 5
	MQ VMQ PVMQ	3 days/100°C (212°F)	-5 -5 -10	-5 -10 -10	-5 -5 -10	5 5 10
	MQ VMQ PVMQ	1 day/150°C (302°F)	-10 -5 -10	-10 -10 -15	5 -10 -10	5 10 10
	MQ VMQ PVMQ FVMQ	3 days/150°C (302°F)	-10 -10 -10 -5	-10 -5 -20 nil	nil -5 -15 -5	5 10 10 nil
	MQ VMQ PVMQ	7 days/150°C (302°F)	-10 -10 -10	-10 -10 -20	-10 -10 -10	10 10 10
	VMQ	30 days/150°C (302°F)	-10	-35	-25	10
	MQ VMQ PVMQ	3 days/177°C (350°F)	-10 -5 -15	-10 -10 -20	-10 -10 -10	5 10 10
	VMQ	7 days/177°C (350°F) 14 days/177°C (350°F)	-20 -20	-50 -50	-30 -30	10 10
ASTM No. 2 Oil	VMQ FVMQ	70 hr/150°C(302°F)	-6 nil	4 nil	-2 -14	1 1
	VMQ FVMQ	7 days/150°C (302°F)	-6 -2	8 1	nil -13	8 1
ASTM No. 3 Oil	MQ PVMQ	3 days/24°C (75°F)	-5 -10	- -	- -	15 25
	MQ PVMQ	3 days/100°C (212°F)	-10 -15	- -	- -	20 35
	PVMQ FVMQ	7 days/110°C(230°F)	-30 -5	-75 -5	-60 -5	60 5
	MQ VMQ PVMQ FVMQ	1 day/150°C (302°F)	-20 -15 -25 -5	-50 -35 -40 -10	-20 -20 -20 10	50 45 50 5
	MQ VMQ PVMQ PVMQ FVMQ	3 days/150°C (302°F)	-25 -20 -35 -25 -5	-50 -45 -50 - -25	-25 -25 -30 - -10	35 35 55 85 5
	VMQ FVMQ	7 days/150°C (302°F)	-25 -5	-45 -17	nil -15	40 5
	FVMQ	14 days/150°C (302°F) 21 days/150°C (302°F) 28 days/150°C (302°F)	-5 -10 -10	-25 -60 -85	5 5 -20	5 5 5

MQ - methyl groups only **P - phenyl groups**
V - vinyl groups **F - fluorine-containing groups**

ASTM and IRM Oils, Fuels and Fluids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
ASTM No. 3 Oil (cont.)	VMQ	4 hr/177°C (350°F)	-25	-35	-25	45
	MQ	3 days/177°C (350°F)	-35	-85	-25	55
	VMQ		-40	-60	-15	60
	PVMQ		-40	-65	5	70
	FVMQ		-10	-25	5	5
	VMQ	7 days/177°C (350°F)	-50	-80	-30	70
	FVMQ		-10	-40	5	5
	VMQ	3 days/200°C (392°F)	-15	-45	nil	5
	FVMQ	14 days/200°C (392°F)	-25	-40	-10	nil
IRM-902 Oil	VMQ	3 days/23°C (73°F)	-5	-12	-14	5
	PVMQ		-8	-12	-12	7
	FVMQ		-6	-7	-1	1
	VMQ	3 days at 150°C (302°F)	-6	-7	-17	10
	PVMQ		-16	-7	-21	19
	FVMQ		0	-7	-8	1
IRM-903 Oil	VMQ	3 days/23°C (73°F)	-12	-7	-11	18
	PVMQ		-21	-31	-23	33
	FVMQ		-4	-7	-3	1
	VMQ	3 days/150°C (302°F)	-26	-23	-28	40
	PVMQ		-33	-68	-62	84
	FVMQ		-2	-11	-15	2
	FVMQ (70 Durometer)	70 hours/150°C (302°F)	-4	-8	4	2
		7 days/150°C (302°F)	-3	-9	6	2
ASTM Test Fluid 101 **Di** (2-Ethylhexyl) **Sebacate +0.5% Phenothiozine Di** (2-Ethylhexyl) **Sebacate** (Plexol-201)	FVMQ	7 days/135°C (275°F)	-4	-7	-11	5
		48 hr/150°C (302°F)	-10	-25	-25	10
	MQ	7 days/100°C (212°F)	-15	-	-	20
	VMQ		-10	-	-	20
	FVMQ	4 days/232°C (450°F)	DT	DT	DT	DT
ASTM Reference Fuel A - Isooctane (also TTS-735 Type I)	VMQ	5 min/-54°C (-65°F)	-	-	-	10
	PMQ		-	-	-	10
	PVMQ		-	-	-	10
	VMQ	10 min/-54°C (-65°F)	-	-	-	20
	PMQ		-	-	-	20
	PVMQ		-	-	-	15
	VMQ	30 min/-54°C (-65°F)	-	-	-	30
	PMQ		-	-	-	35
	PVMQ		-	-	-	30
	VMQ	5 min/24°C (75°F)	-	-	-	25
	PMQ		-	-	-	30
	PVMQ		-	-	-	25
	VMQ	10 min/24°C (75°F)	-	-	-	35
	PMQ		-	-	-	50
	PVMQ		-	-	-	40
	VMQ	30 min/24°C (75°F)	-	-	-	90
	PMQ		-	-	-	85
	PVMQ		-	-	-	75
	FVMQ	7 days/24°C (75°F)	-5	-40	-30	15
		3 days/150°C (302°F)	-20	-60	-30	25

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated

ASTM and IRM Oils, Fuels and Fluids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
ASTM Reference Fuel B (70% Isooctane, 30% Toluence by Volume) (also TTS-735 Type III)	FVMQ	1 day/-54°C (-65°F)	-5	-20	-20	10
		3 days/24°C (75°F)	-5	-55	-35	20
		7 days/24°C (75°F)	-5	-40	-30	20
		14 days/24°C (75°F)	-10	nil	-30	15
	VMQ	3 days/65°C (150°F)				215
	FVMQ		-5	-50	-40	15
	FVMQ	3 days/150°C (302°F)	-20	-60	-35	30
		3 days/232°C (450°F)	DT	DT	DT	DT

MIL Specification Oils, Fuels and Fluids

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
ASTM Reference Fuel C (M0)	FVMQ (60 Durometer)	1 day/23°C (73°F)	-15	-25	-23	18
		1 week/23°C (73°F)	-14	-20	-19	19
		3 months/23°C (73°F)	-14	-23	-20	19
		1 year/23°C (73°F)	-13	-22	-18	19
		1 day/60°C (140°F)	-14	-30	-15	21
		1 week/60°C (140°F)	-14	-36	-32	21
		3 months/60°C (140 F)	-17	-37	-28	22
		6 months/60°C (140°F)	-14	-33	-35	21
85% ASTM Reference Fuel C 15% Methanol (M15)	FVMQ (60 Durometer)	1 day/23°C (73°F)	-24	-52	-29	26
		1 week/23°C (73°F)	-18	-56	-42	24
		3 months/23°C (73°F)	-18	-50	-38	25
		1 year/23°C (73°F)	-14	-53	-38	24
		1 day/60°C (140°F)	-21	-57	-41	29
		1 week/60°C (140°F)	-21	-64	-48	31
		3 months/60°C (140°F)	-24	-64	-45	31
75% ASTM Reference Fuel C 25% Methanol (M25)	FVMQ (60 Durometer)	1 day/23°C (73°F)	-19	-53	-43	26
		1 week/23°C (73°F)	-19	-54	-40	25
		3 months/23°C (73°F)	-18	-50	-39	25
		1 year/23°C (73°F)	-13	-51	-36	24
		1 day/60°C (140°F)	-20	-63	-51	32
		1 week/60°C (140°F)	-23	-62	-48	33
		3 months/60°C (140°F)	-26	-68	-48	33
		6 months/60°C (140°F)	-27	-64	-45	28
50% ASTM Reference Fuel C 50% Methanol (M50)	FVMQ (60 Durometer)	1 day/23°C (73°F)	-18	-52	-41	25
		1 week/23°C (73°F)	-18	-48	-37	24
		3 months/23°C (73°F)	-19	-49	-39	23
		1 year/23°C (73°F)	-17	-50	-33	22
		1 day/60°C (140°F)	-21	-60	-47	29
		1 week/60°C (140°F)	-22	-59	-46	30
		3 months/60°C (140°F)	-24	-64	-43	28
15% ASTM Reference Fuel C 85% Methanol (M85)	FVMQ (60 Durometer)	1 day/23°C (73°F)	-15	-36	-27	14
		1 week 23°C (73°F)	-14	-37	-19	13
		3 months/23°C (73°F)	-11	-32	-21	11
		1 year/23°C (73°F)	-11	-38	-20	11
		1 day/60°C (140°F)	-17	-38	-24	15
		1 week/60°C (140°F)	-18	-42	-20	14
		3 months/60°C (140°F)	-17	-49	-25	12
		6 months/60° C (140°F)	-15	-50	-31	8
60% ASTM Reference Fuel C 40% Methanol by Volume (M40)	FVMQ (75 Durometer)	24 hours/110°C (230°F)	-30	-66	-50	46

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated

MIL Specification Oils, Fuels and Fluids

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
TTS-735 Type VII (30% Toluene, 10% Isooctane, 59% Cyclohexane, 1.0%n-Butyl Disulfide)	FVMQ	3 days/24°C (75°F) 3 days/100°C (212°F)	-10 -10	-40 -40	-25 -35	20 20
MIL-H-5606 Oil (Exxon Univis J-43)	VMQ PVMQ	14 days/24°C (75°F)	- -	- -	- -	65 95
	MQ PMQ FVMQ	1 day/71°C (160°F)	-20 -30 -5	-75 -65 -30	-60 -55 -10	160 120 5
	FVMQ	3 days/71°C (160°F)	-10	-30	-15	5
	VMQ PVMQ	14 days/71°C (160°F)	- -	- -	- -	80 110
	FVMQ	19 days/121°C (250°F) 3 days/150°C (302°F) 3 days/177°C(350°F) 7 days/177°C(350°F) 3 days/200°C (392°F)	-10 -10 -20 -20 -35	-10 -35 -50 -55 -85	-15 -10 -10 5 15	5 10 10 10 15
MIL-H-5606 (American Oil PQ 4226)	FVMQ	70 hr/150°C (302°F)	-6	-8	-16	6
MIL-O-6085 Oil	FVMQ	14 days/177°C (350°F)	-20	-70	-15	10
MIL-L-7808D Oil (Exxon Turbo Oil No. 15)	FVMQ	1 day/-54°C (-65°F)	-5	-15	nil	nil
	MQ VMQ PMQ	3 days/24°C (75°F)	-5 -10 -10	-10 -10 -25	nil -5 -15	10 10 20
	PVMQ	3 days/24°C (75°F) 7 days/24°C (75°F)	-15 -25	-10 -55	-5 -40	20 30
	VMQ PMQ	3 days/71°C (160°F)	-15 -15	-10 -45	-10 -40	15 30
	MQ VMQ PMQ PVMQ	7 days/71°C (160°F)	-10 -10 -20 -25	- - - -65	- - - -50	15 15 30 35
	MQ VMQ PMQ	1 day/121°C (250°F)	-10 -10 -10	- - -	- - -	20 20 40
	VMQ FVMQ	3 days/121°C (250°F)	-10 -5	-25 nil	-20 nil	20 5

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups

MIL Specification Oils, Fuels and Fluids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
MIL-L-7808D Oil (Exxon Turbo Oil No. 15)	MQ	1 day/150°C (302°F)	-10			15
	VMQ		-5	-	-	10
	PMQ		-10	-	-	20
	VMQ	3 days/150°C(302°F)	-15	-40	-10	25
	PVMQ		-25	-45	5	40
	FVMQ		-5	-15	nil	10
	MQ	1 hr/177°C (350°F)	-10	-	-	10
	FVMQ	1 day/177°C (350°F)	-10	-35	-10	10
	MQ	3 days/177°C (350°F)	-30	-65	-5	35
	VMQ		-35	-	-	30
	PMQ		-25	-50	-15	45
	PVMQ		-35	-55	-15	50
	FVMQ		-15	-40	-10	5
	FVMQ	7 days/177°C (350°F)	-20	-60	nil	10
		14 days/177°C (350°F)	DT	DT	DT	DT
		1 day/200°C (392°F)	-30	-70	-15	15
	VMQ	3 days/200°C (392°F)	-35	-	-	30
	FVMQ		-45	-95	-45	15
MIL-L-7808E Oil (Brayco 880D)	VMQ	70 hr/150°C (302°F)	-20	-35	-10	25
	FVMQ		-5	-80	-60	5
	VMQ	70 hr/177°C (350°F)	-35	-75	-30	25
	FVMQ		-5	-95	-90	-5
MIL-L-7808E, F, and G Oil (StaufferJet I)	VMQ	70 hr/150°C (302°F)	-20	-25	-10	25
	FVMQ		-10	-25	-25	10
	VMQ	70 hr/177°C (350°F)	-35	-65	-10	35
	FVMQ		-15	-60	-35	10
MIL-L-7808F Oil (Gulf Synthetic Lube No. 2)	FVMQ	70 hr/150°C (302°F)	-10	-30	-15	15
MIL-L-7808F Oil (Royco 808GF)	FVMQ	70 hr/150°C (302°F)	-10	-45	-15	10
		70 hr/177°C (350°F)	-20	-60	-20	15
MIL-L-7808F Oil (Brayco 880G)	FVMQ	70 hr/150°C (302°F)	-15	-30	-20	10
MIL-L-7808G (Amendment 2) PQ8365	VMQ	70 hr/150°C (302°F)	-14	-21	-19	25
	FVMQ		-8	-9	-24	8
MIL-A-8243 Deicer Fluid	PVMQ	70 hr/71°C (160°F)	-5	-15	-10	nil
MIL-L-23699 Oil (Mobil XRM-139A)	FVMQ	96 hr/177°C (350°F)	-15	-	-	10
StaufferJet II Oil	FVMQ	70 hr/177°C (350°F)	-8	-25	-21	12
	VMQ	100 hr/177°C (350°F)	-9	2	42	11
	FVMQ		-9	-19	-36	12
	VMQ	300 hr/177°C (350°F)	-8	-3	50	7
	FVMQ		-15	-73	-33	9

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated

ASTM and MIL Specification Oils, Fuels and Fluids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Mobil Jet II Oil	VMQ FVMQ	22 hr/25°C (77°F)	- -	- -	- -	4 3
	VMQ FVMQ	70 hr/150°C (302°F)	-10 nil	10 20	15 -35	10 10
	VMQ FVMQ	7 days/1500C(302°F)	-10 nil	10 5	25 -35	10 10
MIL-L-4600 Oil Bis (2-Ethylhexyl) **Sebacate**	PVMQ	3 days/25°C (77°F) 7 days/25°C (77°F)	-14 -14	- -	- -	28 30
MIL-L-7808JJet Engine Oil	75% FVMQ 25% VMQ Blend.	22 hours/24°C (75°F)	-6	-28	-22	4

Automotive Oils and Fluids

Motor Oils

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
SAE No. 10 Oil (Sunoco HD)	FVMQ	3 days/150°C (302°F)	-5	-5	nil	nil
SAE No. 20 Oil (Mobil Oil)	MQ PMQ	1 day/100°C (212°F)	- -	- -	- -	10 20
	MQ PMQ	1 day/121°C (250°F)	- -	- -	- -	15 25
	MQ PMQ	1 day/150°C (302°F)	- -	- -	- -	15 25
10W-30 Motor Oil (Texaco)	FVMQ	15 days/177°C(350°F) 30 days/177°C (350°F)	-4 1	-33 -52	-8 -58	2 1
	50/50 VMQ/FVMQ	15 days/177°C (350°F) 30 days/177°C (350°F)	-16 -9	-35 -76	10 -80	9 3
AMOCO Super Permalube 10W-30	VMQ	250 hr/150°C (302°F)	-18	-21	5	23
Sun 5W-30 SJ Auto Engine Oil	FVMQ (70 Durometer)	70 hours/150°C (302°F) 7 days/150°C (302°F)	-1 1	1 -3	0 -6	0 0
Mobil 5W-30 HP Engine Oil	75% FVMQ 25% VMQ Blend.	3 days/150°C (302°F) 7 days/150°C (302°F)	-9 -9	-21 -26	-15 -22	12 12

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups

Automotive Oils and Fluids (Cont.)

Automobile Transmission Fuids

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Dynaflow Automatic Transmission Fluid	MQ VMQ PMQ	70 hr/93°C (200°F)	-15 -15 -10	- - -	- - -	15 25 35
GM Hydramatic Fluid (Type A)	VMQ FVMQ	3 days/150°C (302°F)	-35 -5	-40 -10	-5 -5	35 5
Socony Mobil Transmission Fluid (Type A)	MQ PMQ	1 day/121°C (250°F)	-10 -10	- -	- -	35 40
	MQ	7 days/121°C(250°F)	-10	-	-	35
Sun 109 Transmission Fluid	VMQ	100 hr/177°C (350°F)	-25	-40	nil	30
Texamatic A Transmission Fluid (Texaco)	VMQ	70 hr/65°C (150°F)	-10	-	-	10
	VMQ PVMQ FVMQ	70 hr/150°C (302°F)	-20 -30 nil	-30 -85 -25	-10 -65 -15	25 65 nil
	VMQ	70 hr/177°C (350°F)	DT	DT	DT	DT
Texamatic C Transmission Fluid (Texaco)	MQ PMQ	1 day/121°C (250°F)	-10 -10	- -	- -	35 45
	MQ VMQ	7 days/121°C (250°F) 70 hr/150°C (302°F)	-20 -25	- -60	- -25	40 25
Texamatic TL 3528 Transmission Fluid (Texaco)	VMQ	70 hr/121°C (250°F)	-15	5	nil	25

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated

Automotive Oils and Fluids (Cont.)

Transmission and Differential Lubricants

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Hypoid EP Lubricant	FVMQ	14 days/149°C (300°F)	-20	nil	-10	nil
Mobilube GX-90 General Lubricant	VMQ FVMQ	3 days/149°C(300°F)	DT DT	DT DT	DT DT	DT DT
Swan Finch EP90 Lubricant	FVMQ	3 days/121°C (250°F) 3 days/150°C (302°F)	-10 DT	-70 DT	nil DT	-10 DT
TL 3450 Lubricant	VMQ	3 days/100°C (212°F)	-10	-	-	15
	VMQ FVMQ	3 days/121°C (250°F)	-10 -5	-60 -5	-45 -5	10 5
	VMQ FVMQ	3 days/150°C (302°F)	DT DT	DT DT	DT DT	DT DT

Shock Absorber Fluids

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Delco Shock Absorber Fluid	PMQ	3 days/71°C (160°F)	-	-	-	65
Standard Oil Shock Absorber Fluid	MQ VMQ	1 hr/150°C (302°F)	-15 -20	- -	- -	25 35
	MQ VMQ	1 hr/177°C (350°F)	-15 -20	- -	- -	30 45

Brake Fluids

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Wagner 21B Brake Fluid	MQ VMQ PVMQ	7 days/24°C (75°F)	-5 0 -5	- - -	- - -	5 5 5
	PVMQ FVMQ	3 days/150°C (302°F)	-5 DT	-90 DT	-85 DT	10 DT
	MQ VMQ PVMQ	7 days/88°C(190°F)	-5 -5 -5	- - -	- - -	5 5 5
Delco Supreme 550 Heavy-Duty Brake Fluid	VMQ	70 hr/150°C (302°F)	-4	-25	nil	4

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated

Fuels

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Diesel Fuel	MQ	7 days/24°C (75°F)	-25	-	-	85
	VMQ		-25	-	-	100
	PVMQ		-35	-	-	130
	MQ	7 days/54°C (130°F)	-25	-	-	90
	VMQ		-30	-	-	105
	PVMQ		-40	-	-	140
Gasoline	VMQ	5 min/24°C (75°F)	-	-	-	25
	PVMQ		-	-	-	20
	VMQ	30 min/24°C (75°F)	-	-	-	60
	PVMQ		-	-	-	75
	MQ	18 hr/24°C (75°F)	-25	-	-	245
Gasoline -Regular	FVMQ	24 hr/25°C (77°F)	-12	-39	-30	21
Gasoline -Low Lead	FVMQ	24 hr/25°C (77°F)	-12	-41	-30	20
White Gasoline Vapors	PMQ	14 days/24°C (75°F)	-10	-	-	50
	VMQ	7 days/24°C (75°F)	-20	-	-	165
JP-4 Fuel (MIL-J-5624F)	FVMQ	1 day/-54°C (-65°F)	-5	-10	nil	nil
	PVMQ	10 min/24°C (75°F)	-10	-	-	30
	PVMQ	1 day/24°C (75°F)	-	-	-	105
	FVMQ		-5	-20	-50	10
	FVMQ	3 days/24°C (75°F)	-5	-35	-20	10
	PVMQ	7 days/24°C (75°F)	-25	-75	-60	330
	FVMQ		-5	-20	-50	10
	FVMQ	14 days/24°C (75°F)	-5	-20	-50	10
		21 days/24°C (75°F)	-5	-30	-55	10
		30 days/24°C (75°F)	-5	-30	-55	10
		3 days/115°C (240°F)	-5	-55	-40	15
		15 days/121°C (250°F)	-20	-65	-40	20
		3 days/177°C(350°F)	-25	-65	-20	25
		3 days/200°C (392°F)	-35	-80	-10	30
		3 days/232°C (450°F)	-45	-90	-20	20
JP-5 Fuel (MIL-J-5624F)	FVMQ	7 days/24°C (75°F)	-5	-15	nil	5
JP-5 Fuel Jet Engine Oil	75% FVMQ 25% VMQ Blend.	22 hours/24°C (75°F)	-11	-45	-37	21
JP-8 Fuel	FVMQ	1 day/24°C (75°F)	-9	-8	0	3.7
		7 days/24°C (75°F)	-9	-13	-6	4.6
JP-8Jet Engine Fuel	FVMQ (75 Durometer)	7 days/163°C (325°F)	-11	0	-8	12
		28 days/163°C (325 F)	-18	-73	-38	14
Manufactured Gas (24% Methane, 3% Ethane, 18% Carbon Monoxide, 55% Hydrogen)	FVMQ	2 mo/121°C (250°F)	GR	GR	GR	GR

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
GR - good resistance

Fuels (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Gasohol 10%; Methanol/ 90%; No Lead Gasoline	FVMQ	1 day/24°C (75°F) 7 days/24°C (75°F) 14 days/24°C (75°F) 28 days/24°C (75°F)	-19 -19 -20 -21	-47 -19 -48 -50	-35 -26 -26 -26	27.5 25.9 26.6 24.4
Gasohol 10%; Ethanol/90%;	FVMQ	1 day/24°C (75°F) 7 days/24°C (75°F)	-18 -16	-37 -37	-19 -16	21.5 21.3
Unsymmetrical Dimethyl Hydrazine	VMQ FVMQ	4 days/24°C (75°F)	nil DT	-25 DT	-50 DT	60 DT

Hydraulic Fluids

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Aerosafe 2300 (Stauffer)	VMQ	70 hr/25°C (77°F)	-12	-26	-17	21
	VMQ FVMQ	70 hr/70°C (158°F)	-15 -49	-36 -97	-5 -62	22 18
Exxon WS2406 Fluid	MQ VMQ FVMQ	7 days/71°C(160°F)	-15 -10 -20	- - -	- - -	15 20 35
	MQ VMQ PMQ	1 day/121°C (250°F)	-5 -10 -5	- - -	- - -	20 35 45
	MQ VMQ PMQ	1 hr/177°C (350°F)	-10 -10 -15	- - -	- - -	15 20 30
Hydrolube H-2 Fluid	MQ VMQ PVMQ	70 hr/24°C (75°F)	-5 -5 -5	-15 nil -15	10 15 -10	5 5 5
	MQ PMQ	5 days/24°C (75°F)	-5 -10	- -	- -	5 10
	MQ PMQ	14 days/24°C (75°F)	-5 -10	- -	- -	10 15
	MQ PMQ	27 days/24°C (75°F)	-5 -10	- -	- -	10 15
	MQ PMQ	5 days/65°C (150°F)	-10 -10	- -	- -	10 20
	MQ PMQ	24 days/65°C (150°F)	-5 -10	- -	- -	15 20
	MQ VMQ PVMQ	7 days/70°C (158°F)	-10 -10 -5	-10 - -15	20 - -10	5 5 5
Oronite M2V (Chevron)	VMQ FVMQ	7 days/100°C (212°F)	-19 -3	-57 nil	-62 -16	73 2
	VMQ FVMQ	7 days/150°C (302°F)	-24 nil	-70 -22	-63 -12	96 4
	VMQ FVMQ	7 days/177°C (350°F)	-35 -4	-86 -34	-77 -38	130 5

