



DAI-EL™

Selection Guide

High Performance Fluoroelastomers

Quality + Performance = DAI-EL™

Daikin's DAI-EL™ is a family of high-performance fluoroelastomers. DAI-EL fluoroelastomers possess properties that are unique to fluoro chemicals, providing excellent heat resistance, low compression set even at higher temperatures, inherently flame retardant, and corrosion resistance to oil, fuel mixtures, acids, and solvents.

DAI-EL products are widely used in essential applications. For example, the resistance to heat, oil, and fuel mixtures is vital for automotive applications, such as oil seals, o-rings, hoses, and gaskets. DAI-EL's low-outgassing feature provides a solution in semiconductor manufacturing, and its electrical resistance property benefits wire and cable as well as electronics industries.

Specific features of DAI-EL fluoroelastomers differ based on polymer structure and cure method. According to user's application and fabrication method, *DAI-EL Selection Guide* gives a clear and quick way to select an appropriate DAI-EL grade.















Compound Recipes

The following standard compound formulations are used in this *Selection Guide*.

	Compound No1	Compound No2	Compound No3
Polymer	100phr	100phr	100phr
N990(MT Black)	20phr	20phr	20phr
MgO	3phr		
Ca(OH)2	6phr		
TAIC (75% active)		5.4phr	4.0phr
Peroxide (50% active)		3.0phr	3.0phr
Press Curing	170°C × 10min	160°C × 10min	160°C × 10min
Oven Curing	230°C × 24h	180°C × 4h	180°C × 4h