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated

Hydraulic Fluids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Oronite 8200 Fluid (Chevron)	FVMQ	3 days/177°C(350°F)	-15	-10	-10	5
Oronite 8515 Fluid (Chevron)	FVMQ	1 day/-54°C (-65°F)	nil	5	5	nil
	MQ VMQ PVMQ	3 days/24°C (75°F)	-15 -20 -15	- - -	- - -	40 45 40
	MQ VMQ PVMQ	3 days/130°C (265°F)	-20 -30 -25	- - -	- - -	60 80 115
	FVMQ	3 days/150°C(302°F) 3 days/177°C (350°F) 3 days/200°C (392°F)	-5 -10 -45	-10 -40 -95	-10 -5 -40	5 10 15
Oronite Hyjet (Chevron)	FVMQ VMQ	70 hr/70°C(158°F)	-25 -10	-79 -4	59 9	24 9
Pydraul 60 Fluid	VMQ PVMQ FVMQ	3 days/24°C (75°F)	-5 -10 -5	- - -	- - -	5 5 5
	VMQ PVMQ FVMQ	3 days/121°C (250°F)	-10 -25 -15	- - -	- - -	10 10 5
Pydraul A-200 Fluid	VMQ PVMQ FVMQ	3 days/24°C (75°F)	-5 -10 -5	- - -	- - -	5 5 nil
	VMQ PVMQ FVMQ	3 days/121°C (250°F)	-10 -10 -5	- - -	- - -	10 15 5
	VMQ PVMQ FVMQ	1 day/177°C (350°F)	-5 -10 -5	- - -	- - -	15 120 5
Pydraul F9 Fluid	MQ VMQ PMQ PVMQ	3 days/24°C (75°F)	-5 -5 -10 -10	-15 - - nil	nil - - 5	5 5 10 5
	MQ VMQ PMQ PVMQ FVMQ	3 days/150°C (302°F)	-5 -5 -10 -10 -5	-15 nil - nil -5	-5 10 - -5 5	10 10 15 15 5
	FVMQ	3 days/177°C (350°F)	-10	-60	-15	-10
Pydraul 150	FVMQ	7 days/150°C (302°F)	DT	DT	DT	DT
Skydrol 500B (Monsanto)	VMQ PVMQ	70 hr/70°C (158°F)	-9 -15	-17 -24	3 -11	10 19
Skydrol HT (Monsanto)	VMQ PVMQ	70 hr/70°C (158°F)	-13 -24	-23 -50	-8 -32	20 40

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated

Hydraulic Fluids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Skydrol LD (Monsanto)	VMQ FVMQ	70 hr/70°C (158°F)	-16 -37	-22 -87	-3 -71	26 108
Skydrol LD-4 (Monsanto)	FVMQ	1 day/24°C (75°F) 1 day/70°C (158°F)	-24 -29	-82 -85	-68 -73	68 87
Skydrol 7000 Fluid (Monsanto)	MQ VMQ PVMQ	3 days/24°C (75°F)	-5 nil -10	-10 -5 -10	-5 -5 -5	5 5 10
	MQ PMQ	14 days/24°C (75°F)	nil -10	- -	- -	5 5
	MQ VMQ PVMQ	3 days/93°C (200°F)	-5 -5 -10	-10 -10 -15	nil -10 -10	5 5 10

Transformer and Instrument Oils

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Askerol Transformer Oil (Monsanto) **- Chlorinated**	VMQ	35 days/24°C (75°F) 44 days/24°C (75°F) 60 days/24°C (75°F) 7 days/70°C (158°F) 14 days/70°C (158°F) 28 days/70°C(158°F) 38 days/70°C (158°F) 1 day/121°C (250°F) 3 days/121°C (250°F) 7 days/121°C (250°F) 14 days/121°C (250°F)	nil -5 -5 -5 -5 -5 -5 -5 -5 -10 -5	-20 -10 -10 -10 -20 -15 -15 -15 -15 -15 -10	-15 -15 -15 -20 -20 -15 -15 -15 -15 -15 -15	10 10 10 10 15 10 15 20 20 15 20
Inerteen Transformer Oil (Westinghouse) **- Chlorinated**	MQ VMQ PVMQ	3 days/24°C (75°F)	-5 -5 -10	-10 -10 -15	-5 -5 -15	10 10 15
	MQ PVMQ FVMQ	3 days/115°C (240°F)	-10 -10 nil	-25 -25 -15	-5 -10 nil	15 15 5
	VMQ	3 days/177°C (350°F)	-15	-25	-15	30
N-43 Fluorocarbon Capacitor Fluid	VMQ PVMQ	3 days/150°C (302°F)	-5 nil	- -	- -	5 5
Pyranol Transformer Oil (General Electric) **- Chlorinated**	PMQ	7 days/100°C (212°F)	-10	-	-	25
RCA-Gulf Instrument Oil A	VMQ PVMQ	3 days/93°C (200°F)	-20 -30	- -	- -	70 5
Univolt 35 Transformer Oil	MQ VMQ PVMQ FVMQ	3 days/150°C(302°F)	-15 -15 -30 nil	-25 -45 -30 -10	-20 -45 -15 nil	40 50 55 5

MQ - methyl groups only **P - phenyl groups**
V - vinyl groups **F - fluorine-containing groups**

Transformer and Instrument Oils (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Wemco C Transformer Oil	MQ VMQ PVMQ	3 days/24°C (75°F)	-15 -20 -30	- - -	- - -	35 40 45
	VMQ	1 yr/79°C (175°F)	-35	-	-	40
	VMQ FVMQ	3 days/177°C(350°F)	-55 -5	- 20	- 5	140 10
Coolanol 35 (Monsanto)	VMQ FVMQ	3 days/121°C (250°F)	-21 1	-67 1	-68 -10	101 3
Coolanol 45 (Monsanto)	FVMQ	70 hr/177°C(350°F)	-3	-12	-14	4

Speciality Oils, Greases and Fluids

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
ANG 15 Industrial Grease (Texaco Regal Starfak Special)	MQ VMQ	3 days/24°C (75°F)	-5 -10	nil nil	nil nil	10 10
	MQ VMQ	3 days/150°C (302°F)	-10 -15	nil nil	nil nil	20 20
ANG 25 Diester Base (Texaco TG-749)	VMQ	3 days/25°C (77°F)	-5	-	-	15
ANG 25 Diester Base (Texaco TG-749)	PMQ	3 days/93°C (200°F) 1 day/150°C (302°F) 7 days/ 150°C (302°F)	-15 -20 TB	- - TB	- - TB	30 40 TB
ANG 25 Glycerol Ester (Texaco)	PMQ	1 day/71°C (160°F)	-10	-	-	10
ANO No. 3 Grade M; Extreme Pressure (GAF Corp.)	MQ PMQ	3 days/177°C (350°F)	- -	- -	- -	45 30
ANO No. 6 Oil (GAF Corp.)	MQ PMQ	1 day/24°C (75°F)	-10 -10	- -	- -	30 45
	MQ PMQ	7 days/24°C (75°F)	-15 -20	- -	- -	35 60
	MQ PMQ	1 day/150°C (302°F)	-25 -25	- -	- -	95 145
ANO No. 9 Oil (GAF Corp.)	MQ PMQ	1 day/121°C (250°F)	-10 -15	- -	- -	35 40
	MQ PMQ	3 days/121°C (250°F)	-15 -20	- -	- -	45 70
	MQ PMQ	7 days/121°C(250°F)	-15 -20	- -	- -	45 65
ANO No. 11 Oil (GAF Corp.)	MQ PMQ	1 day/121°C (250°F)	-5 -15	- -	- -	10 20
	MQ PMQ	3 days/121°C (250°F)	-10 -15	- -	- -	15 25
	MQ PMQ	7 days/121°C (250°F)	-10 -15	- -	- -	15 25
ANO No. 366 Oil (GAF Corp.)	MQ PMQ	3 days/93°C (200°F)	-20 -10	- -	- -	95 140

MQ - methyl groups only **P - phenyl groups** **TB - too brittle to test**
V - vinyl groups **F - fluorine-containing groups**

Speciality Oils, Greases and Fluids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Aroclor 1254 (Monsanto)	VMQ	3 days/24°C (75°F) 3 days/150°C(302°F)	-5 -10	10 -5	5 nil	5 10
Cosmoline 2046 (Fritzsche, Dodge & Olcutt)	VMQ	4 days/24°C (75°F)	-35	-	-	55
Crude Oil 7 API	FVMQ	14 days/24°C (75°F)	-	-	-	5
	VMQ	3 days/83°C (180°F)	-10	-	-	25
	FVMQ	14 days/83°C (180°F) 14 days/135°C (275°F)	- -10	- -	- -	5 5
Crude Oil 315 API	VMQ	14 days/24°C (75°F) 3 days/83°C (180°F)	- -20	- -	- -	10 60
	FVMQ	14 days/83°C (180°F) 14 days/135°C (275°F)	- -5	 -70	- -45	5 -2
Delco No. 9	PVMQ	1 day/100°C (212°F)	-15	-15	15	10
	VMQ PVMQ	5 days/100°C (212°F)	-10 -15	- -	- -	10 10
Delco No. 11	MQ VMQ	5 days/100°C (212°F)	-5 -5	- -	- -	5 5
Dowtherm A Heat Transfer Oil (Dow)	VMQ	3 days/24°C (75°F) 3 days/177°C (350°F)	-10 -30	- -	- -	10 40
FC-75 Fluorochemical Fluid (3M)	VMQ PVMQ FVMQ VMQ PVMQ FVMQ	1 day/24°C (75°F) 7 days/65°C (150°F)	-5 -5 5 nil -5 nil	- - - - - -	- - - - - -	nil nil nil 5 5 5
Gas Drip Oil	VMQ PVMQ FVMQ	3 days/24°C (75°F)	-25 -30 -5	- - -	- - -	250 500 20
GE Transil Oil	VMQ	3 days/24°C (75°F) 3 days/93°C (200°F)	-20 -30	- -	- -	35 50
GM 14X Heavy Duty Oil	VMQ	5 days/100°C (212°F)	-5	-	-	5
Mineral Oil	VMQ PVMQ	3 days/24°C (75°F)	-10 -15	-30 -20	-10 -10	25 35
Mineral Oil (Shell No. 5)	VMQ PVMQ	3 days/121°C (250°F)	-20 -35	-55 -55	-35 -20	60 75
	MQ PMQ	1 day/100°C (212°F)	-10 -5	- -	- -	25 40
	MQ PMQ	1 day/121°C (250°F)	-15 -10	- -	- -	25 40
	MQ PMQ	1 day/149°C (300°F)	-15 -10	- -	- -	30 55

MQ - methyl groups only **P - phenyl groups**
V - vinyl groups **F - fluorine-containing groups**

Speciality Oils, Greases and Fluids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Navy Crankcase Oil No. 2135	VMQ	4 days/93°C (200°F)	-15	-	-	10
Navy Crankcase Oil No. 9250	VMQ	4 days/93°C (200°F)	-10	-	-	10
Pacemaker Fluid 100T	VMQ PVMQ	1 day/177°C (350°F)	-25 -35	- -	- -	50 60
	VMQ PVMQ FVMQ	3 days/177°C (350°F)	-30 -40 -5	- - -20	- - -10	55 65 5
PRL 3313 (Rohm and Haas)	MQ VMQ PMQ	1 day/71°C (160°F)	-15 -15 -20	- - -	- - -	15 15 30
	MQ PMQ	3 days/71°C (160°F)	DT DT	DT DT	DT DT	DT DT
	MQ VMQ PMQ	1 day/121°C (250°F)	DT -25 DT	DT - DT	DT - DT	DT 20 DT
SG 4766 Glycol Ester Base Grease (Standard Oil)	MQ PMQ	70 hr/24°C (75°F)	-10 -10	- -	- -	5 10
	MQ PMQ	3 days/24°C (75°F)	-10 -10	- -	- -	10 15
	PMQ	1 day/71°C (160°F) 3 days/71°C (160°F)	-10 -10	- -	- -	10 10
Shell Aircraft Turbine Lubricant A	FVMQ	70 hr/150°C (302°F) 140 hr/150°C(302°F)	-5 -11	-9 -24	-25 -32	8 10
Shell Aircraft Turbine Lubricant B	FVMQ	70 hr/150°C (302°F) 140 hr/150°C (302°F)	-3 -8	-26 -71	-50 -69	6 7
Shell B & B Grease	VMQ	70 hr/74°C (165°F) 912 hr/74°C (165°F)	-15 -16	-34 -9	-10 -20	26 26
	PMQ	70 hr/74°C (165°F) 912 hr/74°C (165°F)	-17 -19	-11 -15	-7 -13	30 30
Socony Mobil RL 147-A No. 7	PMQ	1 day/150°C (302°F) 6days/150°C (302°F)	-15 -20	- -	- -	50 50
Sun Oil No. 8X2513-1 L	PMQ	1 day/150°C (302°F) 6days/150°C (302°F)	-25 -45	- -	- -	70 55
Tectyl 502C Rust Inhibitor	MQ	14 days/24°C (75°F)	-5	5	5	nil
Tectyl 511-M Rust Inhibitor	MQ	14 days/24°C (75°F)	nil	5	-5	nil
Texas 1500 Oil (HD Concentrate)	MQ	10 days/150°C (302°F) 21 days/150°C (302°F)	-15 -20	-20 -30	-20 -10	10 10

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated

Speciality Oils, Greases and Fluids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Tricresyl Phosphate	MQ	3 days/24°C (75°F)	nil	nil	-5	nil
	VMQ		nil	-5	5	nil
	PVMQ		nil	-5	-5	nil
	MQ	3 days/177°C (350°F)	nil	-40	-40	5
	VMQ		-5	-25	-10	5
	PVMQ		nil	-45	-50	5
	VMQ	3 days/200°C (392°F)	DT	DT	DT	DT
Turbo Oil No. 35	PVMQ	7 days/24°C (75°F)	-15	-35	-20	15
		7 days/65°C (150°F)	-20	-35	-25	15
	VMQ	3 days/71°C (160°F)	-10	-10	-15	10
	PMQ		-15	-35	-25	15
	VMQ	3 days/121°C (250°F)	-15	-10	-15	10
	PMQ		-15	-35	-20	15
	FVMQ	3 days/150°C (302°F)	-10	-30	25	10
Ucon Lubricant LB1145 (gear oil) (Union Carbide)	MQ	3 days/150°C (302°F)	nil	-	-	nil
	VMQ		nil	-	-	nil
	PMQ		nil	-	-	nil
Ucon Water-Soluble Lubricant 50-HB-55 (Union Carbide)	MQ	3 days/150°C (302°F)	-5	-	-	nil
	VMQ		-5	-	-	nil
	PMQ		nil	-	-	nil
Ucon Lubricant 50-HB-100 (Union Carbide)	MQ	3 days/150°C (302°F)	nil	-	-	nil
	VMQ		-5	-	-	nil
	PMQ		nil	-	-	nil
Ucon Lubricant 50-HB-260 (Union Carbide)	MQ	3 days/150°C (302°F)	nil	-	-	nil
	VMQ		nil	-	-	nil
	PMQ		nil	-	-	nil
Ucon Lubricant 50-HB-280-X (Union Carbide)	MQ	3 days/150°C (302°F)	-5	-	-	nil
	VMQ		-5	-	-	nil
Ucon Lubricant 50-HB-660 (Union Carbide)	MQ	3 days/150°C (302°F)	nil	-	-	nil
	VMQ		nil	-	-	nil
	PMQ		nil	-	-	nil
Ucon Lubricant 50-HB-5100 (Union Carbide)	MQ	3 days/150°C (302°F)	nil	-	-	nil
	VMQ		nil	-	-	nil
	PMQ		nil	-	-	nil

Solvents

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Acetone	MQ	7 days/24°C (75°F)	-10	-	-	25
	VMQ		-10	-	-	15
	PVMQ		-10	-	-	20
	FVMQ		-20	-85	-75	180
Benzene	VMQ	14 days/24°C (75°F)	-	-	-	175
	FVMQ		-17	-22	-15	23
	FVMQ	3 days/70°C (158°F)	-10	-50	-40	20

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated

Solvents (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Butyl Acetate	VMQ	7 days/24°C (75°F)	-30	-	-	150
	PMQ		nil	-	-	150
	PVMQ		-25	-	-	125
Butyl Alcohol (Butanol)	MQ	7 days/24°C (75°F)	-10	-	-	20
	VMQ		-10	-	-	15
	PMQ		-15	-	-	40
	PVMQ		-10	-	-	35
	FVMQ		nil	-	-	10
Carbon Tetrachloride	VMQ	7 days/24°C (75°F)	-20	-	-	165
	PVMQ		-10	-	-	165
	FVMQ		-5	-45	-30	20
	FVMQ	5 days/49°C (120°F)	-10	-	-	20
Chlorobromomethane	FVMQ	7 days/24°C (75°F)	-10	-45	-50	25
	MQ	2 days/67°C(153°F)	-20	-	-	70
	VMQ		-20	-	-	95
	PVMQ		-25	-	-	235
Chloroform	FVMQ	5 days/24°C (75°F)	-10	nil	nil	30
Chlorothene Solvent (Dow)	FVMQ	1 day/24°C (75°F)	-15	-	-	50
	VMQ	7 days/24°C (75°F)	-	-	-	245
Cyclohexane	FVMQ	2 days/24°C (75°F)	-	-	-	15
	VMQ	7 days/24°C (75°F)	-	-	-	250
Diacetone Alcohol	VMQ	5 days/24°C (75°F)	-5	-	-	5
Dichloroisopropyl Ether	PMQ	7 days/24°C (75°F)	-	-	-	nil
Diethyl Ether	FVMQ	7 days/24°C (75°F)	-10	-40	-45	50
Ethyl Alcohol	MQ	7 days/24°C (75°F)	-5	-	-	nil
	VMQ		-5	-	-	5
	PVMQ		-10	-	-	20
	FVMQ		nil	-30	-15	5
Ethylenedichloride	FVMQ	3 days/24°C (75°F)	-10	-	-	50
	VMQ	7 days/24°C (75°F)	-	-	-	45
Heptane	FVMQ	7 days/60°C (140°F)	-10	-30	-30	25
Isopropyl Alcohol	PMQ	7 days/24°C (75°F)	-10	-	-	10
Methyl Alcohol	MQ	7 days/24°C (75°F)	nil	nil	nil	nil
Methyl Chloride	FVMQ	14 days/25°C (77°F)	-12	-34	-11	4
	MQ	7 days/24°C (75°F)	NR	NR	NR	NR
	VMQ		-15	-	-	150
	PVMQ		-15	-	-	150
Methylene Chloride	VMQ	72 hr/25°C (77°F)	-	-	-	180
	FVMQ		-	-	-	70
Mineral Spirits	FVMQ	30 days/24°C (75°F)	nil	nil	nil	nil
Monochlorobenzene	FVMQ	7 days/24°C (75°F)	-5	-45	-40	25

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
NR - not recommended

Solvents (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Naphtha	FVMQ	3 days/24°C (75°F)	-	-	-	10
Nitrocellulose Solvent (Toluene, Ethyl Alcohol, Ethyl Acetate, Methylethylketone, Butyl Acetate)	VMQ PVMQ FVMQ	2 days/24°C (75°F)	-25 -45 -25	- - -	- - -	135 165 65
Ortho-Chloroethylbenzene	FVMQ	7 days/24°C (75°F)	-5	-55	-40	15
Ortho-Chlorotoluene	FVMQ	7 days/24°C (75°F)	-5	-45	-45	20
Oxylene Solvent	FVMQ	1 day/24°C (75°F)	-15	-	-	90
Perchloroethylene	FVMQ	3 days/24°C (75°F)	-10	-	-	10
	PMQ	14 days/24°C (75°F)	-10	-	-	45
	FVMQ	1 day/107°C (225°F)	-15	-	-	20
Propylenedichloride	FVMQ	5 days/49°C (120°F)	-10	-	-	55
Solvatone Solvent (Union Carbide)	VMQ	1 day/24°C (75°F)	-15	-	-	30
Stoddard Solvent	MQ VMQ PVMQ	7 days/24°C (75°F)	NR -20 -15	NR - -	NR - -	NR 160 150
Toluene	MQ VMQ PVMQ FVMQ	7 days/24°C (75°F)	NR - -20 -10	NR - - -50	NR - - -35	NR 205 150 20
Toluene Vapor	PMQ	14 days/24°C (75°F)	-10	-	-	50
Turpentine	VMQ FVMQ	16 hr/24°C (75°F)	- -	- -	- -	230 15
Xylene (Xylol)	VMQ	15 min/24°C (75°F) 30 min/24°C (75°F) 1 hr/24°C (75°F) 2 hr/24°C (75°F) 5 days/24°C (75°F)	-20 -25 -30 -30 -35	- - - - -	- - - - -	40 45 60 80 135
	FVMQ	3 days/24°C (75°F) 7 days/24°C (75°F)	-10 -10	-45 -55	-35 -40	20 20

Silicone Fluids

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
XIAMETER® PMX-200 Silicone Fluid, 0.65 centistokes	FVMQ	3 days/24°C (75°F) 1 day/100°C (212°F) 3 days/150°C (302°F)	-5 -5 -10	-45 - -60	-30 - -30	5 15 25
XIAMETER® PMX-200 Silicone Fluid, 3 centistokes	FVMQ	3 days/24°C (75°F) 3 days/150°C (302°F)	nil -10	-15 -30	-10 -10	nil 10
XIAMETER® PMX-200 Silicone Fluid, 10 centistokes	FVMQ (40 Durometer)	3 days/23°C (73°F) 14 days/23°C (73°F) 3 days/100°C (212°F) 14 days/100°C (212°F)	-1 -2 -3 -1	-5 -9 -4 -6	3 0 3 0	0 0 1 1
XIAMETER® PMX-200 Silicone Fluid, 100 centistokes	FVMQ (40 Durometer)	3 days/23°C (73°F) 14 days/23°C (73°F) 3 days/100°C (212°F) 14 days/100°C (212°F)	-3 -4 -4 -3	3 1 6 5	7 5 10 10	0 0 0 0

MQ - methyl groups only **P - phenyl groups** **NR - not recommended**
V - vinyl groups **F - fluorine-containing groups**

Silicone Fluids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
XIAMETER® PMX-200 Silicone Fluid, 1000 centistokes	FVMQ (40 Durometer)	3 days/23°C (73°F) 14 days /23°C (73°F) 3 days/100°C (212°F) 14 days/100°C (212°F)	-3 -4 -5 -2	3 1 -2 0	4 2 0 5	0 0 1 0
XIAMETER® PMX-200 Silicone Fluid, 60000 centistokes	VMQ PMQ FVMQ	1 day 24°C (75°F)	-5 -5 nil	-10 -10 -10	nil -10 nil	5 5 nil
	PMQ FVMQ	3 days/24°C (75°F)	-5 nil	-15 -10	-5 -15	5 nil
	VMQ PMQ FVMQ	7 days/24°C (75°F)	-5 -10 nil	-10 -5 -5	nil -5 nil	10 10 nil
	VMQ PMQ FVMQ	1 day 150°C (302°F)	-5 -10 -5	-15 -5 -15	-10 nil -5	15 10 nil
	VMQ PMQ FVMQ	3 days/150°C (302°F)	-10 -10 -5	-15 -15 -25	-10 -10 nil	15 10 nil
	VMQ PMQ FVMQ	7 days/150°C (302°F)	-10 -10 -5	-30 nil -25	-20 -25 -15	15 15 nil
XIAMETER® RSN-0220 Flake Resin	FVMQ	2 days/150°C (302°F)	nil	-	-	10
***Dow Corning*® 510 Fluid**	MQ VMQ PVMQ	3 days/24°C (75°F)	-15 -15 -20	- - -	- - -	40 35 35
	VMQ	1 day/I50°C (302°F)	-20	-	-	35
	MQ VMQ PVMQ FVMQ	3 days/150°C (302°F)	-20 -25 -30 nil	- - - -10	- - - -15	40 45 50 nil
***Dow Corning*® 550 Fluid**	MQ VMQ PVMQ	3 days/24°C (75°F)	-5 -5 -10	- - -	- - -	5 10 10
	MQ VMQ PVMQ FVMQ	3 days/150°C (302°F)	-10 -10 -10 nil	- - - -3	- - - -15	10 10 10 nil
	VMQ	7 days/150°C (302°F)	-	-	-	10

MQ - methyl groups only **P - phenyl groups** **NE - no effect**
V - vinyl groups **F - fluorine-containing groups**

Silicone Fluids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
***Dow Corning*® 702 Diffusion Pump Fluid**	VMQ	1 day/150°C (302°F)	-25	-	-	60
***Dow Corning*® 710 Fluid**	FVMQ	3 days/150°C (302°F)	nil	nil	-15	nil
	VMQ	7 days/150°C (302°F)	-5	-	-	5
		7 days/150°C (302°F)	-10	-	-	5
		7 days/200°C (392°F)	-10	-	-	10
***Dow Corning*® 710 Fluid**	MQ	3 days/24°C (75°F)	-5	-	-	nil
	VMQ		-5	-	-	5
	PVMQ		-5	-	-	5
	MQ	3 days/150°C (302°F)	-10	-	-	5
	VMQ		-5	-	-	5
	PVMQ		-10	-	-	10
	FVMQ	14 days/200°C (392°F)	-20	-70	10	nil
***Dow Corning*® FS-1265 Fluid**	VMQ	7 days/150°C (302°F)	nil	10	-5	nil
	FVMQ		-20	-55	-45	80
	PVMQ		-5	15	-10	5

Silicone Compounds and Greases

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
***Dow Corning*® 4 Compound**	PMQ	1 day/24°C (75°F)	-5	-	-	5
		3 days/24°C (75°F)	-5	-	-	10
		7 days/24°C (75°F)	-5	-	-	20
	MQ	1 day/150°C (302°F)	-20	-	-	25
	VMQ		-15	-	-	25
	PMQ		-5	-	-	15
	VMQ	3 days/150°C (302°F)	-	-	-	25
	PMQ		-10	-	-	25
	VMQ	7 days/150°C (302°F)	-	-	-	30
	PMQ		-10	-	-	30
	PMQ	1 day/200°C (392°F)	-10	-	-	20
		3 days/200°C (392°F)	-20	-	-	30
		7 days/200°C (392°F)	-30	-	-	40
***Dow Corning*® 5 Compound**	MQ	1 day/150°C (302°F)	-20	-	-	20
	VMQ		-15	-	-	15
***Molykote*® 33 Grease**	FVMQ	3 days/25°C (77°F)	-5	-	-	4
		3 days/177°C (350°F)	-11	-	-	9

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups

Silicone Compounds and Greases (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
***Molykote*® 44L Grease**	VMQ	7 days 150°C (302°F)	-	-	-	15
***Molykote*® 55 Pneumatic Grease**	PMQ	3 days/93 °C (200 °F) 3 days /250°C (482°F)	-15 DT	- DT	- DT	60 DT
	VMQ FVMQ	3 days/177°C (350°F) 3 days/25°C (77°F) 3 days/177°C (350°F)	DT -5 -11	DT - -	DT - -	DT 4 9
***Dow Corning*® 340 Heat Sink Compound**	VMQ	70 hr/150°C (302°F)	-9			11
***Molykote*® FS-1292 Grease**	75/25 VMQ/FVMQ 50/50 VMQ/FVMQ	70 hr/177°C(350°F) 70 hr/177°C (350°F)	-6 -17	-11 1	-28 -6	6 16

Food Products

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Beer	VMQ FVMQ	22 hr/70°C (158°F)	nil -5	-	-	nil nil
Butter (liquid)	VMQ FVMQ	22 hr/70°C(158°F)	-5 -3	- -	- -	nil nil
Coca-Cola Syrup	VMQ PVMQ FVMQ	1 day/24°C (75°F)	nil nil 5	nil 10 nil	nil 15 5	nil nil nil
	VMQ PVMQ FVMQ	28 days/24°C (75°F)	nil nil nil	-10 20 nil	-10 20 10	nil nil nil
	VMQ PVMQ FVMQ	60 days/24°C (75°F)	nil nil 5	-10 -5 -5	-10 -5 -5	nil nil nil
Coffee	VMQ	7 days/83°C(180°F) 14 days/83°C (180° F)	-5 -5	-15 -5	nil nil	nil 5
Lard	VMQ (High Strength)	1 day/200°C (392°F) 3 days/200°C (392°F) 7 days/200°C (392°F)	nil -5 BR	-35 -80 BR	-40 -75 BR	5 5 BR
	VMQ	7 days/200°C (392°F) 1 hr/260°C (500°F)	nil -10	-30 -25	-35 -20	nil 5
Mazola Oil	VMQ	7 days/150°C (302°F)	-5	-15	-10	nil
Orange Peel Oil	VMQ	1 day/24°C (75°F)	-	-	-	-100

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated
BR - brittle

Food Products (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Orange Syrup	VMQ	1 day/24°C (75°F)	nil	nil	5	nil
	PVMQ		nil	5	10	nil
	FVMQ		nil	-15	5	5
	VMQ	28 days/24°C (75°F)	nil	-5	-5	nil
	PVMQ		nil	15	25	nil
	FVMQ		-5	-15	5	nil
	VMQ	60 days/24°C (75°F)	nil	-5	-10	nil
	PVMQ		nil	nil	5	nil
	FVMQ		-5	-35	-15	5
Scotch Whisky	VMQ	1 day/24°C (75°F)	nil	nil	-5	nil
	PVMQ		nil	nil	5	nil
	FVMQ		nil	-15	3	5
	VMQ	28 days/24°C (75°F)	nil	-5	10	nil
	PVMQ		nil	5	20	nil
	FVMQ		-5	-15	15	nil
	VMQ	60 days/24°C (75°F)	nil	-10	5	nil
	PVMQ		nil	-10	-5	5
	FVMQ		-5	-35	-15	3
Spry Shortening	VMQ	7 days/150°C (302°F)	-5	-15	-15	nil
Tab Concentrate	VMQ	1 day/24°C (75°F)	nil	nil	5	nil
	PVMQ		nil	nil	3	nil
	FVMQ		nil	-5	3	nil
	VMQ	28 days/24°C (75°F)	nil	5	30	nil
	PVMQ		nil	5	10	nil
	FVMQ		nil	nil	10	nil
	VMQ	60 days/24°C (75°F)	nil	nil	-10	nil
	PVMQ		nil	-5	-5	nil
	FVMQ		nil	-10	-5	nil
Tia Maria Liquor	VMQ	1 day/24°C (75°F)	nil	nil	5	nil
	PVMQ		nil	10	10	nil
	FVMQ		nil	-10	3	nil
	VMQ	28 days/24°C (75° F)	nil	nil	10	nil
	PVMQ		nil	10	10	nil
	FVMQ		-5	-15	20	nil
	VMQ	60 days/24°C (75°F)	nil	-5	-5	nil
	PVMQ		nil	-5	nil	nil
	FVMQ		-5	-25	-5	nil
Vegetable Oil (Kraft)	VMQ	1 day/200°C (392°F)	-5	-30	-25	5
	(High Strength)	3 days/200°C (392°F)	nil	-40	-45	5
		7 days/200°C (392°F)	-5	-80	-75	5
Vinegar	VMQ	1 day/24°C (75°F)	nil	-5	nil	nil
	(High Strength)	7 days/24°C (75°F)	nil	-5	nil	nil

MQ - methyl groups only **P - phenyl groups**
V - vinyl groups **F - fluorine-containing groups**

Water and Steam

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Water	MQ	7 days/24°C (75°F)	nil	-5	-5	5
	VMQ		nil	-	-	nil
	PVMQ		nil	-5	-10	nil
	MQ	7 days/70°C (158°F)	-5	-5	5	5
	VMQ		nil	-5	10	nil
	PVMQ		-5	-10	-5	nil
	VMQ	3 days/100°C (212°F)	-5	-5	-15	nil
	PVMQ		-3	-5	-5	nil
	FVMQ		nil	-	-	nil
	MQ	7 days/100°C (212°F)	-5	-20	20	nil
	VMQ		nil	-	-	5
	VMQ	14 days/100°C (212°F)	nil	-	-	5
	MQ	1 day/121°C (250°F)	-5	-	-	5
		3 days/121°C (250°F)	-5	-	-	5
	FVMQ	70 hr/150°C (302°F)	-5	-	-	nil
	MQ	1 day/177°C (350°F)	-15	-	-	15
		3 days/177°C (350°F)	DT	DT	DT	DT
Steam	MQ	7 days/5 psi	-5	-25	5	nil
	VMQ		-5	-15	5	5
	PVMQ		-5	-10	10	nil
	MQ	14 days/5 psi	-5	-35	-10	5
	VMQ		-5	-30	-15	3
	PVMQ		-5	-3	10	nil
	MQ	7 days/10 psi	-5	-30	-10	5
	VMQ		-5	-30	-10	5
	PVMQ		-5	-10	-10	nil
	MQ	14 days/10 psi	-5	-35	-15	5
	VMQ		-5	-40	-20	5
	PVMQ		-5	-10	-10	nil
	MQ	7 days/20 psi	-5	-35	-15	5
	VMQ		-5	-35	20	3
	PVMQ		-5	-15	-15	nil
	MQ	14 days/20 psi	-5	-45	-20	5
	VMQ		-5	-45	-40	5
	PVMQ		-5	-20	-15	nil
	VMQ	1 day/50 psi	-5	-25	-10	5
		3 days/50 psi	-5	-30	-5	5
		5 days/50 psi	-5	-40	-25	5
		7 days/50 psi	-5	-65	-30	5

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated

Water and Steam (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Steam	VMQ	1 day/65 psi	-10	-30	-30	5
		3 days/65 psi	-5	-50	-25	5
		7 days/65 psi	-10	-65	-50	5
		1 day/80 psi	-10	-40	-10	5
		3 days/80 psi	-10	-60	-40	10
		7 days/80 psi	-10	-75	-45	5
	MQ	16 hr/100psi	-10	-30	25	nil
	MQ	1 day/100 psi	-10	-40	-10	5
	VMQ*		3	-11	-2	-2
	PVMQ		-5	-25	5	nil
	FVMQ		-5	-20	15	nil
	MQ	3 days/100 psi	-10	-60	-20	10
	VMQ		4	-25	-10	-4
	PVMQ		-10	-35	-5	nil
	MQ	7 days/100 psi	-20	-30	-25	5
	VMQ		6	-35	-26	-6
	PVMQ		-20	-75	-75	nil

Acids

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Acetic Acid (5%)	VMQ	7 days/24°C (75°F)	-5	-	-	5
Acetic Acid, glacial	MQ	7 days/24°C (75°F)	-5	-	-	nil
	VMQ		-5	-	-	5
	PVMQ		-5	-	-	5
	FVMQ	2 days/24°C (75°F)	-	-	-	20
Hydrochloric Acid (5% in Perchloroelhylene)	VMQ	1 day/100°C (212°F)	-30	-	-	100
	FVMQ		-15	-	-	10
Hydrochloric Acid (10%)	MQ	7 days/24°C (75°F)	nil			nil
	VMQ		-5	-	-	nil
	PVMQ		nil	-	-	nil
	FVMQ		-5	-25	-15	nil
Hydrochloric Acid (18%)	FVMQ	3 days/24°C (75°F)	nil	-20	-10	nil
		3 days/65°C (150°F)	nil	-35	-10	10
Hydrochloric Acid (36%, concentrated)	MQ	7 days/24°C (75°F)	PR	PR	PR	PR
	VMQ		-5	-	-	5
	PVMQ		BR	BR	BR	BR
	FVMQ		-5	-45	-30	10
Hydrofluoric Acid (48%)	PMQ	9 days/27°C (80°F)	DT	DT	DT	DT
Nitric Acid (10%)	MQ	7 days/24°C (75°F)	nil	-	-	10
	VMQ		nil	-	-	nil
	PVMQ		nil	-	-	nil
	FVMQ		nil	-10	-3	nil

* Data based on *Silastic*® NCP-80 and NCP-40 Silicone Rubber.

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated
PR - poor
BR - brittle

Acids (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Nitric Acid (50%)	FVMQ	3 days/24°C (75°F) 3 days/65°C (150°F)	5 -10	-15 -80	-10 -30	5 5
Nitric Acid (70%, concentrated)	MQ VMQ PVMQ FVMQ	7 days/24°C (75°F)	PR 5 BR nil	PR - BR -40	PR - BR -30	PR -10 BR 5
Phosphoric Acid (10%)	MQ PMQ MQ PMQ	7 days/24°C (75°F) 7 days/100°C (212°F)	UA UA UA UA	UA UA UA UA	UA UA UA UA	UA UA UA UA
Phosphoric Acid (85%, concentrated)	MQ PMQ VMQ FMQ	7 days/24°C (75°F) 7 days/100°C (212°F)	UA UA UA 4	UA UA -39 -8	UA UA nil -9	UA UA -23 -2
Stearic Acid	MQ PMQ	7 days/100°C (212°F)	UA UA	UA UA	UA UA	UA UA
Sulfuric Acid (20%)	MQ	1 day/83°C (180°F) 7 days/83°C (180°F)	nil nil	-10 -25	-5 -15	-5 -10
Sulfuric Acid (30%)	PVMQ	2 hr/93°C (200°F)	nil	-20	-5	nil
Sulfuric Acid (50%)	FVMQ	3 days/24°C (75°F) 3 days/65°C (150°F)	nil 5	-5 -35	-5 -15	nil nil
Sulfuric Acid (95%, concentrated)	MQ VMQ FVMQ PVMQ	7 days/24°C (75°F)	DC DC DC DC	DC DC DC DC	DC DC DC DC	DC DC DC DC

Bases

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Ammonium Hydroxide (saturated)	MQ VMQ PMQ PVMQ FVMQ	7 days/24°C (75°F)	-5 nil UA nil -5	- - UA - -45	- - UA - -5	nil nil UA 0 5
Calcium Oxide (10%, saturated)	VMQ	1 day/150°C (302°F)	5	-15	-10	5
Lithium Hydroxide (2%)	VMQ	1 day/150°C (302°F)	nil	-25	-10	-5
Lithium Hydroxide (5%)	VMQ	1 day/150°C (302°F)	-10	-70	nil	-35
Lithium Hydroxide (10%, saturated)	VMQ	1 day/150°C (302°F)	DT	DT	DT	DT
Potassium Hydroxide (10%)	VMQ	1 day/150°C (302°F)	5	-20	-15	-5
Potassium Hydroxide (25%)	MQ PMQ	7 days/83°C (180°F)	nil -5	- -	- -	5 nil
Potassium Hydroxide (saturated)	VMQ	1 day/150°C (302°F)	-20	-40	-10	-10

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated
PR - poor
BR - brittle
UA - unaffected
DC - decomposed

Bases (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Sodium Hydroxide (10%)	MQ	7 days/24°C (75°F)	-5	-	-	nil
	VMQ		-5	-	-	nil
	PMQ		-	-	-	5
	PVMQ		-5	-	-	nil
	FVMQ		-5	-45	-10	nil
Sodium Hydroxide (25%)	MQ	7 days/83°C (180°F)	-5	-	-	nil
	PMQ		-5	-	-	-10
Sodium Hydroxide (50%)	VMQ	7 days/24°C (75°F)	-5	-	-	nil
	PMQ		-	-	-	10
	FVMQ		-5	-10	5	nil
	PMQ	7 days/100°C (212°F)	-	-	-	15

Salts

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Copper Sulfate (50%)	PMQ	5 days/100°C (212°F)	UA	UA	UA	UA
Ferric Chloride (60%)	MQ	7 days/100°C (212°F)	UA	UA	UA	UA
	PMQ		FR	FR	FR	FR
Sodium Carbonate (2%)	MQ	7 days/24°C (75°F)	nil	-	-	nil
	VMQ		-5	-	-	nil
	PVMQ		5	-	-	nil
Sodium Chloride (10%)	MQ	7 days/24°C (75°F)	nil	-	-	nil
	VMQ		nil	-	-	nil
	PVMQ		5	-	-	nil

Other Chemicals

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Acetonitrile	VMQ	20 hr/24°C(75°F)	-	-	-	nil
	FVMQ		-	-	-	5
	VMQ	168hr/150°C (302°F)	-	-	-	5
	FVMQ		DI	DI	DI	DI
Ammonia	MQ	7 days/24°C (75°F)	nil	-	-	nil
	VMQ		-10	-	-	nil
	PVMQ		-5	-	-	5
	VMQ	24hr/110°C(230°F)	-	260	200	-
	FVMQ	300 lb. pressure	DT	DT	DT	DT
Aniline	FVMQ	7 days/24°C (75°F)	nil	-30	-15	5
Bromine (liquid)	MQ	7 days/24°C (75°F)	25	-	-	15
Butylene Oxide	MQ	1 day/24°C (75°F)	-	-	-	20
	PMQ		-	-	-	40
Calcium Silicate (10%, saturated)	VMQ	1 day/150°C (302°F)	nil	nil	nil	5
Caprolactam Monomer	VMQ	3 days/24°C (75°F)	nil	-20	-10	nil
	FVMQ		-5	-20	nil	nil

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated
UA - unaffected
FR - fair
DI - disintegrated

Other Chemicals (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
1-Chlorodecane	FVMQ	7 days/24°C (75°F)	-5	-20	-20	10
Dimethyl Formamide	FVMQ	1 day 24°C (75°F)	DT	DT	DT	DT
	MQ	7 days/24°C (75°F)	nil	-	-	2
	PMQ		nil	-	-	2
Dioctyl Phthalale	VMQ	3 days/70°C (158°F)	-1	-10	-12	10
		6 days/70°C (158°F)	-5	-16	-9	11
		70 hr/150°C (302°F)	-15	-4	8	13
	FVMQ	70 hr/150°C (302°F)	-9	-13	-13	7
Dowtherm 209 (Dow) (50/50 Water)	VMQ	14 days/100°C (212°F)	2	-7	-17	nil
Elhylene Glycol	FVMQ	7 days/24°C (75°F)	nil	-10	-10	nil
Elhylene Glycol (60%)	MQ	7 days/135°C (275°F)	-25	-	-	20
Ethylene Glycol (50%)	VMQ	7 days/83°C (180°F)	nil	nil	10	nil
	FVMQ		nil	-5	5	nil
	VMQ	70 hr/100°C (212°F)	-1	-4	nil	1
		7 days/100°C (212°F)	-7	-5	2	nil
		14 days/100°C (212°F)	-4	-10	-12	1
	PVMQ	7 days/121 °C (250°F)	-5	-	-	5
Ethylene Glycol Mixture (⅓ Ethylene Glycol; ⅓ EthylAlcohol; ⅓ Water)	VMQ	7 days/100°C (212°F)	-1	-2	2	5
Ethylene Oxide	MQ	3 days/24°C (75°F)	-	-	-	25
	FVMQ	7 days/24°C (75°F)	-15	-75	-60	100
	VMQ	7 days/71°C (160°F)	-30	-70	-65	95
	MQ	14 days/71°C (160°F)	-	-	-	45
	PVMQ	32 hr/110°C (230°F)	nil	-25	-30	nil
Freon 11 (DuPont)	VMQ	3 days/24°C (75°F)	-	-	-	175
	PVMQ		-	-	-	260
	FVMQ		-	-	-	30
Freon 12 (DuPont)	VMQ	3 days/24°C (75°F)	-	-	-	150
	PVMQ		-	-	-	195
	FVMQ		-	-	-	45
Freon 21 (DuPont)	MQ	7 days/-55°C (-67°F)	-5	-	-	225
		7 days/24°C (75°F)	-15	-	-	165
Freon 22 (DuPont)	MQ	7 days/-55°C (-67°F)	-10	-	-	110
	FVMQ	3 days/24°C (75°F)	-	-	-	205
	MQ	7 days/24°C (75°F)	-5	-	-	75
	VMQ		-5	-	-	75

MQ - methyl groups only **P - phenyl groups** **DT - deteriorated**
V - vinyl groups **F - fluorine-containing groups**

Other Chemicals (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Freon 113 (DuPont)	MQ	7 days/-55°C (-67°F) 7 days/24°C (75°F)	-5 -5	- -	- -	200 150
Freon 114 (DuPont)	VMQ PVMQ FVMQ	3 days/24°C (75°F)	- - -	- - -	- - -	130 135 25
HMS 20-1083	VMQ PVMQ	3 days/24°C (75°F)	-20 -15	- -	- -	125 100
Hydrazine (Anhydrous)	FVMQ	3 days/24°C (75°F)	ES	ES	ES	ES
Hydrogen Peroxide (3%)	PMQ	7 days/24°C (75°F)	UA	UA	UA	UA
Hydrogen Peroxide (30%)	PMQ	7 days/24°C (75°F)	UA	UA	UA	UA
Hydrogen Peroxide HTP (90%)	FVMQ	7 days/65°C (150°F)	nil	-20	-15	5
Isopropyl Nitrate	FVMQ	7 days/24°C (75°F)	-	-	-	200
Methyl Methacrylate	VMQ FVMQ	4 hr/25°C (77°F)	- -	- -	- -	106 104
Molybdenum Disulfide	VMQ PVMQ FVMQ	3 days/24°C (75°F)	nil nil nil	- - -	- - -	nil nil nil
	VMQ PVMQ FVMQ	3 days/150°C (302°F)	nil nil 5	- - -	- - -	nil nil nil
Monoethanolamine	VMQ	70 hr/24°C (75°F) 70 hr/38°C (100°F)	nil -5	-20 -25	5 5	nil 5
	VMQ FVMQ	70 hr/121°C (250°F)	-25 DT	-80 DT	-5 DT	5 DT
Pentachlorophenol (10% in Ethanol)	PMQ	7 days/24°C (75°F)	-	-	-	5
Phenol (70%)	MQ	7 days/100°C (212°F)	-30	-	-	5
Phenol (85%)	MQ	7 days/24°C (75°F)	-10	-	-	10
Phthalic Acid Anhydride	MQ	7 days/149°C (300°F)	5	-	-	nil
Phthalic Anhydride	MQ VMQ FVMQ	1 day/200°C (392°F)	nil nil nil	- - -	- - -	nil nil nil
	MQ VMQ FVMQ	5 days/200°C (392°F)	-2 nil -2	- - -	- - -	nil nil 7
	MQ VMQ FVMQ	7 days 200°C (392°F)	-2 nil 2	- - -	- - -	2 nil 7

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated
UA - unaffected
ES - excessive swell

Other Chemicals (Cont.)

Immersion Medium	ASTM Designation	Immersion Conditions	Hardness Change points	Tensile Change %	Elongation Change %	Volume Change %
Polyglycol (Dow 80-6)	VMQ PVMQ	7 days/24°C (75°F)	-5 -5	- -	- -	5 5
	MQ VMQ	7 days/121°C (250°F)	-5 -10	- -	- -	5 5
Polystyrene (expandable)	VMQ	7 days/24°C (75°F)	nil	5	10	nil
Propylene Oxide	MQ	7 days/24°C (75°F)	-20	-	-	150
RX-1099 (Vinyl Plastisol)	VMQ FVMQ	7 days/24°C (75°F)	-5 -5	- -	- -	10 5
Salicylanilide (10% in 2 B Ethanol)	PMQ	7 days/24°C (75°F)	-	-	-	5
Santicizer 141 (Monsanto)	VMQ PVMQ FVMQ	70 hr/150°C (302°F)	DT DT DT	DT DT DT	DT DT DT	DT DT DT
Styrene Monomer	PVMQ	1 hr/24°C (75°F) 1 hr/100°C (212°F)	-10 -20	- -	- -	55 115
Sulfur (molten)	PMQ	7 days/121°C (250°F)	UC	UC	UC	UC
	VMQ	4 days/199°C (390°F)	-22	DT	DT	DT
Sulfur Dioxide (dry gas)	MQ VMQ PVMQ	7 days/24°C (75°F)	nil -5 nil	- - -	- - -	nil nil nil
Sulfur Dioxide (liquid)	MQ	7 days/24°C (75°F)	nil	-	-	5
Sulfur Hexafluoride	VMQ FVMQ	1 day/150°C (302°F)	nil nil	- -	- -	nil nil
	VMQ FVMQ	2 days/199°C (390°F)	nil 5	- -	- -	nil nil
	VMQ FVMQ	3 days/199°C (390°F)	nil 5	- -	- -	nil nil
Tar	PMQ	7 days/100°C (212°F)	nil	-	-	10
Tetrahydrofuran (Tetramethylene Oxide)	VMQ FVMQ	1 day/25°C (77°F)	- -	- -	- -	260 170
Trichloroethylene	FVMQ	1 day/24°C (75°F)	-10	-	-	25
	MQ	7 days/24°C (75°F)	-	-	-	250
	FVMQ	5 days/49°C (120°F)	-10	-	-	20
Trifluorochloroethylene	MQ	7 days/-58°C (-65 °F)	-20	-	-	100

MQ - methyl groups only
V - vinyl groups
P - phenyl groups
F - fluorine-containing groups
DT - deteriorated
UC - unchanged

For information about silicone elastomers from the XIAMETER brand

A global leader in silicones, silicon-based technology and innovation, the XIAMETER brand from Dow Corning offers an extensive line of silicone elastomers that meet performance requirements across a wide range of industrial and consumer applications.