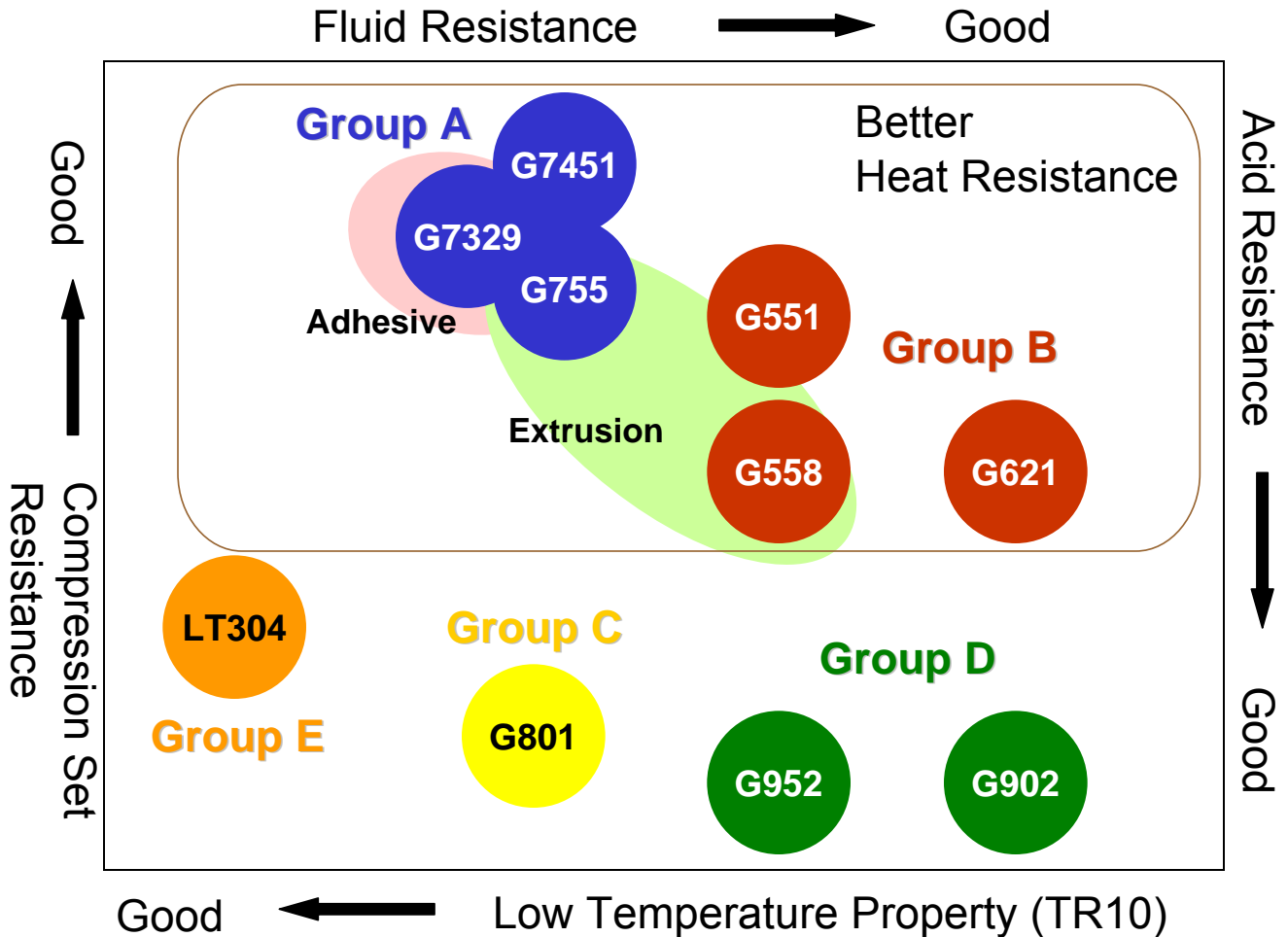
PART 1: DAI-EL APPLICATION GUIDE

Part 1 of the *DAI-EL Application Guide* lets you select an appropriate grade of DAI-EL based on your intended application and fabrication method.

Fabrication Method	Standard Product	Application Requirement
Compression Molding	 G7451	Compression set  G7801 Adhesion  G7329 Fluid resistance  G551 Acid resistance Chemical resistance  G901 Low temperature property  LT302
Extrusion Transfer Molding	 G755	Chemical resistance Fuel resistance  G558 Fluid resistance No postcure  G902 Low temperature property  LT304
Injection Molding	 G7261	Fluid resistance  G5853 Fluid resistance No postcure  G902 Low temperature property  LT303L

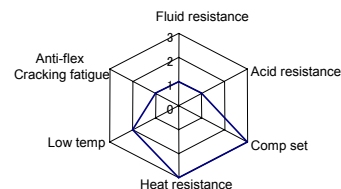
PART 2: DAI-EL MAP

DAI-EL Fluoroelastomers are classified into Group A to Group E by polymer and vulcanization system. The relative position of each group suggests its uniquely advantageous properties.



- Group A** - Bisphenol-Curable Copolymer
- Group B** - Bisphenol-Curable Terpolymer
- Group C** - Peroxide-Curable Copolymer
- Group D** - Peroxide-Curable Terpolymer
- Group E** - Peroxide-Curable FKM for Low Temperature Use

Group A



Bisphenol-Curable Copolymer

Copolymers of vinylidene fluoride and hexafluoropropylene with a bisphenol type curing agent and an accelerator exhibit the best heat resistance and lowest compression set among the DAI-EL fluoroelastomers. Group A polymers are suitable for o-ring and oil seal applications in high-heat environments.

Products

General Grade

Fluorine Content 66%

G701

Medium Viscosity

G704

Low Viscosity

Extrusion Grade

Fluorine Content 66%

G755

Low Viscosity

Metal Adhesion Grade

Fluorine Content 66%

G7329

Medium Viscosity

CSR Grade

Fluorine Content 66%

G7261

Low Viscosity
For Injection Molding

G7451

Medium Viscosity

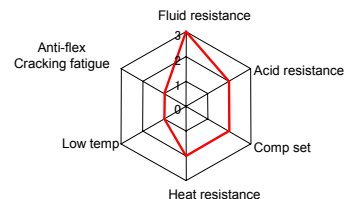
G7801

High Viscosity
Best CS Resistance

Grade		G7261	G7451	G7801	G755	G701	G704
Compound Recipe No							
	-	1	1	1	1	1	1
Fluorine %							
	%	66	66	66	66	66	66
Mooney Viscosity							
ML(1+10) 121°C	-	22	40	66	29	41	30
Mechanical Characteristics							
100% modulus	MPa	3.9	4.3	4.4	2.3	5.3	3.4
Tensile strength	MPa	14	15	16	14.8	14.6	12.7
Elongation	%	210	210	230	330	190	230
Tearing strength ^{a)}	kN/m			34			
Hardness ShoreA	-	71	72	73	65	72	72
Specific gravity	-			1.85	1.85		
Low-temperature property/TR test							
TR10	°C	-18	-18	-18	-18	-18	-18
Compression set							
200°C x72h	%	11	10	9	22	17	22
Air heat age characteristics							
230°C x72h							
Tensile strength change rate	%			+8	-5		
Elongation change rate	%			-5	+4		
Hardness change rate	%			+1	+1		
275°C x72h							
Tensile strength change rate	%			-21	-28		
Elongation change rate	%			+42	+23		
Hardness change rate	%			+3	0		
Oil and chemical resistance							
IRM903 175°C	%			+2	+3		
Methanol 40°C	%			+70	+137		
Fuel C 40°C	%			+13	+14		