XIAMETER brand silicone rubber products are designed for customers who simply need an efficient way to buy reliable, high-quality standard materials at market-driven prices. For product information, visit **www.xiameter.com**.

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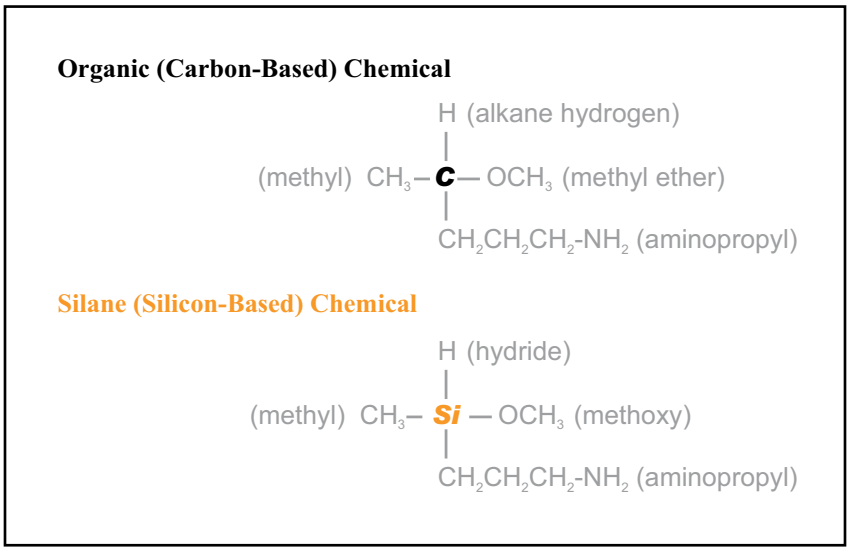
A Guide to Silane Solutions

The Basics of Silane Chemistry

The Basics of Silane Chemistry

Silicon is in the same family of elements as carbon in the periodic table. In their most stable state, silicon and carbon will both conveniently bond to four other atoms; but silicon-based chemicals exhibit significant physical and chemical differences compared to analogous carbon-based chemicals. Silicon is more electropositive than carbon, does not form stable double bonds, and is capable of very special and useful chemical reactions. Silicon-based chemicals include several types of monomeric and polymeric materials.

Figure 1. Carbon vs. silicon chemistry.



Monomeric silicon chemicals are known as silanes. A silane structure and an analogous carbon-based structure are shown in Figure 1. The four substituents have been chosen to demonstrate differences and similarities in physical and chemical properties between silicon- and carbon-based chemicals. A silane that contains at least one carbon-silicon bond (CH_3-Si-) structure is known as an organosilane. The carbon-silicon bond is very stable, very non-polar and gives rise to low surface energy, non-polar, hydrophobic effects. Similar effects can be obtained from carbon-based compounds, although these effects are often enhanced with silanes. The silicon hydride (–Si-H) structure is very reactive. It reacts with water to yield reactive silanol (-Si-OH) species and, additionally, will add across carbon-carbon double bonds to form new carbon-silicon-based materials. The methoxy group on the carbon compound gives a stable methyl ether, while its attachment to silicon gives a very reactive and hydrolyzable methoxysilyl structure. The organofunctional group, the aminopropyl substituent, will act chemically the same in the organosilicon compound as it does in the carbon-based compound. The distance of the amine, or other organofunctional group, from silicon will determine whether the silicon atom affects the chemistry of the organofunctional group. If the organic spacer group is a propylene linkage (e.g., -$CH_2CH_2CH_2$-), then the organic reactivity in the organofunctional silane will be similar to organic analogs in carbon chemistry. Certain reactive silanes, particularly vinyl silanes (-Si-CH=CH_2) and silicon hydrides (-Si-H), are useful reactive groups in silicon chemistry, even though the reactive group is attached directly to the silicon atom.

Attachment of chlorine, nitrogen, methoxy, ethoxy or acetoxy directly to silicon yields chlorosilanes, silylamines (silazanes), alkoxysilanes and acyloxysilanes, respectively, that are very reactive and exhibit unique inorganic reactivity. Such molecules will react readily with water, even moisture adsorbed on a surface, to form silanols. These silanols then can react with other silanols to form a siloxane bond (-Si-O-Si-), a very stable structure; or in the presence of metal hydroxyl groups on the surface of glass, minerals or metals, silanols will form very stable –Si-O-metal bonds to the surface. This is the key chemistry that allows silanes to function as valuable surface-treating and coupling agents.

Chloro-, alkoxy-, and acetoxysilanes, and silazanes (-Si-NH-Si) will react readily with an active hydrogen on any organic chemical (e.g., alcohol, carboxylic acid, amine, phenol or thiol) via a proc-ess called silylation.

$$R_3Si\text{-}Cl + R'OH \rightarrow R_3Si\text{-}OR' + HCl$$

Silylation is very useful in organic synthesis to protect functional groups while other chemical manipulations are being performed. The silylated organofunctional group can be converted back to the original functional group once the chemical operation is completed. Silylation is very important in the manufacture of pharmaceutical products.

Typical Silane Applications

Coupling Agent: Organofunctional alkoxysilanes are used to couple organic polymers to inorganic materials. Typical of this application are reinforcements, such as fiberglass and mineral fillers, incorporated into plastics and rubbers. They are used with both thermoset and thermoplastic systems. Mineral fillers, such as silica, talc, mica, wollastonite, clay and others, are either pretreated with silane or treated *in situ* during the compounding process. By applying an organofunctional silane to the hydrophilic, non-organoreactive filler, the surfaces are converted to reactive and organophilic. Fiberglass applications include auto bodies, boats, shower stalls, printed circuit boards, satellite dishes, plastic pipes and vessels, and many others. Mineral-filled systems include reinforced polypropylene, silica-filled molding compounds, silicon-carbide grinding wheels, aggregate-filled polymer concrete, sand-filled foundry resins and clay-filled EPDM wire and cable. Also included are clay- and silica-filled rubber for automobile tires, shoe soles, mechanical goods and many other applications.

Adhesion Promoter: Silane coupling agents are effective adhesion promoters when used as integral additives or primers for paints, inks, coatings, adhesives and sealants. As integral additives, they must migrate to the interface between the adhered product and the substrate to be effective. As a primer, the silane coupling agent is applied to the inorganic substrate before the product to be adhered is applied. In this case, the silane is in the optimum position (in the interphase region), where it can be most effective as an adhesion promoter. By using the right silane coupling agent, a poorly adhering paint, ink, coating, adhesive or sealant can be converted to a material that often will maintain adhesion even if subjected to severe environmental conditions.

Hydrophobing and Dispersing Agent: Alkoxysilanes with hydrophobic organic groups attached to silicon will impart that same hydrophobic character to a hydrophilic inorganic surface. They are used as durable hydrophobing agents in construction, bridge and deck applications. They are also used to hydrophobe inorganic powders to make them free-flowing and dispersible in organic polymers and liquids.

Crosslinking Agent: Organofunctional alkoxysilanes can react with organic polymers to attach the trialkoxysilyl group onto the polymer backbone. The silane is then available to react with moisture to crosslink the silane into a stable, three-dimensional siloxane structure. Such a mechanism can be used to crosslink plastics, especially polyethylene, and other organic resins, such as acrylics and urethanes, to impart durability, water resistance and heat resistance to paints, coatings and adhesives.

Moisture Scavenger: The three alkoxy groups on silanes will hydrolyze in the presence of moisture to convert water molecules to alcohol molecules. Organotrialkoxysilanes are often used in sealants and other moisture-sensitive formulations as water scavengers.

Polypropylene Catalyst "Donor": Organoalkoxysilanes are added to Ziegler-Natta catalyzed polymerization of propylene to control the stereochemistry of the resultant polypropylene. The donors are usually mono- or di-organo silanes with corresponding tri- or di-alkoxy substitution on silicon. By using specific organosilanes, the tacticity (and hence the properties) of the polypropylene is controlled.

Silicate Stabilizer: A siliconate derivative of a phosphonate-functional trialkoxysilane functions as a silicate stabilizer to prevent agglomeration and precipitation of silicates during use. The predominant application is in engine coolant formulations to stabilize the silicate corrosion inhibitors.

Benefits of Silanes

Below is a listing of some industries that can utilize XIAMETER® brand silanes and the corresponding benefits.

Industries	Benefit(s)
Fiberglass and Composites	Improved: • Mechanical strength of the composites • Electrical properties • Resistance to moisture attack at the interface • Wet-out of the glass fiber • Fiber strand integrity, protection and handling • Resistance to hot solder during fabrication • Performance in cycling tests from hot to cold extremes
Mineral and Filler Treatment	Improved: • Adhesion between the mineral and the polymer • Wet-out of the mineral by the polymer • Dispersion of the mineral in the polymer • Electrical properties • Mechanical properties Reduced viscosity of the filler/polymer mix
Paints, Inks and Coatings	Improved: • Abrasion resistance • Adhesion • Flow • Crosslinking to improve thermal stability and durability • Pigment and filler dispersion • UV resistance • Water and chemical resistance
Plastics and Rubber	• Coupling and dispersing agents for fillers in rubber and plastics formulations • Polymerization modifiers in the synthesis of polypropylene • Crosslinking agents for polyethylene homopolymers and copolymers • Inorganic filler in place of carbon black in the reinforcement of rubber
Adhesives and Sealants	Improved: • Initial adhesion • Adhesive bond with longer life • Temperature resistance • Chemical resistance
Water Repellents and Surface Protection	Improved: • Water repellency • Long-term durability • UV stability • Depth of penetration • Water vapor permeability • Dilution capability and stability • Appearance

Product Information

A complete list of XIAMETER® brand silanes is available at xiameter.com.

In addition, Dow Corning Corporation also offers a wide variety of *Dow Corning*® brand specialty silicone material and service options as well as other silicon-based materials available to help you keep your innovative edge in the marketplace. Visit dowcorning.com to learn more about the many additional silicone and silicon-based options available to you from Dow Corning.

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Silicones Simplified
XIAMETER®
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The Right Products, The Right Expertise:
Tips for successful moldmaking with silicone rubbers

Once you've selected the correct product and determined how to use it properly, you're on the way to making good, flexible molds with silicone rubber. The following recommendations will further ensure your success.

1. De-airing

De-airing is recommended for all silicone moldmaking rubbers when not using automatic dispensing equipment.

The small air bubbles that result from hand mixing become trapped in the mixture and, if not removed by de-airing, can interfere with exact surface reproduction. One exception is XIAMETER® RTV-3112 Base. Due to its low viscosity, this material can be used in many applications without de-airing.

Because the mixture of base and catalyst or base and curing agent will expand during de-airing, it is important to use a container that is between three and five times the volume of the material itself. The higher viscosity silicone moldmaking rubbers will expand the most.

The mixture can be quickly and easily de-aired in a vacuum chamber. This important step usually takes just a few minutes. Entrapped air may be removed by applying a vacuum of 27 to 29 inches of mercury. XIAMETER® HS Moldmaking series RTV silicone rubbers should not be de-aired for more than 5 minutes. Any more de-airing will change physical properties. In all cases, the material will expand and then contract to its original level. For approximate time to complete de-airing, consult the individual product data sheets.

2. Inhibition

Cure of XIAMETER® brand RTV materials may be inhibited by certain contaminants in or on the pattern to be molded.

If in doubt as to possible surface inhibition, a "patch test" is recommended. Brush or pour a small amount of the catalyzed RTV selected onto a noncritical area of the pattern. Inhibition has occurred if the rubber is gummy or uncured after the recommended cure time has passed.

Addition Cure Systems. Inhibition in addition cure systems (platinum cure) such as the XIAMETER® brand silicone moldmaking product line can range from tackiness to complete lack of cure. Among materials found to cause inhibition are sulfur-containing modeling clays, natural rubber such as latex and rubber gloves, masking tape, amine- or sulfur-containing materials, and condensation cure (tin-catalyzed) silicone RTVs.

Surfaces previously in contact with any of the materials mentioned may also be inhibited. Water, when present on the part to be molded, can also cause inhibition.

Condensation Cure Systems
Inhibition in condensation cure systems (tin catalyzed) such as XIAMETER® RTV-31xx series and XIAMETER® HS Moldmaking series RTV silicone rubbers is not common. However, there are some sulfur-containing modeling clays that can retard the cure of some of the condensation cured RTVs. Complete cure may take days (with severe inhibition), but unlike inhibited addition cure materials, the condensation cure RTVs will cure when the clays are removed.

XIAMETER® RTV-3081-F Curing Agent, when used with its recommended bases, has been formulated to cure against inhibition-prone clays.

Techniques to Prevent Inhibition. A standard practice to prevent inhibition is the use of a "barrier coating" to prevent the inhibiting agent from contacting the uncured RTV material. A thin layer of clear acrylic lacquer sprayed directly onto the pattern is an effective barrier coating in most instances.

Polyvinyl alcohol (PVA) is another effective barrier coat. This water-based solution can be applied by brushing, wiping or spraying onto the master. It is important the film be completely dry before molding.

After the mold is cast, the film of PVA can be removed from the pattern by placing it underwater and rubbing briskly. The film will dissolve.

3. Thinners

Silicone oil (PDMS) serves as a thinner and can be used with all XIAMETER® brand silicone moldmaking rubbers. A wide variety of viscosities is available: 20, 50, 100 and 350 centistokes, with 50 cSt the most common.

Thinners can be used to reduce RTV base viscosity and cured rubber durometer. Reduction of viscosity and durometer can be achieved using 1 to 3 percent of PDMS fluid with minimal effect on physical properties. Further viscosity and durometer reduction can be achieved with increased PDMS levels; however, higher levels of PDMS will affect the mechanical properties, which will require end-user evaluation

4. Release Agents for Patterns/Masters

A release agent should be used to ensure easy removal of the cured rubber from the pattern/master. For molds cured at room temperature, a simple mixture of 10 parts petroleum jelly to 90 parts solvent is recommended. Suitable solvents include VM&P naphtha or mineral spirits.

The petroleum jelly–solvent mixture can easily be prepared by putting the items together in a suitable container and setting aside overnight. With slight agitation before use, the mixture is ready to apply.

To ensure complete coverage, brush the mold liberally with the petroleum jelly–solvent mixture, then hit with a spray of air from an air gun. The air will aid in evaporating the solvent, eliminating puddling and the resultant loss of detail. This process will leave a thin film of petroleum jelly over the entire pattern/master.

When casting a two-part mold, it is extremely important to completely cover the cured half of the mold with a good release agent to prevent the two halves from bonding together. Straight petroleum jelly can be used, as well as a solution of 30 to 50 percent petroleum jelly. Dusting with talc or baby powder has been found to be effective, as well as the use of Teflon® aerosols.

For Silicone Molds. When first cast, silicone rubber molds exhibit natural release characteristics. Over time, however, the reactant agents in most casting resins will deplete mold lubricity and parts will begin to stick in the mold. A release agent should be used at the first sign of sticking and reapplied only when sticking reoccurs.

When using a silicone release agent, it is necessary to burnish the release agent only on the area(s) where sticking occurs.

If using a silicone release agent in an aerosol container, there are cautions to be taken. Silicone can cause non-wetting spots (fisheyes) in nearby areas where painting is being performed. It is best to use silicone oil (PDMS) and rub it into the mold where sticking is occurring. Wiping off any excess will prevent non-wetting areas on the piece(s) cast from the mold.

5. Calculating Material Needs

A few simple calculations can help determine the amount of material you'll need to cast your mold:

- Find the specific gravity of the moldmaking material you have chosen. (This data can be found in the product selection guide or in the product data sheets.)
- Calculate the approximate volume of the mold.
- Multiply the volume by the specific gravity.
- Add 10% to cover loss during mixing and handling.

Example:
- Product specific gravity = 1.21
- Mold volume = 1000 cm3
- 1.21 x 1000 = 1210
- 1210 + 10% = 1331 g of product should be prepared

6. Patching Torn Molds

Using a steel brush, abrade the area to be patched, then clean the tear with a good grease-cutting solvent such as naphtha or mineral spirits. Be sure the solvent has completely evaporated before proceeding.

Because silicone rubber sticks so well to itself, for the strongest patch, it is

recommended that you use the same silicone rubber that was used to make the mold. *Dow Corning*® 732 RTV Multipurpose Sealant[Δ] can also be used to repair torn molds.

7. Compression Casting

When using silicone rubber materials to do compression casting, holes must be drilled to permit venting. One hole for every 25 square inches of surface area should be sufficient. Maximum size is 1/16 inch.

8. Oak Wood Patterns

When using new oak wood patterns, a microsized porosity often occurs at the open grain of the wood. To avoid this, apply some petroleum jelly to a clean cloth and gently rub the surface in the direction of the grain.

9. Mold Box Release

A coating of *Dow Corning*® 236 Dispersion on wooden mold boxes prevents resins, especially polyurethanes, from sticking to the mold boxes.

10. Mold Life Extension

Barrier Coating. The use of a barrier coat when casting polyurethanes can greatly extend mold life, in some cases up to 200 percent. The barrier coat should be sprayed into the silicone mold prior to each casting. When the cast part is removed from the mold, the barrier coat becomes the outer skin of the casting.

The barrier coat can then be stained or painted, an important feature.

Note that this type of barrier coat is different than the barrier coat mentioned in "Techniques to Prevent Inhibition."

Reconditioning. Reconditioning can be accomplished by burnishing a low viscosity PDMS fluid into the surface. When the mold is to be put back in use, any excess fluid should be removed from the surface. This is necessary to ensure that the cast parts will be paintable. Non-wetting or fisheyes can occur on the surface of the cast parts if all excess PDMS fluid is not removed.

Bake-Out. A bake-out is recommended to remove the hardeners, plasticizers and other materials that leach out of the casting materials and are gradually absorbed into silicone molds.

Bake molds for longer times at lower temperatures, such as 90°C (200°F) for six hours to overnight, or at higher temperatures, such as 120°C (250°F), for one to two hours.

11. Library Life

To extend the library life (shelf life) of a cured silicone rubber mold, it is important to thoroughly clean the mold before storage. If possible, a bake-out (see "Bake-Out," in "Mold Life Extension"), followed by wiping the mold with a solvent, is best. If a bake-out is not possible, wiping the mold out with an aggressive solvent such as toluene will still help considerably. After cleaning the mold, apply a thin film of PDMS fluid (low viscosities of 20, 50, or 100 centistokes are best). Placing a master of wax, plaster or wood in the mold will help retain the mold's shape.

Molds made with condensation cure (tin catalyzed) systems may revert (soften) if placed in airtight storage. For maximum library life, XIAMETER recommends platinum cured molds.

Caution

Always provide adequate ventilation-when using any solvent. In addition, all solvents should be completely evaporated before catalyzed RTV rubber is applied to the master pattern. When using any solvent, avoid heat, sparks and open flame. Follow the manufacturer's directions on container labels, including precautionary handling statements.

Health and Environmental Information

To support customers in their product safety needs, ***Dow Corning*** has an extensive Product Stewardship organization and a team of Product Safety and Regulatory Compliance (PS&RC) specialists available in each area. For further information, please see our website, dowcorning.com, or consult your local Dow Corning representative.

Contact Us

Visit www.xiameter.com to learn more about the many product options available to you from the XIAMETER® brand.

Δ While this product is a Dow Corning brand product, it is sold via the XIAMETER Web-enabled business model from Dow Corning. Visit www.xiameter.com to order these products or to learn more.

Form No. 95-988-01

XIAMETER® brand Silicones for Foam Control in the Food Processing Industry

Foaming issues in food and beverage processing applications can negatively impact efficiency, productivity and cost. Silicone antifoaming agents from Dow Corning have been designed to safely and effectively reduce problems with foam under the numerous conditions encountered when processing foods and beverages.

And whether used as pure liquids or powders or in a compound or emulsion, silicone antifoams are more effective than organic antifoaming agents.

Dow Corning offers a range of foam-control agent types to meet the diverse needs of the food processing industry:

- Silicone fluids are used for controlling foam in nonaqueous systems.
- Compounds of finely powdered silica in silicone fluids are used for controlling foam in aqueous systems.
- Silicone emulsions are used for applications in which water is the predominant phase of the foam.
- Powdered silicones prevent foaming in dry products when liquids are added.

Subgroup	Application	Proven Solution	Details
DRINKS			
Alcoholic beverage	Vodka and wine production	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used in fermentation tanks to increase capacity, reducing foam in the resultant wastewater.
	Alcoholic drink production	XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used during the mash processing step for alcoholic drink production and the cleaning of the processing equipment.
	Beer production	XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used as process aids and cleaning aids during production of beer.
Beverage	Natural juices and carbonated beverages	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used during filling of containers, allowing containers to be filled to maximum weight. Typical addition level is 10 ppm.
	Soft drink production	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used during mixing before bottling. Typically, antifoam is diluted prior to addition.
	Soft drink production	XIAMETER® AFE-0100 Antifoam Emulsion, Food Grade	Has been used to keep foam down to a minimum level during filling of bottles.
	Tank cleaning	XIAMETER® ACP-1500 Antifoam Compound XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used during cleaning of tanks used for process water (e.g., at breweries).
	Fruit juice production	XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used as process aids and cleaning aids during production of fruit juices.

Subgroup	Application	Proven Solution	Details
	Sugar-free soft drink production	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used during dilution of drinks prior to and during bottling stage, reducing spillage or loss of product.
	Tea	XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used during extraction process.
Dry drink mix	Powdered protein sports supplement drink	XIAMETER® ACP-1920 Antifoam Compound	Has been used in powdered protein sports supplement drink that has a tendency to foam upon mixing with water. Powdered antifoam is required for incorporation into dry mix. The product is packed for the consumer as a dry powder that the end user mixes with water at the point of use.
	Powdered drinks	XIAMETER® ACP-1920 Antifoam Compound	Powdered antifoam can be added to powdered beverage products to prevent foaming.
	Powdered coffee	XIAMETER® ACP-1920 Antifoam Compound	Has been used during production of powdered coffee for ice creams.
Fermentation	Wheat fermentation during bioethanol production	XIAMETER® AFE-1520 Antifoam Emulsion	Has been used during wheat fermentation stage of bioethanol production.
SAVORY			
Bread	Bread production	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used in dough during bread production. Typically added at 10 ppm.
	Cereal and bakery processing	XIAMETER® ACP-1500 Antifoam Compound XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used during cereal and bakery processing.
Brine	Pickling	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used in pickling brine to increase speed of pickle packing. Antifoam added at 10 ppm can increase packing speed from 10 to 160 jars per minute.
	Pickling	XIAMETER® AFE-0300 Antifoam Emulsion	Has been used in pickling brine to allow for higher-speed packing.
Meat, poultry and seafood	Rendering step of meat processing	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used during the high-temperature rendering process. Typical addition level is 10-20 ppm.
	Gelatin production	XIAMETER® ACP-1500 Antifoam Compound XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used during the cooking of animal fat to produce gelatin. Effective in the harsh conditions experienced during this process.
	Seafood processing	XIAMETER® AFE-0100 Antifoam Emulsion, Food Grade	Has been used during brine freezing of crab and lobster. XIAMETER® AFE-0100 Antifoam Emulsion, Food Grade, controls foam that results from high salt and protein that is leached from the seafood, thus extending the life of the brine solution before it needs to be replaced.
	Poultry processing	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used during rendering of poultry. During rendering of inedible poultry by-products, poultry fat is added to increase possible cooking temperatures. Antifoam is added to control the resulting foam and to reduce the fouling of equipment. Typically, 100 g of antifoam is added to 2,500 kg of poultry.
	Meat processing	XIAMETER® ACP-1500 Antifoam Compound XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used during meat processing.

Subgroup	Application	Proven Solution	Details
	Shrimp cleaning treatment	XIAMETER® ACP-1500 Antifoam Compound XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used during washing of shrimps.
Pasta	Spinach pasta ready meals	XIAMETER® AFE-0100 Antifoam Emulsion, Food Grade	Has been used during production of spinach pasta ready meals. Process starts with spinach and water. Antifoam is added to the water to prevent foaming.
Soup	Powdered soup	XIAMETER® ACP-1920 Antifoam Compound	Has been used in powdered soup.
	Powdered soup	XIAMETER® AFE-1520 Antifoam Emulsion	Has been used during production of powdered soup.
Soybeans/tofu	Cooking of soybeans during soybean processing	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used in cookers during soybean processing, allowing full utilization of vessel.
	Soy sauce	*Dow Corning Toray* SM 5571 Emulsion	Has been used during processing of soy sauce.
	Soybean protein	*Dow Corning Toray* SM 5571 Emulsion	Has been used during processing of soybean protein.
	Powdered soy	XIAMETER® ACP-1920 Antifoam Compound	Has been used in powdered soy.
Starch/potatoes	Manufacture of potato flakes, chips and French fries	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used in a caustic bath during potato washing and peeling processes. The natural surfactants and starch present create foaming problems. Typically, antifoam is diluted with water (one part antifoam to three parts water) prior to addition. Diluted antifoam should be used within 8 hours.
	Manufacture of potato flakes, chips and French fries	XIAMETER® AFE-1510 Antifoam Emulsion	Has been used in protein-based foam caused during potato washing. Typical usage level is 1-10 ppm of XIAMETER® AFE-1510 Antifoam Emulsion as supplied.
	Cornstarch processing	*Dow Corning Toray* SM 5571 Emulsion	Has been used during processing of cornstarch from sweet potatoes.
Vegetable oil	Sunflower oil	XIAMETER® ACP-1500 Antifoam Compound	Has been used in sunflower oil used for cooking and frying.
	Margarine production	XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used as process aids and cleaning aids during production of margarine.
	Margarine production	XIAMETER® ACP-1920 Antifoam Compound	Has been used in margarine and canola oil plants.
SWEET/SAVORY			
Dairy products	Whey processing	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used during whey production and processing. Whey is forced through an electric dialysis machine to extract minerals, and this typically is part of a continuous process. Addition of antifoam facilitates this continuous operation.
	Powdered egg	XIAMETER® ACP-1920 Antifoam Compound	Has been used in powdered eggs.
	Pudding manufacturing	XIAMETER® AFE-0100 Antifoam Emulsion, Food Grade	Has been used during production of puddings, preventing foam-over.
	Dairy and cheese products	XIAMETER® ACP-1500 Antifoam Compound XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used during production and bottle filling (e.g., in yogurt drinks). Effective over wide temperature range and under agitation.

Subgroup	Application	Proven Solution	Details
Flavors and spices	Vacuum packing of food products and seasonings	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used during vacuum-packing process used to package foodstuffs and seasonings, reducing clogging in the vacuum line. Typical addition level is 1-10 ppm of antifoam.
	Processing of flavors and fragrances	XIAMETER® ACP-1500 Antifoam Compound XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used during processing of flavors and fragrances.
	Powdered flavorings	XIAMETER® ACP-1920 Antifoam Compound	Has been used in powdered flavorings.
	Powdered seasonings	XIAMETER® ACP-1920 Antifoam Compound	Has been used in powdered seasonings.
	Liquid seasonings	XIAMETER® AFE-0300 Antifoam Emulsion	Has been used during blending of liquid seasonings. Typical addition level is 5 ppm of antifoam.
	Food colorant	*Dow Corning Toray* SM 5571 Emulsion	Has been used during manufacture of food colorant.
Fruits and vegetables	Processing of maraschino cherries	XIAMETER® AFE-0100 Antifoam Emulsion, Food Grade	Has been used during pumping of sugar solutions.
	Fruit processing	XIAMETER® ACP-1500 Antifoam Compound XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used during production of pineapple purée.
	Fruit processing	XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used during cooking processes.
	Vegetable water bath	XIAMETER® AFE-0100 Antifoam Emulsion, Food Grade	Has been used in water bath used for vegetables. Processing of vegetables containing wheat gluten tends to generate foam. Antifoam is added to keep this foaming action to a minimum.
SWEET			
Confectionery	Sweets production	XIAMETER® ACP-1500 Antifoam Compound	Has been used during production of sweets.
	Toffee and soft ice production	XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used as process aids and cleaning aids during production of toffees and soft ices.
Desserts	Manufacture of flavored dessert and pudding toppings	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used during preparation of flavored pudding and dessert toppings, resulting in full utilization of manufacturing equipment and preventing spillage.
Jam	Production of jam (boiling stage)	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used during the boiling of fruit-and-sugar mixture, preventing spillage.
	Marmalade production	XIAMETER® AFE-1510 Antifoam Emulsion XIAMETER® AFE-1520 Antifoam Emulsion	Have been used as process aids and cleaning aids during production of marmalade.

Subgroup	Application	Proven Solution	Details
Sugar	Manufacture of sugar from sugar beets	XIAMETER® AFE-0010 Antifoam Emulsion	Has been used in many processes during sugar production, such as washing, sugar extraction and sugar purification. Can be used undiluted or diluted with at least 4 parts of water. Antifoam typically is added just upstream from the raw juice, either in or after the carbonator.
	Maple syrup processing	XIAMETER® AFE-0300 Antifoam Emulsion	Has been used during bottling of maple syrup, speeding up bottling process. Typical addition level is 10 ppm of antifoam.
ANIMAL			
Animal feed	Mixed fodder	XIAMETER® ACP-1500 Antifoam Compound	Has been used in mixed fodder.

Products listed under "Proven Solution" have been shown to be beneficial in the application listed. Other products may also be effective but have not been tested.

NOTE: A preservative to guard against microbial growth is included in most XIAMETER® antifoam emulsions. Dilution will substantially diminish the effectiveness of the preservative. If diluted material is to be stored for more than several days, additional preservative may be required. Please contact a XIAMETER® technical representative for more information.

Product	Geographic Availability	Product Type
XIAMETER® ACP-1500 Antifoam Compound	Asia, Americas and Europe	Compound
XIAMETER® AFE-0010 Antifoam Emulsion	Asia (Except Japan) and Americas (This product does not meet Japan's food grade requirements.)	Emulsion
XIAMETER® AFE-0100 Antifoam Emulsion, Food Grade	Global	Emulsion
XIAMETER® AFE-0300 Antifoam Emulsion	Global	Emulsion
XIAMETER® AFE-1520 Antifoam Emulsion	Global (Except Japan) (This product does not meet Japan's food grade requirements.)	Emulsion
XIAMETER® AFE-1510 Antifoam Emulsion	Global (Except Japan) (This product does not meet Japan's food grade requirements.)	Emulsion
Dow Corning Toray SM 5571 Emulsion	Japan only	Emulsion
XIAMETER® ACP-1920 Antifoam Compound	Global (Except Japan) (This product does not meet Japan's food grade requirements.)	Powder

Antifoam agents used in food processing applications are "direct additives" and thus remain in the food when it is consumed. As such, they are highly regulated. All XIAMETER® silicone antifoams comply with relevant local regulations.

- The antifoams indicated in this selection guide comply with the Recommendations of the Federal Institute for Risk Assessment (BfR) "XV. Silicones."

Additional Information on European Union Directives for Direct Food Additives

The active substance in these products is authorized as food additive following Regulation (EU) 1129/2011 amending Annex II to Regulation (EC) 1333/2008 of the European Parliament and of the Council by establishing a Union list of food additives. The active substance in this product is dimethyl polysiloxane (E 900) for which Annex II Part E sets up the conditions of use in food categories: fats and oils essentially free from water (excluding anhydrous milkfat): ML = 10 mg/kg, only oils and fats for frying; other fat and oil emulsions including spreads as defined by Council Regulation (EC) No 1234/2007 and liquid emulsions: ML = 10 mg/kg, only oils and fats for frying; canned or bottled fruit and vegetables: ML = 10 mg/kg; jams, jellies and marmalades and sweetened chestnut purée as defined by Directive 2001/113/EC: ML = 10 mg/kg; other similar fruit or vegetable spreads: ML = 10 mg/kg; other confectionery including breath freshening microsweets: ML = 10 mg/kg; decorations, coatings and fillings, except fruit-based fillings covered by category 4.2.4: ML = 10 mg/kg; batters: ML = 10 mg/kg; soups and broths: ML = 10 mg/kg; fruit juices as defined by Directive 2001/112/EC and vegetable juices: ML = 10 mg/l, only pineapple juice and sød … saft and sødet … saft; flavored drinks: ML = 10 mg/l; cider and perry: ML = 10 mg/l, excluding cidre bouché; chewing gum: ML = 100 mg/kg.

Additional Information on Additives in Plastics

- The Commission Regulation (EU) No 10/2011 of 14 January 2011 on plastic materials and articles intended to come into contact with food.
- Code of Federal Regulations 40 CFR concerning "Tolerances and Exemption from Tolerances for Pesticide Chemicals in or on Raw Agricultural Commodities" under Section 180.910: "Inert ingredients used pre- and post-harvest; exemptions from the requirement of a tolerance."

Contact Us

Visit www.xiameter.com to learn more about the many product options available to you from the XIAMETER® brand.

HANDLING PRECAUTIONS

PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED IN THIS DOCUMENT. BEFORE HANDLING, READ PRODUCT AND MATERIAL SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE MATERIAL SAFETY DATA SHEET IS AVAILABLE ON THE DOW CORNING WEBSITE AT DOWCORNING.COM, OR FROM YOUR DOW CORNING SALES APPLICATION ENGINEER, OR DISTRIBUTOR, OR BY CALLING DOW CORNING CUSTOMER SERVICE.

LIMITED WARRANTY INFORMATION – PLEASE READ CAREFULLY

The information contained herein is offered in good faith and is believed to be accurate. However, because conditions and methods of use of our products are beyond our control, this information should not be used in substitution for customer's tests to ensure that our products are safe, effective, and fully satisfactory for the intended end use. Suggestions of use shall not be taken as inducements to infringe any patent.

Dow Corning's sole warranty is that our products will meet the sales specifications in effect at the time of shipment.

Your exclusive remedy for breach of such warranty is limited to refund of purchase price or replacement of any product shown to be other than as warranted.

DOW CORNING SPECIFICALLY DISCLAIMS ANY OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY.

DOW CORNING DISCLAIMS LIABILITY FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

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Silicones Simplified
XIAMETER®
from DOW CORNING

Silicones Simplified

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XIAMETER® from DOW CORNING

Silicone Foam Control for Beverage Applications

Foam is a problem.

When excess foam causes your processing vessels to overflow, your maintenance costs increase. You lose capacity, reducing your production efficiency. Your processing time increases, and you may require larger, more expensive equipment to handle the foam.

Silicone foam control is the solution.

XIAMETER® brand silicone foam control agents eliminate problem foam. Eliminating foam can increase your productivity and reduce your production costs.

Available as fluids, compounds, and emulsions, XIAMETER® brand silicone foam control agents are suitable for use in both aqueous and non-aqueous systems. They have proved successful in a wide range of applications in diverse industries around the world, including beverage brewing, processing, and bottling.

Silicone foam control agents have low surface tension for effective foam control in a variety of foaming media and act as both antifoams and defoamers. They are efficient, long-lasting and many are safe for use in food-contact applications – FDA-, USDA-, and Kosher-compliant options are available.

Solutions for beverage applications.

The chart that follows lists foam-control problems reported by our customers and the XIAMETER® brand foam-control products we recommended to solve those problems.

Every foaming situation is unique. The products listed may or may not be appropriate for your application. For specific foam-control product recommendations, contact us through our website: www.xiameter.com/en/forms/pages/formviewer.aspx?formname=ProdRecAFCFB&Target=thankyou.aspx

Product technical data sheets and selection guides are also available at www.xiameter.com.

Application/Foam Problem Description	XIAMETER® Brand Product
10% Juice Drink – Foams during reconstitution	XIAMETER® AFE-0010 AF Emulsion
Alcohol Beverage – Foams during mixing and filling	XIAMETER® AFE-1510 Antifoam Emulsion
Alcohol Beverage – Foams during mixing and filling	XIAMETER® AFE-0300 Antifoam Emulsion Food Grade
Alcohol Beverage – Foams during mixing and filling	XIAMETER® AFE-0010 AF Emulsion
Alcoholic Beverages – Foams during bottling	XIAMETER® AFE-0100 AF Emulsion
Apple Juice – Foams during pressing	XIAMETER® AFE-0100 AF Emulsion
Apple Juice – Foams during pressing	XIAMETER® AFE-0100 AF Emulsion
Banana Fruit Beverage – Foams during mixing	XIAMETER® AFE-1510 Antifoam Emulsion
Banana Fruit Beverage – Foams during mixing	XIAMETER® AFE-1520 Antifoam Emulsion
Berry Flavored Beverage – Foams during mixing and filling	XIAMETER® AFE-0100 AF Emulsion
Beverage – Foams during mixing and filling stages and brewing process	XIAMETER® AFE-0010 AF Emulsion
Beverage – Foams during mixing processing (pH 7, 40-100°C)	XIAMETER® AFE-1520 Antifoam Emulsion
Beverage (Freeze Dried) – Foams FG-10	XIAMETER® AFE-0010 AF EMU
Beverage and Emulsion	XIAMETER® AFE-0100 AF Emulsion
Beverage Application – Foams	XIAMETER® AFE-1510 Antifoam Emulsion
Beverage Dry Mixes – Foams	XIAMETER® ACP-1920 Antifoam Compound
Beverage Soft Drink – Foams during batch mixing and bottling due to particulates and caramel	XIAMETER® ACP-1920 Antifoam Compound
Bloody Mary Triple Sec Mix (pH 3-4, 11% solids)	XIAMETER® ACP-1920 Antifoam Compound
Brewery – Foam Problem	XIAMETER® AFE-0100 AF Emulsion
Brewery – Foam Problem	XIAMETER® AFE-1510 Antifoam Emulsion
Cappucino Powdered Mix – Foams when processing	XIAMETER® ACP-1920 Antifoam Compound
Carbonated Beverage – Foams at filling	XIAMETER® AFE-0300 Antifoam Emulsion Food Grade
Carbonated Beverage – Foams at filling	XIAMETER® AFE-0010 AF Emulsion
Carbonated Beverage – Foams during mixing and at filler	XIAMETER® ACP-1920 Antifoam Compound
Carbonated Beverage – Foams during mixing and at filler	XIAMETER® ACP-1500 Antifoam Compound
Carbonated Beverage – Foams when degassed	XIAMETER® AFE-0100 AF Emulsion
Carbonated Beverage Fountain Syrups – Foams	XIAMETER® AFE-0010 AF Emulsion
Carbonated Beverage Syrup Foams	XIAMETER® AFE-0010 AF Emulsion
Carbonated Coffee Drink – Foams	XIAMETER® AFE-0010 AF Emulsion
Carbonated Cola Beverage – Foams prior to bottling	XIAMETER® AFE-0300 Antifoam Emulsion Food Grade
Carbonated Flavored Milk – Foams at filling station	XIAMETER® AFE-1510 Antifoam Emulsion
Carbonated Grapefruit – Foams during bottling	XIAMETER® ACP-1920 Antifoam Compound
Chocolate Drink – Foams during processing and bottling	XIAMETER® AFE-0100 AF Emulsion
Chocolate Liqueur – Foams during bottling	XIAMETER® AFE-0010 AF Emulsion
Citrus Beverage – Foams during filling	XIAMETER® AFE-1510 Antifoam Emulsion
Coffee and Tea Extracts/Concentrates – Foam during processing	XIAMETER® AFE-1510 Antifoam Emulsion
Coffee Beverage	XIAMETER® AFE-1510 Antifoam Emulsion
Coffee Beverage – Foams during mixing and filling	XIAMETER® AFE-1510 Antifoam Emulsion
Coffee Beverage – Foams during mixing and filling	XIAMETER® AFE-0010 AF Emulsion
Coffee Beverage Concentrate Antifoams	XIAMETER® AFE-0010 AF Emulsion
Coffee Syrup/Powder Coffee For Sweetener – Foams during bottling	XIAMETER® AFE-0010 AF Emulsion
Coffee Whitener Foams, Spray Dry Product	XIAMETER® AFE-1510 Antifoam Emulsion
Cold Tea Drink – Foams	XIAMETER® AFE-0010 AF Emulsion
Concentrated Beverage – Foams in finished product	XIAMETER® ACP-1920 Antifoam Compound
Concentrated Beverage – Foams in finished product	XIAMETER® AFE-1510 Antifoam Emulsion
Cordial Liqueur – Foams during homogenization process	XIAMETER® AFE-0010 AF Emulsion

Application/Foam Problem Description	XIAMETER® Brand Product
Cordial Liquor – Foams at bottling Line	XIAMETER® AFE-1510 Antifoam Emulsion
Cordial Liquor – Foams at bottling Line	XIAMETER® AFE-0010 AF Emulsion
Cordials/Spirits – Foams when blending in tanks	XIAMETER® AFE-0010 AF Emulsion
Cranraspberry Juice and Carbonated Beverages – Foam during bottling	XIAMETER® AFE-0010 AF Emulsion
Cream Sauce – Foams in Microwave	XIAMETER® AFE-0010 AF Emulsion
Date Shake Beverage – Foams	XIAMETER® AFE-0300 Antifoam Emulsion Food Grade
Decaffeinated Tea (Distillation Column) – Foams in column	XIAMETER® ACP-1400 Antifoam Compound
Decaffeinated Tea (Distillation Column) – Foams in column	XIAMETER® AFE-1410 Antifoam Emulsion
Decaffeinated Tea (Distillation Column) – Foams in column	XIAMETER® ACP-1500 Antifoam Compound
Decaffeinated Tea (Distillation Column) – Foams in column	XIAMETER® AFE-1510 Antifoam Emulsion
Diet Cola – Foams when dispensed	XIAMETER® AFE-0010 AF Emulsion
Dry Powder Drink and Carbonated Beverage	XIAMETER® AFE-0010 AF Emulsion
Flavored Beverage – Foams	XIAMETER® AFE-1510 Antifoam Emulsion
Flavored Beverage – Foams	XIAMETER® AFE-1510 Antifoam Emulsion
Flavored Carbonated Beverage – Foams	XIAMETER® AFE-0100 AF Emulsion
Flavored Carbonated Beverage – Foams	XIAMETER® AFE-0300 Antifoam Emulsion Food Grade
Flavored Carbonated Beverage – Foams	XIAMETER® AFE-0010 AF Emulsion
Flavored Juice Beverage – Foams during bottling	XIAMETER® AFE-0010 AF Emulsion
Fruit Beverage – Foams at mixing	XIAMETER® AFE-0010 AF Emulsion
Fruit Drink – Foams during mixing	XIAMETER® AFE-1510 Antifoam Emulsion
Fruit Flavored Beverage – Foams at filler	XIAMETER® AFE-0010 AF Emulsion
Fruit Juice – Foams	XIAMETER® AFE-1510 Antifoam Emulsion
Fruit Juice – Foams when bottling	XIAMETER® AFE-1520 Antifoam Emulsion
Fruit Juice Concentrate – Foams	XIAMETER® AFE-0100 AF Emulsion
Grape Juice – Foams	XIAMETER® AFE-0100 AF Emulsion
Grape Juice – Foams	XIAMETER® AFE-1520 Antifoam Emulsion
Grape/Prune/Apple Concentrated Juice – Foams when mixing	XIAMETER® AFE-0010 AF Emulsion
High Protein Beverage – Foams/powder	XIAMETER® ACP-1920 Antifoam Compound
Hot Fill Beverage – Foams at fill station	XIAMETER® AFE-1520 Antifoam Emulsion
Ice Tea Mix – Foams	XIAMETER® ACP-1920 Antifoam Compound
Instant Coffee – Foams when put in the microwave	XIAMETER® AFE-1510 Antifoam Emulsion
Instant Flavored Protein Beverage – Foams during mixing	XIAMETER® ACP-1920 Antifoam Compound
Juice – Foams during packaging	XIAMETER® AFE-0300 Antifoam Emulsion Food Grade
Juice Beverage – Foams at filler	XIAMETER® AFE-0010 AF Emulsion
Juice Concentrates – Foams during freeze-drying	XIAMETER® AFE-0100 AF Emulsion
Juice Product – Foams	XIAMETER® AFE-0010 AF Emulsion
Low-Calorie Diet Cola – Foams during bottling	XIAMETER® AFE-0010 AF Emulsion
Malt Beverage – Foams	XIAMETER® AFE-0300 Antifoam Emulsion Food Grade
Malt Beverage – Foams	XIAMETER® AFE-0010 AF Emulsion
Manufacturing Antifoam	XIAMETER® AFE-0100 AF Emulsion
Milk/fruit Drink – Foams at filling	XIAMETER® AFE-0010 AF Emulsion
Orange Beverage – Foams in processing	XIAMETER® AFE-0010 AF Emulsion
Orange Juice Drink	XIAMETER® AFE-1520 Antifoam Emulsion
Pineapple Juice – Foams at filler	XIAMETER® AFE-1520 Antifoam Emulsion
Pineapple Juice – Foams at filler	XIAMETER® AFE-0010 AF Emulsion
Powdered Tea Formulation Antifoam	XIAMETER® ACP-1920 Antifoam Compound
Process-Dry Mix Beverage – Foams	XIAMETER® ACP-1920 Antifoam Compound

Application/Foam Problem Description	XIAMETER® Brand Product
Process-Dry Mix Beverage – Foams	XIAMETER® ACP-1500 Antifoam Compound
Protein Beverage – Foams during filtering at bottling station	XIAMETER® AFE-0100 AF Emulsion
Protein Beverage – Foams in filler	XIAMETER® AFE-0010 AF Emulsion
Root Beer – Foams	XIAMETER® AFE-0100 AF Emulsion
Root Beer Fountain Syrup – Foams when carbonating	XIAMETER® AFE-0300 Antifoam Emulsion Food Grade
Soy processing – Foams during boiling	XIAMETER® AFE-0010 AF Emulsion
Soy processing – Foams during boiling	XIAMETER® AFE-0300 Antifoam Emulsion Food Grade
Sports Drinks, Ready-to-Drink Beverages	XIAMETER® AFE-1520 Antifoam Emulsion
Tea – Foams at filler	XIAMETER® AFE-0010 AF Emulsion
Tea – Foams in bottling/filling process	XIAMETER® AFE-0300 Antifoam Emulsion Food Grade
Tea Beverage – Foams during process of adding water and sweetener, mixing and packaging	XIAMETER® AFE-0010 AF Emulsion
Thick and Juice Product – Foams	XIAMETER® AFE-0010 AF Emulsion
Wine Cooler Beverage (using malt in cooler instead of wine) – Foams when bottle is opened	XIAMETER® AFE-0010 AF Emulsion
Wine Coolers and Fruit Fillings – Foam	XIAMETER® AFE-0100 AF Emulsion
Wine Coolers/Fruit fillings – Foams during processing	XIAMETER® AFE-0100 AF Emulsion
Wine/Alcoholic Beverage Application – Foams in production	XIAMETER® AFE-0010 AF Emulsion
Wine/Cider Processing	XIAMETER® AFE-1510 Antifoam Emulsion

Contact Us

Visit www.xiameter.com to learn more about the many product options available to you from the XIAMETER® brand.

Form No. 95-1093-01

Resins and Intermediates Selection Guide

Silicone resins for high-performance decorative and protective coatings

Silicon-based chemistry from the XIAMETER® brand helps you solve tough performance challenges and gain a competitive edge in the coatings marketplace.

XIAMETER brand silicone resins and resin intermediates feature resistance to temperature extremes, moisture,corrosion, electrical discharge, and weathering. They are compatible with many organic resins, and many combinations of silicone resins can beformulated for specific applications and film properties.

Product Choice

The XIAMETER brand from Dow Corning offers a diverse line of silicone resins and intermediates for formulating high-performance decorative and protective coatings. Solvent-based, solventless liquid and solid flake options ranging in silicone content from 50 to 100 percent, by weight, are available. This variety allows formulators to fulfill a wide range of performance and regulatory requirements and to achieve the best combination of performance and economy for each application. Tables 2 through 6 provide general guidelines for the selection of appropriate resins and intermediates.

Innovative Technology

The use of silicones in coatings markets has evolved over the decades, allowing formulators to create differentiated, high-performance product offerings. Hybrid resin systems include cold-blended interpenetrating resin networks and copolymerized "true" resin hybrids. Silicone resins and intermediates found utility in silicone alkyd maintenance paints (1950s), silicone polyester coil coatings (1970s) and most recently, silicone epoxy industrial and marine maintenance coatings (1990s). Gloss and color retention, along with corrosion, moisture, weather, and heat resistance are achieved via the incorporation of silicon-based materials into a wide array of paints, finishes, and coatings.