Group B

Bisphenol-Curable Terpolymer



Group B consists of terpolymers of vinylidene fluoride, tetrafluoroethylene, and hexafluoropropylene with a bisphenol type curing agent and accelerator. These polymers are ideal for the applications that require resistance to fuel mixtures and solvents, such as fuel hoses and seals used in chemical plants. Due to the higher fluorine content, Group B's resistance to low temperature and compression set are lower than that of Group A.

Products

General Grade

Fluorine Content 69%

G551

High Viscosity

Extrusion Grade

Fluorine Content 69%

G558

Low Viscosity

Fluid Resistance Grade

Fluorine Content 71%

G603

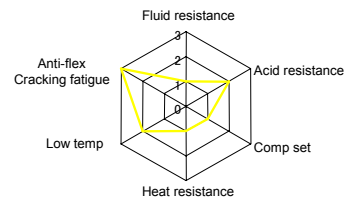
Medium Viscosity

G621

High Viscosity
Better CS Resistance
than G603

Grade		G551	G558	G603	G621
Compound Recipe No		1	1	1	1
Fluorine %	%	69	69	71	71
Mooney Viscosity					
ML(1+10) 121°C		48	34	31	50
Mechanical Characteristics					
100% modulus	MPa	3.9	7.2	3.7	3.3
Tensile strength	MPa	14.3	12.1	14.1	15.9
Elongation	%	250	290	300	300
Tearing strength ^{a)}	kN/m	21	21	21	20
Hardness ShoreA	-	72	68	77	74
Specific gravity	-	1.89	1.89	1.92	1.92
Low-temperature property/TR test					
TR10	°C	-14	-14	-8	-8
Compression set					
200°C x72h	%	25	28	60	29
Air heat age characteristics					
230°C x72h					
Tensile strength change rate	%	+1	+2	1	5
Elongation change rate	%	-1	+1	-1	-2
Hardness change rate	%	0	0	1	0
275°C					
Tensile strength change rate	%	-35	-38	-46	-33
Elongation change rate	%	+36	+47	+38	+26
Hardness change rate	%	0	+2	+1	+1
Oil and chemical resistance					
IRM903 175°C	%	+2	+2	+2	+2
Methanol 40°C	%	+15	+15	+4	+3
Fuel C 40°C	%	+11	+11	+8	+7

Group C



Peroxide-Curable Copolymer

Group C consists of copolymers of vinylidene fluoride and hexafluoropropylene that are peroxide curable. Group C grades have better flex resistance, acid resistance, and overall mechanical properties than Group A polymers, while they are not optimal in the higher temperature environment and do not offer compression set as low as Group A polymers. They offer the same level of resistance to solvents as Group A grades. Also, for Group C polymers post-cure could be omitted.

Products

General Grade

Fluorine Content 66%

G801 Medium Viscosity

Better mold flow grade

Fluorine Content 66%

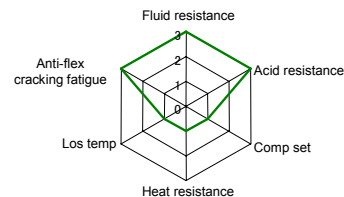
G802 Low Viscosity

Grade		G801	G802
Compound Recipe No		2	2
	-		
Fluorine %		66	66
	%		
Mooney Viscosity			
ML(1+10) 121°C	-	38	23
Mechanical Characteristics			
100% modulus	MPa	1.8	1.9
Tensile strength	MPa	20.4	19.8
Elongation	%	440	410
Tearing strength ^{a)}	kN/m	21	
Hardness ShoreA	-	66	66
Specific gravity	-	1.80	
Low-temperature property/TR test			
TR10	°C	-19	-19
Compression set			
200°C x72h	%	38	27
Air heat age characteristics			
230°C x72h			
Tensile strength change rate	%	-10	-7
Elongation change rate	%	+6	+7
Hardness change rate	%	-2	-1
275°C x72h			
Tensile strength change rate	%	Large	Large
Elongation change rate	%	Large	Large
Hardness change rate	%	Large	Large
Oil and chemical resistance			
IRM903 175°C	%	+2	+2
Methanol 40°C	%	+119	+119
Fuel C 40°C	%	+13	+13

Group D

Peroxide-Curable Terpolymer

Group D includes terpolymers of vinylidene fluoride, tetrafluoroethylene, and hexafluoropropylene that are peroxide curable. Group D grades have better flex resistance, acid resistance, solvent resistance, and overall mechanical properties than Group A polymers, while they are not optimal in the higher temperature environment and do not offer compression set as low as Group A polymers. Also the post-cure process could be omitted for Group D polymers.



Products

General Grade

Fluorine Content 71%

G902

Low Viscosity

G901

Medium Viscosity

Low Compression Set Grade

Fluorine Content 71%

G912

Medium Viscosity

Lower Temp. Use Grade*

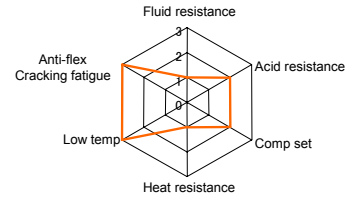
Fluorine Content 69%

G952

Medium Viscosity
Best Low Temp.
Properties in Group D

Grade		G901	G902	G912	G952
Compound Recipe No					
	-	2	2	2	2
Fluorine %					
	%	71	71	71	69
Mooney Viscosity					
ML(1+10) 121°C	-	48	19	58	40
Mechanical Characteristics					
100% modulus	MPa	2.7	2.9	6.5	1.8
Tensile strength	MPa	21.7	20.2	19.4	20.4
Elongation	%	350	320	170	440
Tearing strength ^{a)}	kN/m	20	20	18	20
Hardness ShoreA	-	70	70	74	66
Specific gravity	-	1.87	1.87	1.87	1.84
Low-temperature property/TR test					
TR10	°C	-8	-8	-8	-14
Compression set					
200°C×72h	%	32	28	16	38
Air heat age characteristics					
230°C×72h					
Tensile strength change rate	%	-22	-13	-13	-10
Elongation change rate	%	+13	+14	+12	+10
Hardness change rate	%	-1	+2	0	+1
275°C×72h					
Tensile strength change rate	%	Large	Large	Large	Large
Elongation change rate	%	Large	Large	Large	Large
Hardness change rate	%	Large	Large	Large	Large
Oil and chemical resistance					
IRM903 175°C×72h	%	+2	+2	+2	+2
Methanol 40°C×72h	%	+4	+4	+4	+13
Fuel C 40°C×168h	%	+8	+7	+7	+10

Group E



Peroxide-Curable Fluoroelastomers for Low Temperature Use

Group E represents low temperature peroxide curable fluoropolymers. Group E grades have excellent mechanical properties, flex resistance, acid resistance, better than Group A polymers, while they are not optimal in the higher temperature environment and do not offer compression set as low as Group A polymers. They offer the same level of resistance to solvents as Group A grades. Also, the post-cure process could be omitted for Group E polymers.

Products

General Grade

LT302 Medium Viscosity

LT304 Low Viscosity
Better CS Resistance
than LT302

Fluid Resistant Grade

LT252 Medium Viscosity

High Elongation Grade

LT303L Very Low Viscosity

Grade		LT252	LT302	LT303L	LT304
Compound Recipe No		3	3	3	3
Fluorine %		67	65	65	65
Mooney Viscosity					
ML(1+10) 121°C	-	20	44	14	26
Mechanical Characteristics					
100% modulus	MPa	2.2	2.8	2.2	3.3
Tensile strength	MPa	15.9	16.6	16.9	14.3
Elongation	%	250	270	290	210
Tearing strength ^{a)}	kN/m	50	57		
Hardness ShoreA	-	63	62	62	63
Specific gravity	-	1.84	1.8		
Low-temperature property/TR test					
TR10	°C	-25	-30	-30	-30
Compression set					
200°C×72h	%	30	25	28	16
Air heat age characteristics					
230°C×72h					
Tensile strength change rate	%	-19	+1	-17	-15
Elongation change rate	%	+9	-6	+9	+9
Hardness change rate	%	0	0	0	0
275°C×72h					
Tensile strength change rate	%	Large	Large	Large	Large
Elongation change rate	%	Large	Large	Large	Large
Hardness change rate	%	Large	Large	Large	Large
Oil and chemical resistance					
IRM903 175°C×72h	%	+2	+2	+2	+2
Methanol 40°C×72h	%	+9	+102	+52	+60
Fuel C 40°C×168h	%	+11	+15	+14	+14

Specialty Polymers

Daikin offers liquid fluoroelastomer G101 and thermoplastic fluoroelastomer T530. DAI-EL G101 is an excellent processing aid and/or hardness modifier. DAI-EL Thermoplastic T530 is the world's first thermoplastic fluoroelastomer. While at the normal temperature it has elastomeric characteristics, at temperatures above its melting point it flows like thermoplastic materials.