The level of silicone modification is dictated by the severity of the application performance requirements (See Table 1) and can range from a minimum of 15 to 90 percent silicone incorporation into the organic resin. Higher levels of silicone resin (90 to 100 percent of resin binder) provide the highest level of thermal and ultra-violet radiation resistance, but benefit from the inclusion of small portions of organic resins to improve physical properties such as hardness (phenolics and melamines), air dry (acrylics), corrosion resistance (epoxies), and toughness (alkyds).

Temperature and Hardness

Silicone resin choice is heavily influenced by the environmental temperatures to which the end application will be exposed. Film hardness is another important consideration. Optimum coating performance is achieved by balancing these two parameters. Softer, more flexible resins are recommended for coating formulations intended for the highest temperature ranges. Rigid resins with excellent hot hardness are recommended for mid-range temperature applications.

See Tables 1, 3, and 4 for temperature and resin hardness information.

Pigments

When formulating silicone or silicone modified organic binder systems, the performance requirements of the application determine pigment suitability. Standard pigments used with organic binder systems can be employed for those coatings intended for applications exposed to low or moderate temperatures (121 to 204°C [250 to 400°F]). For higher temperatures, only heat-stable inorganic pigments should be utilized. Consideration should also be given to coatings exposed to weather or chemical attack. Aluminum pastes and metal oxides, in particular iron

Table 1. Using Resins for Cost-Effective High-Temperature Performance

Performance Temperature Range [1] (121°C (250°F) ◄——► 760°C (1400°F))	Resin Type	Pigment
121-204°C (250-400°F)	Silicone-modified organic [2]	All pigments
204-316°C (400-600°F)	Silicone-modified organic [2]	Aluminum
	Organic-modified silicone [3]	Colored
316-427°C (600-800°F)	Organic-modified silicone [3]	Black, aluminum
	Silicone	Colored
427-538°C (800-1000°F)	Silicone	Black, aluminum
538-760°C (1000-1400°F)	Silicone	Ceramic

[1] 1000 hours, minimum. [2] 15-50 percent silicone. [3] 51-90 percent silicone.

and titanium, are useful. Hydroxyl reactivity on the surface of the pigment allows direct interaction of the pigment with the silicone binder. At elevated temperatures, thermally stable metalo-silicon ceramics are formed. Non-reactive pigments, such as carbon black, or graphite can be used to achieve color shading, but should be minimized in the formulation.

Thinners

The resins described in this selection guide can be thinned with aromatic hydrocarbon solvents and hydrocarbon blends. They can also be thinned with most ketones, esters, chlorinated solvents, glycol ethers, and butanol.In selected situations, volatile methylsiloxanes (VMS) can be used as a diluent to reduce viscosity without increasing volatile organic compound (VOC) content. (Note: Exempt status of VMS must be approved by the state in which VMS is used.)

Catalysts

The addition of metallic driers such as zinc or cobalt octoate will improve the rate of cure of XIAMETER® silicone resins. Suggested amounts are 0.1 to 0.2 percent metal based on the resin solids. Lead catalysts should not be used with these silicone resins. Containers with soldered seams may cause gelation.

Curing

Coatings formulated with silicone-based resins or intermediates generally require a bake or cure at elevated temperatures to achieve optimum film properties. This is especially true if the coating is to be exposed to extreme temperatures or to thermal cycling and shock. With silicone-based coatings, there is a greater danger of under-curing than over-curing. Under-cured films are relatively soft and have poor adhesion.

Curing cycles are primarily determined by the silicone content of the resin vehicle. The typical cure for a coating based on a 100 percent silicone resin is 30 minutes at 232°C (450°F). A satisfactory cure time for a 50 to 80 percent silicone resin is 15 to 30 minutes at 218°C (425°F). For blends or copolymers of silicone and organic resins in which silicone is not the primary component, follow the cure recommendation for the primary resin.

Corrosion Resistance

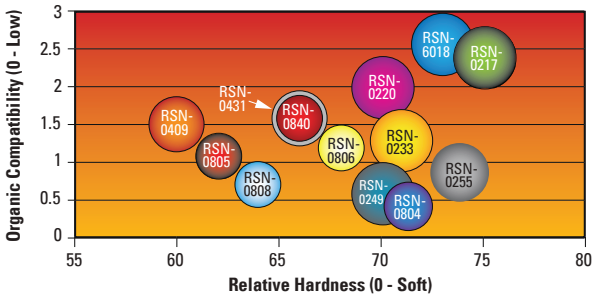
Properly cured, XIAMETER silicone resins have good resistance to water and most dilute acids. The degree of corrosion resistance is dependent on several variables such as type of silicone resin, cure conditions, film thickness, pigmentation, if used, and the application environments.

Intercompatibility of Silicone Resins

In general, XIAMETER silicone resins have good intercompatibility. Resins with a phenyl/methyl ratio lower than 1.0/1 tend to be less compatible. Laboratory testing of resin mixtures should be done before commercial use.

XIAMETER® Resin Properties

(Bubble Size Denotes Percent Non-Volatile Content)



All products are XIAMETER® brand.

Table 2. Characteristics and Typical Properties

Specification Writers: Please contact your local sales office before writing specifications on this product.

	Liquid						
XIAMETER brand Product	RSN-0409 HS Resin	RSN-0431 HS Resin	RSN-0804 Resin	RSN-0805 Resin	RSN-0806 Resin	RSN-0808 Resin	RSN-0840 Resin
Characteristics							
Physical Form	Solvent solution	Solvent solution	Solvent solution	Solvent solution	Solvent solution	Solvent solution	Solvent solution
Functionality	Silanol	Silanol	Silanol	Silanol	Silanol	Silanol	Silanol
Silicon Dioxide Content [1]	52	52	64	52	52	57	52
Silanol Content [1]	1	3	3	1	1	1	3
Degree of Crosslinking, percent [2]	60	66	68	60	66	63	66
Phenyl/Methyl Ratio	1.1/1	1.2/1	0.4/1	1.1/1	1.2/1	0.7/1	1.2/1
Molecular Weight [3]	2000 - 7000	2000 - 7000	2000 - 7000	200,000 - 300,000	200,000 - 300,000	200,000 - 300,000	2000 - 7000
Typical Properties							
Resin Solids, percent by weight [4] by volume	 80 74	 80 74	 60 51	 50 42	 50 41	 50 42	 60 51
Solvent	Xylene	Toluene	Toluene	Xylene	Toluene/Xylene	Xylene	Toluene
Specific Gravity	1.12	1.14	1.07	1.01	1.02	1.01	1.06
VOC [5], g/L (lb/gal)	228 (1.9)	228 (1.9)	431 (3.6)	503 (4.2)	515 (4.3)	503 (4.2)	431 (3.6)
Viscosity (centipoise)	200	800	30	125	150	125	20
Flash Point, closed cup, °C (°F)	27 (81)	7 (45)	7 (45)	27 (81)	7 (45)	27 (81)	7 (45)

	Flake Resins					Resin Intermediates			
XIAMETER brand Product	RSN-0217 Flake Resin	RSN-0220 Flake Resin	RSN-0233 Flake Resin	RSN-0249 Flake Resin	RSN-0255 Flake Resin	RSN-6018 Intermediate	RSN-3037 Intermediate	RSN-3074 Intermediate	RSN-5314 Intermediate
Characteristics									
Physical Form	Solid flake	Solid flake	Solid flake	Solid flake	Solid flake	Solid flake	Liquid	Liquid	Liquid
Functionality	Silanol	Silanol	Silanol	Silanol	Silanol	Silanol	Methoxy	Methoxy	Methoxy
Silicon Dioxide Content [1]	47	52	52	63	62	51	65	54	46
Silanol Content [1]	6	6	5	5	5 [6]	6	15-18 [7]	15-18 [7]	35 [7]
Degree of Crosslinking, percent [2]	75	70	71	71	74	75	58	67	68
Phenyl/Methyl Ratio	n/a	2.0/1	1.3/1	0.6/1	0.84	2.7/1 [8]	0.5/1	1.0/1	3.3/1
Molecular Weight [3]	1500 - 2500	2000 - 4000	2000 - 4000	2000 - 4000	2500 - 4500	1500 - 2500	800 - 1300	1000 - 1500	Monomer blend
Typical Properties									
Resin Solids, percent by weight [4] by volume	 99 -	 99 -	 99 -	 99 -	 >98 -	 99 -	 100 (actives) -	 100 (actives) -	 100 (actives) -
Solvent	-	-	-	-	-	-	-	-	-
Specific Gravity	1.34	1.33	1.32	1.30	1.22	1.31	1.07	1.16	1.04
VOC [5], g/L (lb/gal)	-	-	-	-	-	-	-	-	-
Viscosity (centipoise)	-	-	-	-	-	-	14	120	1.87
Flash Point, closed cup, °C (°F)	138 (280)	138 (280)	138 (280)	138 (280)	138 (280)	138 (280)	138 (280)	138 (280)	28 (83)
Glass Transition Temperature (Tg) °C (°F)	65 (149)	49 (120)	47 (117)	41 (106)	56 (133)	-	-	-	-

[1] Percent by weight.
[2] Silica (SiO_2) – 100% crosslinked; dimethyl silicone fluids $[(CH_3)_2SiO]_x$ – 50% crosslinked.
[3] Weight average.
[4] 1.5 g, 3 hr at 135°C (275°F).
[5] Volatile Organic Compound, EPA Reference Method 24.
[6] Hydroxyl content.
[7] Methoxy content.
[8] Propyl.

Table 3. Silicone Liquid Resin Guide

	Product Name	Hardness	Finished Paint Temperature Performance Range, °C (°F)	Resin System (Solids Content, wt%)	Typical Applications
High Solids	XIAMETER® RSN-0409 HS Resin	Soft, flexible	To 538 (1000); short term: 650 (1200)	Solvent-based (80)	High-performance coatings; high-temperature applications where low VOC content is required. Used alone or blended with a variety of solvent-based silicone and organic resins. Similar to XIAMETER® RSN-0805 Resin except for solids content.
	XIAMETER® RSN-0431 HS Resin	Medium-hard	To 427 (800)	Solvent-based (80)	Same as XIAMETER® RSN-0840 Resin; when reduced VOC content is desired.
Standard	XIAMETER® RSN-0804 Resin	Hard, brittle	To 315 (600)	Solvent-based (60)	Maintenance paints, colored baking enamels, decorative finishes. As an additive to improve paint flow-out.
	XIAMETER® RSN-0805 Resin	Soft, flexible	To 650 (1200)	Solvent-based (50)	Maintenance paints, colored baking enamels, decorative finishes; primarily with metallic pigments. Used alone or blended with XIAMETER® RSN-0806 Resin to promote intermediate hardness.
	XIAMETER® RSN-0806 Resin	Medium-hard	To 538 (1000)	Solvent-based (50)	Colored baking enamels for space heaters, stoves, etc. Used alone or blended with XIAMETER® RSN-0805 Resin to promote intermediate hardness.
	XIAMETER® RSN-0808 Resin	Medium-soft	To 538 (1000); short term: 650 (1200)	Solvent-based (50)	Similar to XIAMETER® RSN-0805 Resin
	XIAMETER® RSN-0840 Resin	Hard to medium-hard	To 538 (1000)	Solvent-based (60)	Maintenance paints, colored baking enamels, decorative finishes. Improves heat resistance, weathering of organic resins. As an additive to improve flow-out of epoxy paints, initial gloss.

Table 4. Silicone Flake Resin Selection Guide

	XIAMETER® brand Product	Hardness	Finished Paint Temperature Performance Range, °C (°F)	Resin System (Solids Content, wt%)	Typical Applications
Flake Resins	RSN-0217 Flake Resin	Hard, brittle	To 260 (500)	Solid flake (100)	As a powder coating binder and liquid coating binder to improve thermal stability and weatherability.
	RSN-0220 Flake Resin	HardT	o 315 (600)	Solid flake (100)	As a powder coating binder or co-binder to improve heat stability and weather-ability; for blending with other silicone resins to reduce VOC content; in solvent-based organic coatings to improve film properties; in copolymerization with carbinol-functional organic monomers or polymers.
	RSN-0233 Flake Resin	HardT	o 427 (800)	Solid flake (100)	As a p owder coating binder or co - binder to improve heat stability and weatherability; colored baking enamels, decorative finishes; to increase hardness of other liquid silicone resins.
	RSN-0249 Flake Resin	HardT	o 427 (800)	Solid flake (100)	As a powder coating binder to improve heat stability and weatherability; for blending with solvent-based silicone resins to reduce VOCs; for blending with solvent-based organic resins to improve heat stability and weatherability.
	RSN-0255 Flake Resin	Hard, rigid	To 427 (800)	Solid flake (100)	As a coatings binder to improve heat stability and weatherability; as a blending resin with solvent-based silicone resins to reduce volatile organic compound (VOC) content; as a blending resin in solvent-based organic resins to improve heat stability and weatherability.

Table 5. Silicone Resin Intermediate Selection Guide

	Product Name	Physical Form (Solids Content, wt%)	Functionality	Reactivity	Typical Applications
Resin Intermediates	XIAMETER® RSN-6018 Intermediate	Flaked solid (100)	Silanol	Reacts with alkyds, phenolics, epoxies, polyesters and other organic resins containing hydroxyl groups.	Reactive silicone intermediate in colored maintenance and architectural finishes, appliance finishes, coil coatings and high temperature finishes. Blended with other silicone resins to improve hardness. Blended with organic resins to improve weatherability and heat resistance.
	XIAMETER® RSN-3037 Intermediate	Liquid (90)	Methoxy	Reacts with organic systems containing active hydroxyl groups.	Reactive silicone intermediate for coil coatings, appliance finishes and other finishes where improved heat or weathering resistance is needed. Typically reacted with saturated polyesters or oil-free alkyds to form a silicone polyester copolymer.
	XIAMETER® RSN-3074 Intermediate	Liquid (90)	Methoxy	Reacts with organic resins containing active hydroxyl groups.	Reactive silicone intermediate for coil coatings, appliance finishes and other finishes where improved heat or weathering resistance is needed. Typically reacted with saturated polyesters to form silicone-modified copolymers with 20 to 50 percent silicone content.
	XIAMETER® RSN-5314 Intermediate	Liquid (100, actives)	Methoxy	Reacts with organic resins containing active hydroxyl groups.	Reactive silicone intermediate for upgrading the weatherability of acrylic emulsions. Should work equally well with other emulsion systems that are stable at an alkaline pH.

Table 6. Compatibility of Selection Silicone Resins with Selected Organic Resins[1]

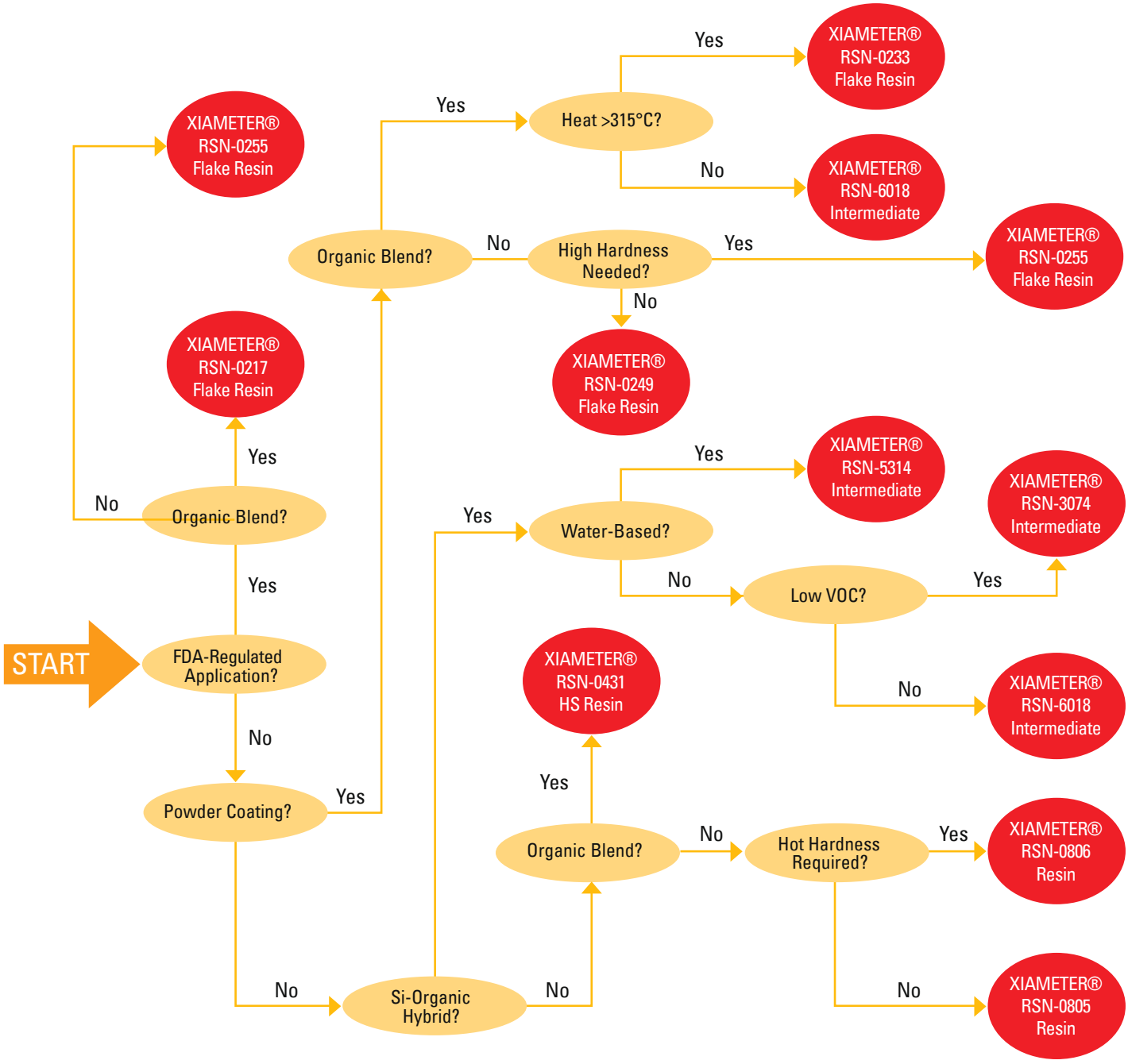
Resin Type	Brand [2, 3]	XIAMETER brand Product					
		RSN-431 HS and RSN-0840 Resins		RSN-6018 Intermediate		RSN-0233 Flake Resin	
		10%	50%	10%	50%	10%	50%
Acrylic (Thermoplastic)	*Paraloid* A-10S	C	SI	C	C	C	C
	Paraloid B-44	SI	I	I	I	SI	I
	Paraloid B-48S	C	C	C	C	C	C
	Paraloid B-66	C	C	C	SI	C	C
	Paraloid B-72	C	C	C	I	C	C
	Paraloid B-82	C	SI	I	I	SI	SI
Acrylic (Thermosetting)	*Paraloid* AT-63	C	C	C	C	C	C
	Paraloid AT-400	C	C	C	C	C	C
Alkyd (Long oil)	*Duramac* 50-5060	SI	SI	SI	I	SI	I
(Medium oil)	*Duramac* 204-2768	C	C	C	C	C	C
(Short oil)	*Duramac* 57-5720	C	SI	C	C	C	C
(Oil-free)	*Polymac* 57-5776	SI	SI	C	SI	C	SI

C – Compatible
SI – Slightly incompatible
I – Incompatible

[1] As determined by dry film on glass slides. This is meant to be representative only. The possible combinations of silicone and organic resins are unlimited.

Selecting a XIAMETER® brand Resin

Is the intended coating...



Important information on storage, handling, and flammability

Storage and Shelf Life

XIAMETER silicone resins should be stored at room temperature in sealed containers away from heat and open flame. XIAMETER® solid flake products should be stored below 22°C (72°F). Refer to the product pages on www.xiameter.com for the shelf life from date of manufacture of the resins and intermediates discussed in this brochure.

Handling Precautions

Product safety information required for safe use is not included. Before handling, read product and safety data sheets and container labels for safe use, physical and health hazard information. The material safety data sheet is available on www.xiameter.com.

When working with XIAMETER® silicone paint resins formulated with flammable solvents, the following safety precautions should be taken:

- Keep away from heat and open flame
- Use only with adequate ventilation
- Avoid prolonged breathing of vapor
- Avoid prolonged or repeated skin contact
- Avoid eye contact

XIAMETER® solid flake resins are electrically nonconductive and, like plastic in particle form, can generate static charges during transfer operations. For this reason, proper precautions should be taken to safely dissipate any charges possibly generated, particularly when solvents or solvent vapors are present. These two important cautions are detailed as follows:

1. The flake itself will generate an electrical potential, and the user should maintain adequate safeguards to properly handle it. The vessel into which the flake is being poured should be grounded along with the platform on which the operator stands.

2. Avoid the presence of ignitable materials during the transfer operation. If possible, have an inert atmosphere in the kettle and keep the solvent vapor content of the surrounding area at safe levels by providing adequate building area ventilation.

Limitations

These products are neither tested nor represented as suitable for medical or pharmaceutical uses.

Flammability

XIAMETER silicone resins in organic solvent have a closed cup flash point from 7 to 27°C (45 to 80°F). The flake resins have a closed cup flash point of approximately 138°C (280°F).

Product Information and Technical Support

Visit www.xiameter.com for:

- Product technical data sheets
- Customer service & limited technical support
- The name of a XIAMETER brand distributor near you

LIMITED WARRANTY INFORMATION - PLEASE READ CAREFULLY

The information contained herein is offered in good faith and is believed to be accurate. However, because conditions and methods of use of our products are beyond our control, this information should not be used in substitution for customer's tests to ensure that our products are safe, effective and fully satisfactory for the intended end use. Suggestions of use shall not be taken as inducements to infringe any patent.

Dow Corning's sole warranty is that our products will meet the sales specifications in effect at the time of shipment.

Your exclusive remedy for breach of such warranty is limited to refund of purchase price or replacement of any product shown to be other than as warranted.

DOW CORNING SPECIFICALLY DISCLAIMS ANY OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY.

DOW CORNING DISCLAIMS LIABILITY FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Form No. 95-1113-01

XIAMETER® brand Antifoam Tips

Answers to commonly asked questions about foam.

What is foam?

Foam is a dispersion of air or other gases in a liquid or solid.

Some foams are useful:

- Shampoos
- Shaving creams and lathers
- Hair styling mousses
- Fire-fighting foams
- Carpet cleaners
- Polyurethane and other plastic or rubber foams that insulate homes, add comfort to footwear
- Whipped cream, egg whites, ice cream

Industrial processing foams cause problems:

- Overflow vessels
- Increase housekeeping costs
- Interfere with processing
- Damage materials
- Slow drainage during drying
- Interfere with packaging

Why and how is foam controlled?

To achieve maximum return on investment in processing equipment and raw materials, process foam must be controlled. Foam control promotes smooth, efficient operation and the production of consistent, high-quality products.

There are two ways to control problem foam:

- Destroy it (defoam)
- Prevent it (antifoam)

Defoamers – Chemicals or formulated products that destroy, or knock down, foam that has already formed. Defoamers, except in relatively large amounts, don't prevent foam from forming.

Antifoams – Chemicals or formulated products that prevent the formation of foam.

Sometimes antifoams are called defoamers and vice versa. When discussing these materials, it is important to notice at what point in the process they are used. There are other factors you should consider as well.

What should I consider when choosing an antifoam?

There are thousands of chemicals that behave as antifoams, either alone or in combination with others. That's why it's important to talk with an expert when choosing an antifoam. Another reason is that when selecting an antifoam, you must consider numerous variables, including:

- Regulatory status
- Effectiveness
- Cost
- Service by the supplier

Antifoam products should be formulated to have minimal impact – other than foam suppression – on the products in which they are used. Generally, the smaller the amount of antifoam required, the less impact there will be on the product. This is one reason why silicone antifoams are frequently the first choice for combating foam in industrial processes.

Silicone antifoams:

- Are efficient
- Are long-lasting
- Act as antifoams and defoamers
- Are safe (many comply with FDA, EPA, USDA and other regulatory requirements)
- Have low surface tension for effective foam control in a variety of foaming media

How do silicone antifoams work?

Basically, a silicone antifoam droplet or particle penetrates a bubble wall, spreading the liquid-gas interface and causing the bubble wall to become unstable and collapse.

How do I know which antifoam to use?

To obtain the best antifoam for your process, consider the following questions:

1. Is the system aqueous or nonaqueous?
2. If aqueous, what is the pH?
3. What is the temperature of the foaming system?
4. Is there agitation? If so, what type?
5. What is the volume or batch size of the foaming material?
6. What defoamer are you using now?

Be prepared to briefly describe the process and explain where it foams.

And remember, while proper product formulation is important, so is efficient use.

How can I test an antifoam?

Simulate the conditions in which the antifoam is expected to perform. Use a test medium that is similar – preferably identical to the foaming medium in which the antifoam will be used.

Various test methods are available to assist in your evaluation:

- ASTM D 892-74 simulates bubble formation at the base of a reaction vessel.
- ASTM D 1173-53 can predict foam generation in showers or cascading liquids.
- ASTM D 3519-76 uses a blender to simulate conditions of high shear and air entrapment.
- ASTM D 3601-77 simulates a low-shear foaming environment.

Whichever test method you choose, follow these procedures:

- Use only clean apparatus.
- Avoid cross-contamination between runs.
- Make multiple runs and statistical evaluations to avoid wrong conclusions.
- Compare your findings with in-plant performance.

For More Information

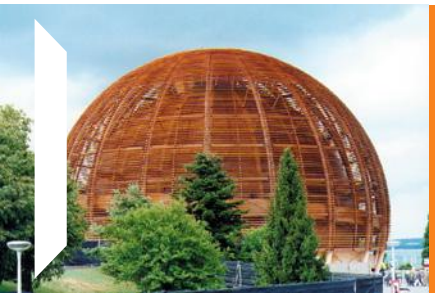
Our Web-enabled XIAMETER® brand and business model offers you high-quality, standard silicone materials at market-based prices. Learn more at www.xiameter.com.

Form No. 95-1114-01

Silicones Simplified

www.xiameter.com

XIAMETER® from DOW CORNING



Water Repellents
Selection Guide Europe

Benefits of the use of silicones in construction substrates

All construction materials are exposed to damaging environments ranging from water ingression, to abrasion by air-borne particles, attack by organisms, to accidental spillages. The XIAMETER® brand has a range of products for use in formulations applied to a diverse range of substrates including:

- Structural Concrete
- Pavers/Flagstones
- Sandstone
- Limestone/Marble
- Bricks/Tile
- Wood

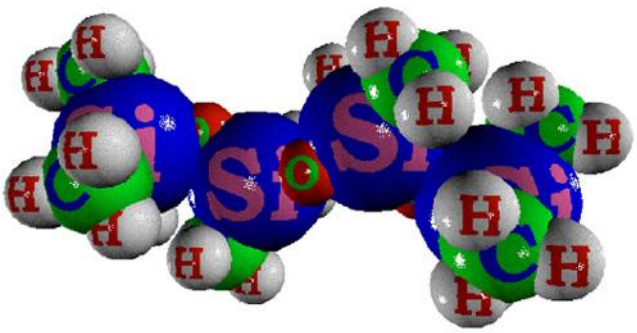
For use either as preventative or remedial treatment for Façade, OEM or Damp Proof Course (DPC).

They provide a variety of benefits:

- Improved long term protection
- Reduced maintenance time/costs
- Reduced efflorescence
- Reduced Spalling (freeze-thaw damage)
- Strengthening fragile masonry
- Reduced staining/easier cleaning
- Dimensional stability of wood

Through unique properties of silicone based technology:

- Repellency to water and oil, depending on attached groups
- Permeable to water vapour



Silicone molecule

Brick treated with *Dow Corning*® Z-6689 Water Repellent

Concrete treated with *Dow Corning*® Z-6689 Water Repellent

- Durable; chemically reacts with substrate and itself
- Deep penetrating; small molecular size
- Low surface tension
- UV stable

Wood protected with *Dow Corning*® 2-9034 Emulsion

1.1 Performance aspects of silicones Protection

Silicones are capable of penetrating and forming a protective repellent layer several millimetres deep within the substrate, with little appreciable effect on the water vapour transmission rate through pores and capillaries. As the depth of treatment is significant, abrasion of the surface has little or no effect on performance. Other treatments to give repellency block or seal only the very top of these pores and capillaries. This results in greater reductions of vapour transmission, together with less abrasion resistance, as the depth of protection is significantly less.

XIAMETER® MHX-1109 Fluid protection against efflorescence in limestone

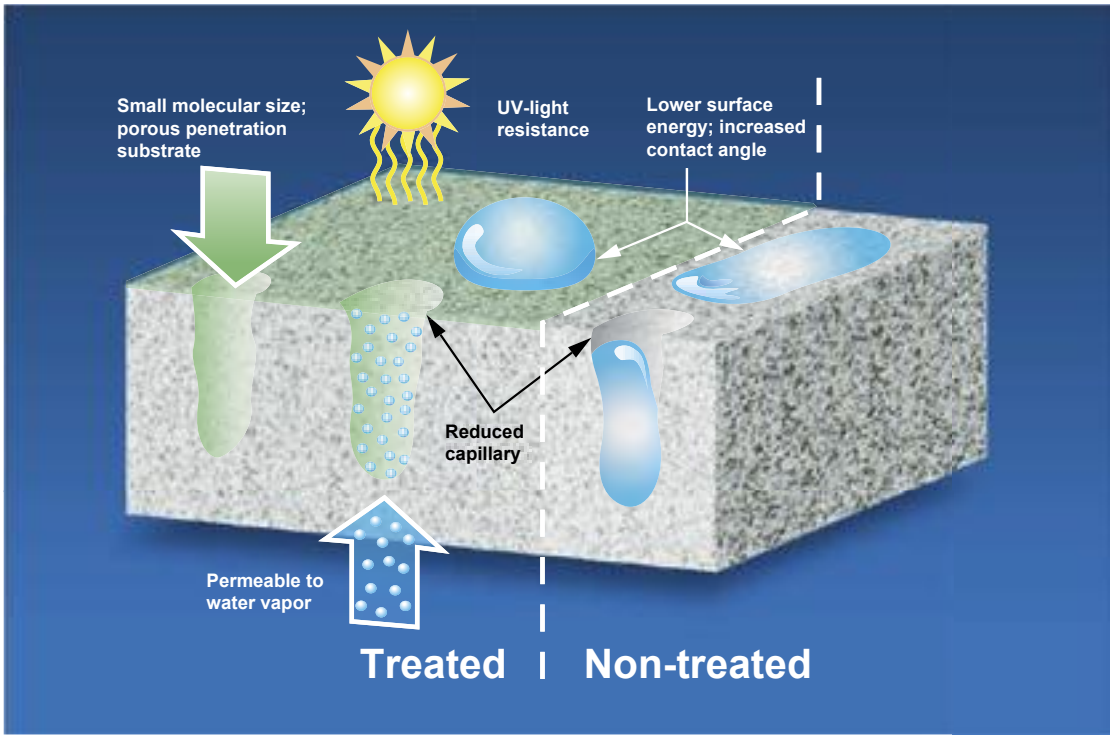


Figure 1 – *Silicone-based water repellents when delivered to the surface penetrate deeply. They chemically react with the substrate and themselves to provide durability protection, also they allow moisture vapour to pass.*

1.2 Physical and Chemical properties of Silicones

Silicones are present in many forms and are often used in combination to give the specifi c properties required for effective treatments.

1.2.1 Silanes

Silanes are the smallest silicone ensuring good Depth of Penetration into substrates. They react with themselves and any hydroxy (OH) groups within the substrate when moisture is present, forming a silicone resin network. This formation of strong chemical bonds provides the durability attributed to siloxane treatments.

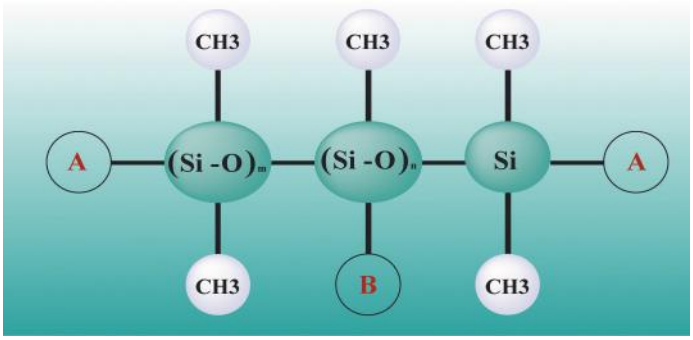
1.2.2 Polymers

Silicone linear polymers are helical in shape, providing a lot of free space within their structure for individual water vapour molecules to pass through, whilst water droplets are repelled by the hydrophobic methyl (CH_3) groups which orientate to the outside, giving repellency to liquid water.

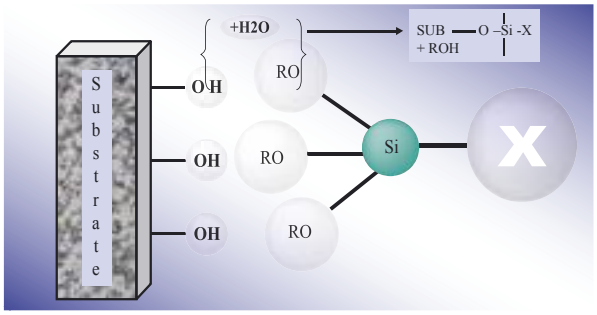
The low surface tension of the methyl groups enables silicones to spread easily, forming a molecular layer penetrating into the substrate.

Various groups can be substituted onto the polymers enabling chemical reactivity with the substrate and other silicone molecules.

Polymers can be linear or cyclic, with various groups substituted into the positions shown below.



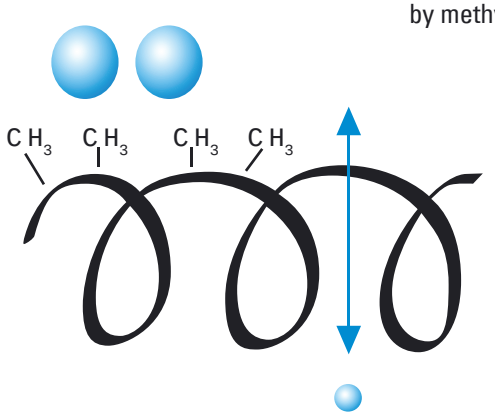
A and B are substituted groups.



Where **RO** *is an* ***alkoxy*** *group, typically methoxy or ethoxy, with the capability to react with hydroxy* (OH) *groups on the substrate*

X *is an* ***organic*** *group such as butyl or octyl to give hydrophobicity. To give oil repellency* **X** *would contain fluorine containing groups*
For strengthening **X = RO**

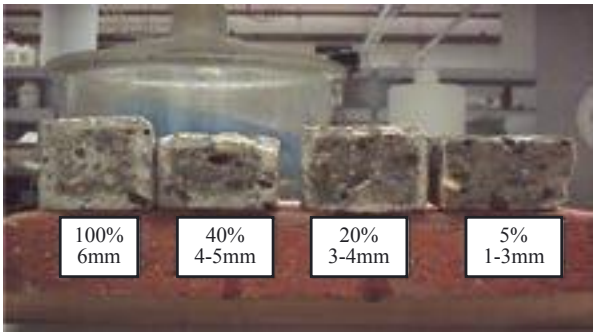
Water Beading – droplets repelled by methyl groups



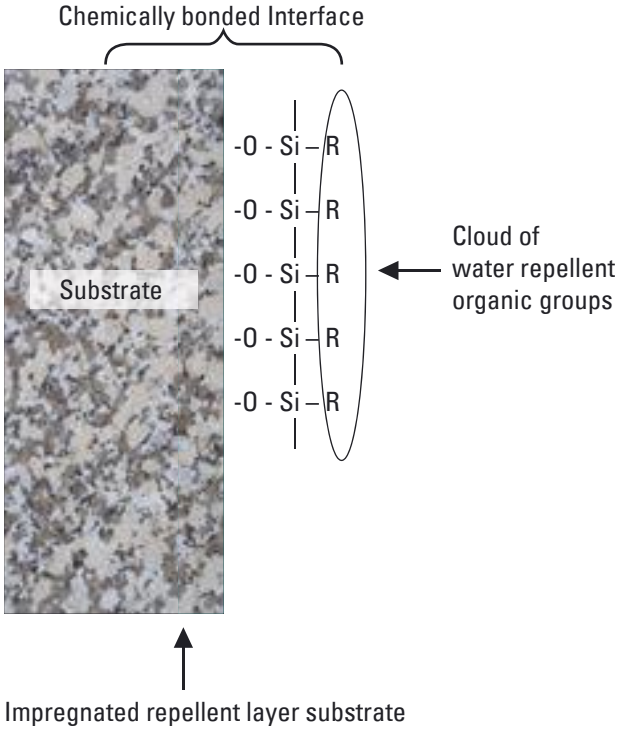
Water vapour – can pass through the open silicone structure

Group	Position	Reactive	Function
Alkyl	A or B	N	Water repellency
Fluoroalkyl	B	N	Oil and Water repellency
Amino	A or B	N	Catalytic
Alkoxy	A	Y	X-linking
Hydroxyl	A	Y	X-linking
Hydrogen	B	Y	X-linking

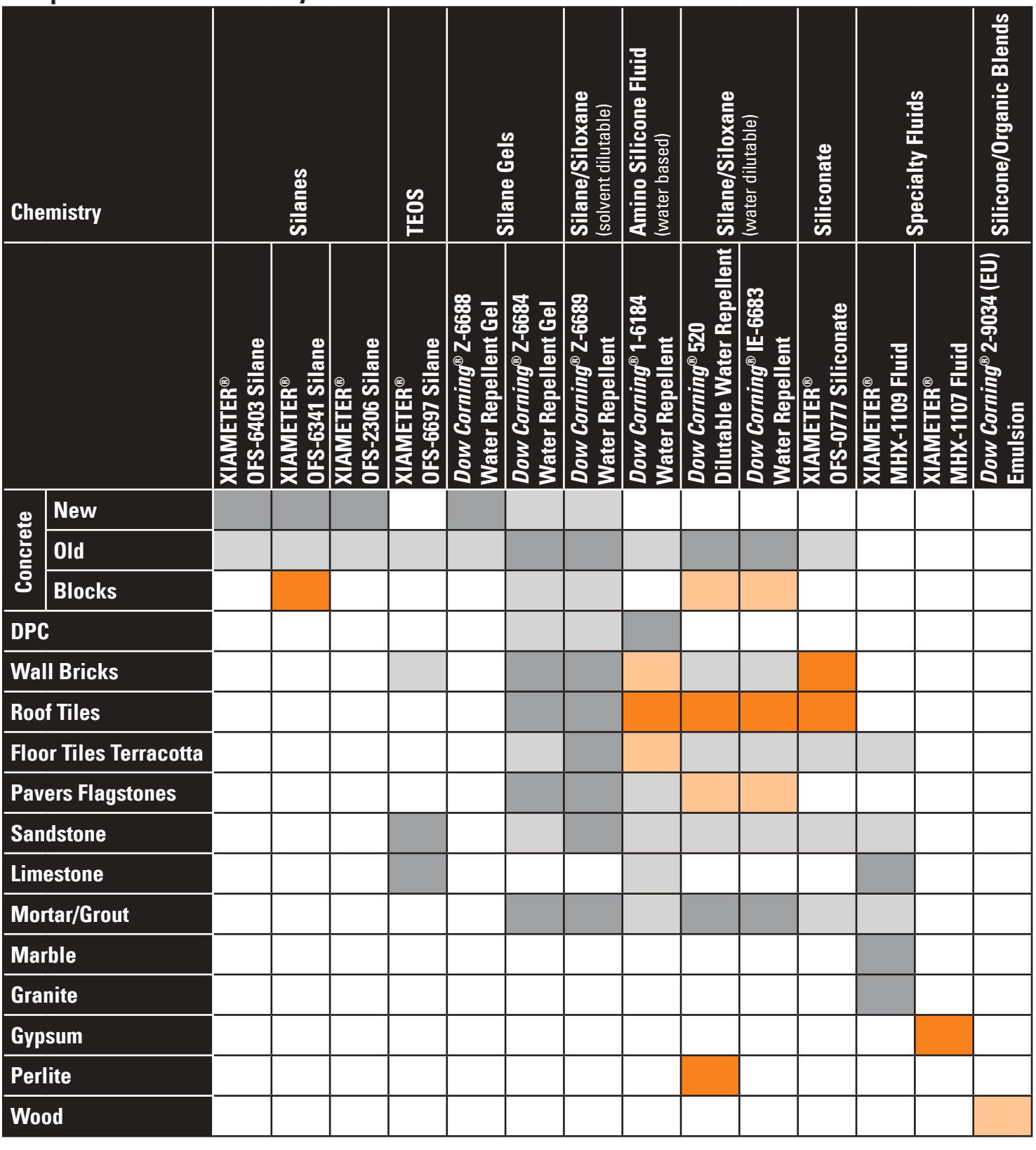
Recommendations of suitability of products for use on various substrates in the following pages are based on consideration of the polymer type and blend required to achieve optimum performance.



XIAMETER® OFS-6341 Silane:
DOP at Various Concentrations



European Selection Guide by substrate



European Selection Guide by properties

Chemistry		Solvent	Chemistry	Substrate pH/ type	Active ingredients	Typical active usage level	Specific gravity	Flash point
		Water	Official tests & approvals		%	%	Kg/l	ºC(F)
Silanes	XIAMETER® OFS-6403 Silane		Butyl triethoxysilane	12 to 14	98	40 or 100	0,88	31
			Protection Against Chloride ion intrusion in to concrete NCHCRP Nº 244					
	XIAMETER® OFS-6341 Silane		Octyl triethoxysilane	12 to 14	98	40 or 100	0,88	63
			Approved at Swedish National Road Administration for Surface tretament of concrete according to 'Bro 2002'					
	XIAMETER® OFS-2306 Silane		Butyl trimethoxysilane	12 to 14	96	40 or 100	0,92	35
			The Department Transport (UK), Technical Report N0 20002 (1991) BE28/14/026					
TEOS	XIAMETER® OFS-6697 Silane		Tetra ethoxysilane	neutral to 10	>99	70 to 100	0,93	46
Silanes Gel	*Dow Corning*® Z-6688 Water Repellent Gel		Octyl triethoxysilane	12 to 14	80	80	0,91	>62
			Approved at Swedish National Road Administrtion for Surface tretament of concrete according to 'Bro 2002'					
	Dow Corning® Z-6684 Water Repellent Gel		Octyl triethoxysilane	neutral to 12	45	45	0,87	>61
Silane/ Siloxane Blends (solvent dilutable) Amino Silicone Fluid (water dilutable)	*Dow Corning*® Z-6689 Water Repellent		Solventless silane/ siloxane blend	neutral to 10	98	5 to 15	0,96	65,5
			CSTC (Belgian Building Research Institute) 'Initial effectiveness, secondary effects and durability of water repellents' HD-340/133-143					
	Dow Corning® 1-6184 Water Repellent		Amino silsesquioxane	neutral to 10	65	3.5 to 7.5	1,05	27
			Rising moisture in masonry test. WBA at IBAC, Aachen Germany					

European Selection Guide by properties (cont.)

Chemistry		Solvent Water	Chemistry	Substrate pH/ type	Active ingredients	Typical active usage level	Specific gravity	Flash point
		Water	Official tests & approvals		%	%	Kg/l	°C(F)
Silane/ Siloxane Emulsions (water dilutable)	*Dow Corning*® 520 Dilutable Water Repellent		Silane/siloxane emulsion blend	slightly alkaline to 12	40	5 to 20	0,99	>100
			Water Exclusion ASTM C642/c67					
	Dow Corning® IE-6683 Water Repellent		Silane/siloxane emulsion blend	slightly alkaline to 12	40	3 to 10	0,99	>100
Siliconates	XIAMETER® OFS-0777 Siliconate		Potassium Methyl Siliconate	neutral to 10	40	0.5 to 3	1,29	>93
Specialty Fluids	XIAMETER® MHX-1109 Fluid		Functional methyl siloxane	neutral to 12	100	5 to 30	0,98	30
			CSTC (Belgian Building Research Institute) 'Initial effectiveness, secondary effects and durability of water repellents' HD-340/133-142					
	XIAMETER® MHX-1107 Fluid		Polymethylhydrogen siloxane	admixture	100	0.05 to 1	1	93
Silicone/ Organic Blends	*Dow Corning*® 2-9034 (EU) Emulsion		Organo-siloxane emulsion	N/A	50	2 to 8	0,94	100
			Water repellency swellometer Test ASTM 4446 QUV Durability Test G53					

European Selection Guide by materials

Material	Application	Chemistry	Delivery form	Products
Steel re-inforced concrete	Bridges, Parckdecks	Silanes	In solvent or 100% solids or Gel	**XIAMETER® OFS-2306 Silane (IBTMS)**
				XIAMETER® OFS-6341 Silane (NOTES)
				XIAMETER® OFS-6403 Silane
				***Dow Corning*® Z-6688 Water Repellent Gel**
Concrete non-reinforced "fresh concrete"	Facade, Pavers, Flagstones, Roof tiles	Silanes	In solvent or 100% solids or admixture	**XIAMETER® OFS-2306 Silane (IBTMS)**
				XIAMETER® OFS-6341 Silane (NOTES)
Concrete non-reinforced "aged concrete"	Facade, Pavers, Flagstones, Roof tiles	Silanes/Siloxane blend	In solvent or as Emulsion water-based	***Dow Corning*® Z-6689 Water Repellent**
				***Dow Corning*® Z-6684 Water Repellent Gel**
				***Dow Corning*® 520 Dilutable Water Repellent**
				***Dow Corning*® IE-6683 Water Repellent**
Natural Stones, Clays, Terracotta	Natural Stone, Clay Bricks, Tiles	Self-catalyzing Siloxanes & Siliconates	Solvent/water-based	***Dow Corning*® Z-6689 Water Repellent**
				***Dow Corning*® 1-6184 Water Repellent**
				XIAMETER® OFS-0777 Siliconate
Natural Stone, Marble, Limestone	High porous substrates protection & reinforcement	Fluid, TEOS	Solvent	**XIAMETER® MHX-1109 Fluid**
				XIAMETER® OFS-6697 Silane
Brick Walls	Wall injection against rising Damp (DPC)	Self-catalyzing Siloxanes & Siliconates	Water	**XIAMETER® OFS-0777 Siliconate**
Wood Pressure or post treatment	Exterior wooden articles	Silane/siloxane/ Organic mix	Water	***Dow Corning*® 2-9034 EU Emulsion**
Gypsum	Gypsum plaster boards	Fluid	Admixture	**XIAMETER® MHX-1107 Flui d**

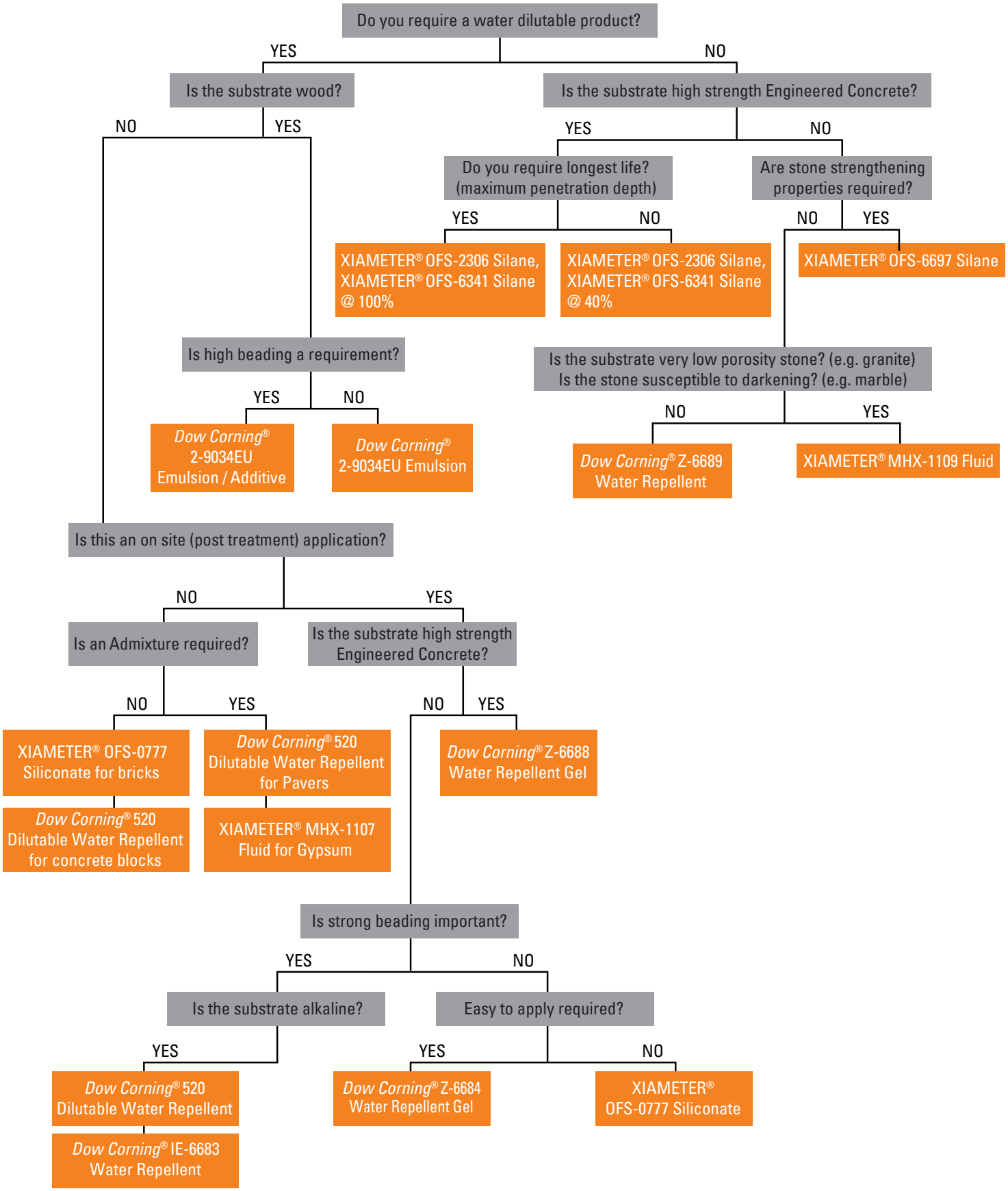
List Products & Benefits

Products	Chemistry	Dilution system	Substrate	Benefits
***Dow Corning*®** **IE-6683 Water Repellent**	Silane/siloxane emulsion	Water based	Alkaline or neutral substrates such as concrete, mortar and brick, stone	Deeply penetrates surface without changing appearance of substrate
***Dow Corning*®** **Z-6689 Water Repellent**	Silane/siloxane blend + catalyst	Solvent based	Neutral and moderately alkaline substrates such as brick, stone and aged concrete	Quick-forming and enduring beading effect, bonds chemically to the surface
***Dow Corning*®** **520 Dilutable Water Repellent**	Silane/siloxane emulsion	Water based	Alkaline or neutral substrates such as concrete, mortar and brick, stone	Deeply penetrates surface without changing appearance of substrate
XIAMETER® OFS-6697 Silane	Tetra ethoxy silane	Solvent based	Natural stone and neutral substrates	Its similar chemistry to the natural stone substrates make ideal as stone strengthener without change the aesthetics and breathability of the substrate.
***Dow Corning*®** **2-9034 EU Emulsion**	Nonionic organosilicone emulsion	Water based	Can be applied to pretreated or untreated wood, and for formulations used in pressure treatment processes.	High and enduring level of water repellence. Used to partially replace CCA.
XIAMETER® MHX-1107 Fluid	Fluid	Solvent based	Gypsum	Unique product to provide hydrophobicity to gypsum plaster boards.
XIAMETER® MHX-1109 Fluid	Fluid	Solvent based	Natural stone: limestone, sandstone, marble and granite.	Unique product providing excellent hydrophobicity on difficult substrates. Does not migrate giving outstanding durability and protection.

List Products & Benefits (cont.)

Products	Chemistry	Dilution system	Substrate	Benefits
***Dow Corning*® Z-6688 Water Repellent Gel & *Dow Corning*® Z-6684 Water Repellent Gel**	Alkoxy silane water emulsion	Water based gel	Concrete & neutral building substrates	Rheology of the gel allows the application on vertical or overhead surfaces. Solvent free.
XIAMETER® OFS-6341 Silane	Silane (NOTES)	Solvent based	Alkaline substrates such as new concrete.	Small molecule that allows deep penetration and provide water repellency by chemical bonding with the substrate.
XIAMETER® OFS-2306 Silane	Silane (IBTMS)	Solvent based	Concrete	Protect Reinforced Concrete from chlorine attach. Methyl releases, fast reaction.
XIAMETER® OFS-0777 Siliconate	Siliconate	Water based	Neutral, bricks, ceramics	Water dilutable solution gives water repellency to a variety of substrates

Decision tree
Water repellents



Contact Us

Visit www.xiameter.com to learn more about the many product options available to you from the XIAMETER® brand.

Photos: AV07433, AV15018, AV13022, AV05806, AV05807, AV05808

LIMITED WARRANTY INFORMATION - PLEASE READ CAREFULLY

The information contained herein is offered in good faith and is believed to be accurate. However, because conditions and methods of use of our products are beyond our control, this information should not be used in substitution for customer's tests to ensure that our products are safe, effective and fully satisfactory for the intended end use. Suggestions of use shall not be taken as inducements to infringe any patent.

Dow Corning's sole warranty is that our products will meet the sales specifications in effect at the time of shipment.

Your exclusive remedy for breach of such warranty is limited to refund of purchase price or replacement of any product shown to be other than as warranted.

DOW CORNING SPECIFICALLY DISCLAIMS ANY OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY.

DOW CORNING DISCLAIMS LIABILITY FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Form No. 95-1130-01

Silicones Simplified
www.xiameter.com
XIAMETER® from DOW CORNING

XIAMETER® brand Silicones for Foam Control

Silicone antifoams from Dow Corning have been designed to safely and efficiently reduce problems with foam during processing or to serve as formulation aids.

The broad range of applications where silicone antifoams are used includes:

- Home laundry
- Detergent
- Textile dyeing and scouring
- Pulp and paper manufacturing
- Adhesives
- Latexes
- Emulsion polymerization
- Chemical production
- Food and beverage
- Distillation
- Paint and coating
- Gas/oil separation
- Refinery operations
- Drilling mud
- Gas treatment
- Lubricants
- Agrochemicals
- Metalworking
- Wastewater treatment
- Water desalination
- Fermentation
- Life sciences

Advantages of silicone antifoams

Silicone antifoams:

- Are effective at much lower dosage rates than organic antifoams, leading to significantly lower cost-in-use.
- Tend to be much more persistent (longer lasting) than organic antifoams
- Tend to be less reactive in the foaming medium, leading to fewer compatibility problems
- Are stable over a wide temperature range

Suggested Usage Level:

A typical usage level is 50 parts per million silicone for industrial applications. This level will depend on the exact application, as factors such as the pH, temperature, shear and formulation composition will affect the antifoaming performance.

Antifoam Types

Fluid: Inert, low-toxicity silicone fluids, available in a wide range of viscosities. Good option for controlling foam in nonaqueous applications.

Dispersion: Aliphatic solvent dispersion of fluids. Mainly used in oil and gas applications.

Compound: Silicone fluids containing a suspension of finely powdered silica to enhance their defoaming efficiency. Primarily used in nonaqueous applications.

Emulsion: Emulsified antifoam compound in water. Good option for controlling foam in aqueous applications.

Concentrate: High-concentration, self-emulsifiable products.

Powder: Solid powdered compound antifoam. Can be added to dry products to prevent foaming when liquids are added.

Foam Control Keywords

Antifoams are added to prevent foam from occurring.

Defoamers are added to reduce or eliminate foam after it has formed.

Foam Control is a general term to describe defoaming and/or antifoams.

Knockdown is a measure of the reduction of the foam height upon addition of a defoamer. While the rapidness of foam being eliminated is important, the critical measure is reduction of foam height.

Persistency is a measure of how long the antifoam performs.

Product Name	Active Content, %	50 ppm Active, kg/1000 kg	Usable Life, months	Current Geographic Availability	Food Grade[1]	Effective at High Temperature (>95°C)	Performance After High-Temperature Aging (10 days @ 80°C)	Performance at High Shear (10 min @ 4500 rpm)	Performance at Low pH (pH < 3)	Performance After Low pH Aging (10 days @ pH < 3)	Performance at High pH (pH > 13)	Performance After High pH Aging (10 days @ pH > 13)	Persistency	Performance After 1% Active Predilution Aging (10 days @ pH7)	Knockdown	Suitable Diluent	1/10 Emulsion Prediltution Stability (12 hr)	Dilution Stability After High Shear (10 min @ 4500 rpm)	Dilution Stability After High-Temperature Aging (10 days @ 80°C)	Dilution Stability After Low pH Aging (10 days @ pH < 3)	Dilution Stability After High pH Aging (10 days @ pH > 13)	Dilution Stability After 1% Active Prediliution Aging (10 days @ pH7)	Deposition Risk (1 hr @ 80°C)
Emulsions																							
XIAMETER® AFE-0010 Antifoam Emulsion FG	10	0.5	36	All regions outside Europe	Y	Y	NE	NE	Y	NE	N	NE	L	NE	H	Demineralized water	L	NE	NE	NE	NE	NE	NE
XIAMETER® AFE-0110 Antifoam Emulsion	10	0.5	12	Europe	N	Y	NE	NE	Y	NE	Y	NE	L	NE	M	Demineralized water	M	NE	NE	NE	NE	NE	NE
XIAMETER® AFE-0200 Antifoam Emulsion	10	0.5	24	Global	N	Y	NE	NE	Y	NE	N	NE	L	NE	H	Demineralized water	M	NE	NE	NE	NE	NE	NE
XIAMETER® AFE-0400 Antifoam Emulsion	10	0.5	18	All regions outside Americas	N	Y	T	N	Y	Y	Y	Y	L	Y	H	Demineralized water	H	L	M	M	L	L	L
XIAMETER® AFE-0700 Antifoam Emulsion	10	0.5	15	Global	N	Y	Y	Y	Y	Y	Y	T	H	Y	M	Demineralized water	H	L	M	L	M	H	M
XIAMETER® AFE-1010 Antifoam Emulsion	10	0.5	36	All regions outside Europe	N	Y	Y	N	Y	Y	N	N	L	Y	H	Demineralized water	L	L	L	L	L	L	L
XIAMETER® AFE-1410 Antifoam Emulsion	10	0.5	12	All regions outside Europe	N	Y	NE	NE	Y	NE	Y	NE	L	NE	M	Demineralized water	L	NE	NE	NE	NE	NE	NE
XIAMETER® AFE-1510 Antifoam Emulsion	10	0.5	24	Global	Y	Y	NE	N	Y	NE	Y	NE	L	NE	H	Demineralized water	L	NE	NE	NE	NE	NE	NE
XIAMETER® AFE-2010 Antifoam Emulsion	10	0.5	12	All regions outside Americas	N	Y	Y	N	Y	N	Y	T	L	Y	H	Demineralized water	M	L	M	M	M	M	L
XIAMETER® AFE-0020 Antifoam Emulsion	20	0.25	12	All regions outside Americas	N	Y	N	T	Y	Y	Y	Y	H	Y	H	Demineralized water	NE	M	M	M	L	M	H
XIAMETER® AFE-1226 Antifoam Emulsion	20	0.05	8	Global	N	Y	NE	NE	Y	NE	Y	NE	L	NE	H	Demineralized water	H	NE	NE	NE	NE	NE	NE
XIAMETER® AFE-1520 Antifoam Emulsion	20	0.25	24	Global	Y	Y	T	N	Y	Y	Y	N	L	Y	H	Demineralized water	M	M	L	L	L	L	L
XIAMETER® AFE-3101 Antifoam Emulsion	20	0.25	12	Global	N	Y	N	T	Y	Y	Y	Y	H	Y	H	Demineralized water	NE	M	M	M	L	M	H
XIAMETER® AFE-0600 Antifoam Emulsion	28	0.18	12	Asia	N	Y	Y	T	Y	Y	Y	T	L	Y	H	Demineralized water	M	H	M	M	M	M	L
XIAMETER® AFE-0030 Antifoam Emulsion	30	0.17	12	Global	N	Y	NE	NE	Y	NE	N	NE	L	NE	M	Demineralized water	L	NE	NE	NE	NE	NE	NE
XIAMETER® AFE-0100 AF Emulsion FG	30	0.17	18	Global	Y	Y	NE	NE	Y	NE	N	NE	L	NE	H	Demineralized water	L	NE	NE	NE	NE	NE	NE

Key: NE – Not evaluated; T – Top (improved performance); Y – Yes (limited or no loss of performance); N – No (loss of performance); H – High; M – Medium; L – Low.
[1]Please refer to "XIAMETER® brand Silicones for Foam Control in the Food Processing Industry," Form No. 95-1082.

Product Name	Active Content, %	50 ppm Active, kg/1000 kg	Usable Life, months	Current Geographic Availability	Food Grade[1]	Effective at High Temperature (>95°C)	Performance After High-Temperature Aging (10 days @ 80°C)	Performance at High Shear (10 min @ 4500 rpm)	Performance at Low pH (pH < 3)	Performance After Low pH Aging (10 days @ pH < 3)	Performance at High pH (pH > 13)	Performance After High pH Aging (10 days @ pH > 13)	Persistency	Performance After 1% Active Prediution Aging (10 days @ pH7)	Knockdown	Suitable Diluent	1/10 Emulsion Prediution Stability (12 hr)	Dilution Stability After High Shear (10 min @ 4500 rpm)	Dilution Stability After High-Temperature Aging (10 days @ 80°C)	Dilution Stability After Low pH Aging (10 days @ pH < 3)	Dilution Stability After High pH Aging (10 days @ pH > 13)	Dilution Stability After 1% Active Prediution Aging (10 days @ pH7)	Deposition Risk (1 hr @ 80°C)
XIAMETER® AFE-0310 Antifoam Emulsion	30	0.17	12	Europe	N	Y	T	N	Y	Y	Y	Y	L	Y	M	Demineralized water	M	M	L	M	L	M	M
XIAMETER® AFE-1247 Antifoam Emulsion	30	0.17	6	All regions outside U.S.	N	Y	NE	NE	Y	NE	Y	NE	L	NE	L	Demineralized water	H	NE	NE	NE	NE	NE	NE
XIAMETER® AFE-1430 Antifoam Emulsion	30	0.17	12	All areas outside Europe	N	Y	NE	NE	Y	NE	Y	NE	L	NE	M	Demineralized water	M	NE	NE	NE	NE	NE	NE
XIAMETER® AFE-3168	30	0.17	12	Global	N	Y	NE	NE	Y	NE	Y	NE	NE	NE	NE	Demineralized water	M	NE	NE	NE	NE	NE	NE
XIAMETER® AFE-0013	50	0.1	12	Asia	N	Y	NE	NE	Y	NE	Y	NE	L	NE	L	Demineralized water	M	NE	NE	NE	NE	NE	NE
XIAMETER® AFE-0050 Antifoam Emulsion	50	0.1	18	Global	N	Y	Y	Y	Y	Y	Y	Y	H	Y	H	Demineralized water	L	H	L	L	L	L	H
XIAMETER® AFE-7500 Antifoam Emulsion	50	0.1	12	Global	N	Y	Y	N	Y	Y	Y	T	H	Y	H	Demineralized water	NE	L	M	M	M	M	H
XIAMETER® AFE-7600 Antifoam Emulsion	50	0.1	12	All regions outside Americas	N	Y	Y	Y	Y	Y	Y	T	H	Y	H	Demineralized water	NE	M	M	M	M	M	H
XIAMETER® AFE-3034 Antifoam Emulsion	50	0.1	18	All regions outside Americas	N	Y	T	NE	Y	N	Y	N	L	N	L	Demineralized water	L	H	L	M	M	M	L
Compounds																							
XIAMETER® ACP-0080 Antifoam Compound	100	0.05	8	Global	N	Y	N	T	Y	N	Y	T	L	N	M	Demineralized water	H	H	L	L	L	H	L
XIAMETER® ACP-0100 Antifoam Compound	100	0.05	12	Europe	N	Y	NE	NE	Y	NE	Y	NE	L	NE	M	Aliphatic or Aromatic solvents	H	NE	NE	NE	NE	NE	NE
XIAMETER® ACP-0544 Antifoam Compound	100	0.05	12	Global	N	Y	NE	NE	Y	NE	Y	NE	L	NE	L	Demineralized water	L	NE	NE	NE	NE	NE	NE
XIAMETER® ACP-1000 Antifoam Compound	100	0.05	24	Global	N	Y	NE	NE	Y	NE	Y	NE	L	NE	H	Aliphatic solvents	H	NE	NE	NE	NE	NE	NE
XIAMETER® ACP-1266 Antifoam Compound	100	0.25	8	Global	N	Y	Y	T	Y	Y	Y	Y	H	Y	M	Demineralized water	NE	H	L	M	L	L	L
XIAMETER® ACP-1400 Antifoam Compound	100	0.05	36	All regions outside Europe	N	Y	NE	NE	Y	NE	Y	NE	L	NE	M	Aliphatic or Aromatic solvents	H	NE	NE	NE	NE	NE	NE
XIAMETER® ACP-1500 Antifoam Compound	100	0.05	36	Global	Y	Y	NE	NE	Y	NE	Y	NE	L	NE	H	Food grade glycols	L	NE	NE	NE	NE	NE	NE
XIAMETER® ACP-3183 Antifoam Compound	100	0.05	12	Global	N	Y	NE	NE	Y	NE	N	NE	L	NE	H	Demineralized water	L	NE	NE	NE	NE	NE	NE

Key: NE – Not evaluated; T – Top (improved performance); Y – Yes (limited or no loss of performance); N – No (loss of performance); H – High; M – Medium; L – Low.
[1]Please refer to "XIAMETER® brand Silicones for Foam Control in the Food Processing Industry," Form No. 95-1082.

Product Name	Active Content, %	50 ppm Active, kg/1000 kg	Usable Life, months	Current Geographic Availability	Food Grade[1]	Effective at High Temperature (>95°C)	Performance After High-Temperature Aging (10 days @ 80°C)	Performance at High Shear (10 min @ 4500 rpm)	Performance at Low pH (pH < 3)	Performance After Low pH Aging (10 days @ pH < 3)	Performance at High pH (pH > 13)	Performance After High pH Aging (10 days @ pH > 13)	Persistency	Performance After 1% Active Predilution Aging (10 days @ pH7)	Knockdown	Suitable Diluent	1/10 Emulsion Predilution Stability (12 hr)	Dilution Stability After High Shear (10 min @ 4500 rpm)	Dilution Stability After High-Temperature Aging (10 days @ 80°C)	Dilution Stability After Low pH Aging (10 days @ pH < 3)	Dilution Stability After High pH Aging (10 days @ pH > 13)	Dilution Stability After 1% Active Predilution Aging (10 days @ pH7)	Deposition Risk (1 hr @ 80°C)
Powders																							
XIAMETER® ACP-1920 Powdered Antifoam	20	0.25	36	Global	Y	Y	NE	NE	Y	NE	Y	NE	L	NE	H	Aliphatic solvents, Demineralized water, food grade glycols	L	NE	NE	NE	NE	NE	NE

Key: NE – Not evaluated; T – Top (improved performance); Y – Yes (limited or no loss of performance); N – No (loss of performance); H – High; M – Medium; L – Low.
[1]Please refer to "XIAMETER® brand Silicones for Foam Control in the Food Processing Industry," Form No. 95-1082.

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HANDLING PRECAUTIONS

PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED IN THIS DOCUMENT. BEFORE HANDLING, READ PRODUCT AND MATERIAL SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE MATERIAL SAFETY DATA SHEET IS AVAILABLE ON THE DOW CORNING WEBSITE AT DOWCORNING.COM, OR FROM YOUR DOW CORNING SALES APPLICATION ENGINEER, OR DISTRIBUTOR, OR BY CALLING DOW CORNING CUSTOMER SERVICE.

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XIAMETER® Silicone Foam Control by Application

Global Application Guide

Silicone foam control products from the XIAMETER® brand have been designed to safely and efficiently reduce problems with foam during process or as formulator aid. This guide features a number of silicone antifoams by application. Remember, every foaming situation is unique. The products listed may or may not be appropriate for your application. For specific foam-control product recommendations, contact us through our website: https://www.xiameter.com/en/CustomerSupport/Pages/ProductSupport.aspx

Product technical data sheets and selection guides are also available at www.xiameter.com. If you are interested in Dow Corning® brand specialty antifoam solutions for health care and coating/paint/ink applications, please visit www.dowcorning.com.

Here are the key questions to ask to identify the best product to select your antifoam:

- What is your market, process?
- Is your system sensitive to silicone?
- What is the foam negative impact?
- Which antifoam performances are needed?
- At what stage of the process does the foam occur?
- What is the foaming solution?
- What is the temperature of foaming solution?
- How is the foam generated?
- Is an antifoam currently used?
- Regulation requirement?

Application	Product	Type	Details
Agro	XIAMETER® ACP-0100 or ACP-1400 or ACP-1500	Compound	Agrochemicals pesticide or herbicide
	XIAMETER® AFE-1510 or AFE-1520	Emulsion	Agrochemicals pesticide or herbicide
Bio-ethanol Production	XIAMETER® AFE-1520	Emulsion	Fermentation antifoam
Chemical Manufacturing	XIAMETER® ACP-0100 or ACP-1400	Compound	Poly Propylene refinery, Epoxy resin manufacturing
	XIAMETER® AFE-1520	Emulsion	Expended Poly Styrene process (beverage cup)
	XIAMETER® AFE-1520	Emulsion	Latex
	XIAMETER® AFE-0700	Emulsion	Nylon production
Construction	XIAMETER® ACP-1266	Compound	Super plasticizer antifoam
	XIAMETER® ACP-0100	Compound	Super plasticizer antifoam
	XIAMETER® AFE-2210	Emulsion	Super plasticized mortar antifoam
	XIAMETER® AFE-0400	Emulsion	Super plasticized mortar antifoam
	XIAMETER® AFE-7600	Emulsion	Metal Working fluid
	XIAMETER® AFE-1247	Emulsion	Metal Working fluid
	XIAMETER® ACP-1266	Compound	Metal Working fluid
Cosmetic	XIAMETER® AFE-1510 or AFE-1520	Emulsion	Hair care applications. Process aid : foam control during Shampoo production. Formulation aid : hair-dye, oil for hair and Body scrub.
	XIAMETER® AFE-1510 or AFE-1520	Emulsion	Hair care applications. Process aid : foam control during Shampoo production. Formulation aid : hair-dye, oil for hair and Body scrub.

Household	XIAMETER® AFE-0110 or AFE-0310 or AFE-1410, or AFE-1430	Emulsion	Deaeration, Liquid Detergent, Fabric softener
	XIAMETER® ACP-1400 or ACP-0100	Compound	Liquid Detergent, Slurry Deaeration
	XIAMETER® ACP-0544	Compound	Liquid Detergent, Slurry Deaeration
	XIAMETER® ACP-3425	Compound	Liquid Detergent, Slurry Deaeration
	XIAMETER® APW-4248	Powder	Powder Detergent
Oil and Gas	XIAMETER® AFE-0110 or AFE-1410	Emulsion	Gas treatment, Drilling mud, Waste water treatment
	XIAMETER® FBL-1165	Dispersion	Gas oil separator , Delayed coker
Paint/Coating/Ink	XIAMETER® AFE-2210	Emulsion	Low cost deaerator/antifoam
Paper tissue	XIAMETER® AFE-0100	Emulsion	Wipes antifoam
Pulp and Paper	XIAMETER® ACP-3258	Compound	Softwood and Hardwood Pulp Aid
	XIAMETER® ACP-3056	Compound	Softwood Pulp Aid
	XIAMETER® AFE-3101	Emulsion	Softwood Pulp Aid
	XIAMETER® AFE-7500	Emulsion	Softwood and Hardwood Pulp Aid
Textile	XIAMETER® ACP-0544	Compound	Jet Dyeing, Finishing, Polymerisation
	XIAMETER® AFE-0050	Emulsion	Desizing, Dyeing, Jet Dyeing, Finishing
	XIAMETER® ACP-1266	Compound	Sizing, Desizing, Scouring, Dyeing, Printing, Finishing, Polymerisation.
	XIAMETER® ACP-1400 or ACP-0100	Compound	Sizing, Desizing
	XIAMETER® ACP-3183	Compound	Sizing, Manufacturing
	XIAMETER® AFE-0700	Emulsion	Sizing, Desizing, Dyeing, Printing
	XIAMETER® AFE-0400	Emulsion	Sizing, Dyeing, Finishing, Manufacturing
	XIAMETER® AFE-1430 or AFE-0310	Emulsion	Desizing, Finishing, Manufacturing
	XIAMETER® AFE-0800	Emulsion	Scouring, Dyeing, Jet Dyeing, Finishing
Waste treatment plant	XIAMETER® AFE-1520	Emulsion	Including biological methods such as anaerobic and aerobic digestion (activated sludge) to treat the waste water.
	XIAMETER® AFE-0110 or AFE-0310	Emulsion	Physical methods such as sedimentation to treat the waste water. Chemical methods such as oxidation to treat the waste water. In the sludge conditioning tanks of waste water treatment plants.

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