Products

Fluorinated rubber-type plasticizer



G101

500 Poise @60 C

Thermoplastic elastomer



T530

MFR 22
(250°C)

DAI-EL[®] Perfluoro

Daikin's high performance perfluoroelastomer (FFKM) is the most stable fluoroelastomer even in the harshest chemical environment. It exhibits resistance to chemicals that standard FKM cannot withstand, such as ketones, ethers, furan, amines, ammonia, and high-concentration alkaline media. Furthermore, DAI-EL Perfluoro is ready-to-go and does not require custom tooling because it already contains cure agent and fillers.

Products

Black



GA55

White



GA65

FKM Compound Products

A wide range of FKM compound products are available from Cri-Tech, Inc., a subsidiary of Daikin-America, Inc. The use of full-compound products could improve the manufacturing productivity by eliminating the capital-intensive process of mixing FKM polymer, acid acceptor, and fillers. It could also eliminate unwanted carbon contamination in the facility.

FKM Compounds

Compound Group		SP	IF/HF	HC	LT/HFLT	FKHT	NPC	TFEP	LC	FDA	GP
Florine %	%	66	68-70	71	65-67	66	70	55	66	66	66
Hardness ShoreA (range)											
Type A		50-90	59-90	72	60-92	72	69-79	76-87	58-92	61-74	58-92
Compression set (range)											
200°Cx22h	%	4-17	14-37	24*	5-21	55**	20	25-40	14-33	12-18	13-31
General Purpose									••		••••
Sealing		••••	•••	••	•••	•••	•••	••	•••	•••	••
Chemicals		••	••••	•••		••		•••	••	••	••
Automotive fuel		••	•••	••••	•••	••	•••	••	••	••	••
Low temp sealing		•••			••••				••		
Extreme high temp						••••					••
Oil field		••	•••	••	•••	••	•••	••••		n/a	••
Cost		\$\$	\$\$\$	\$\$	\$\$\$\$	\$\$\$	\$\$\$	\$\$\$\$	\$	\$\$\$	\$\$
Non-post cure							•••				
FDA										****	

* 135°Cx24hrs ** 275°Cx100hrs *** 150°Cx70hrs **** Approved for U.S. FDA 21 CFR 177.2600(c)(4)(1)

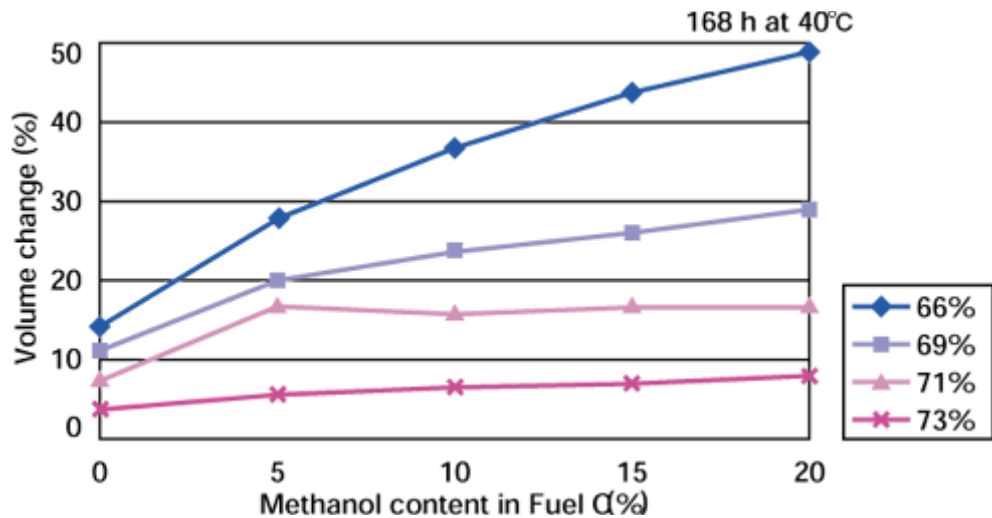
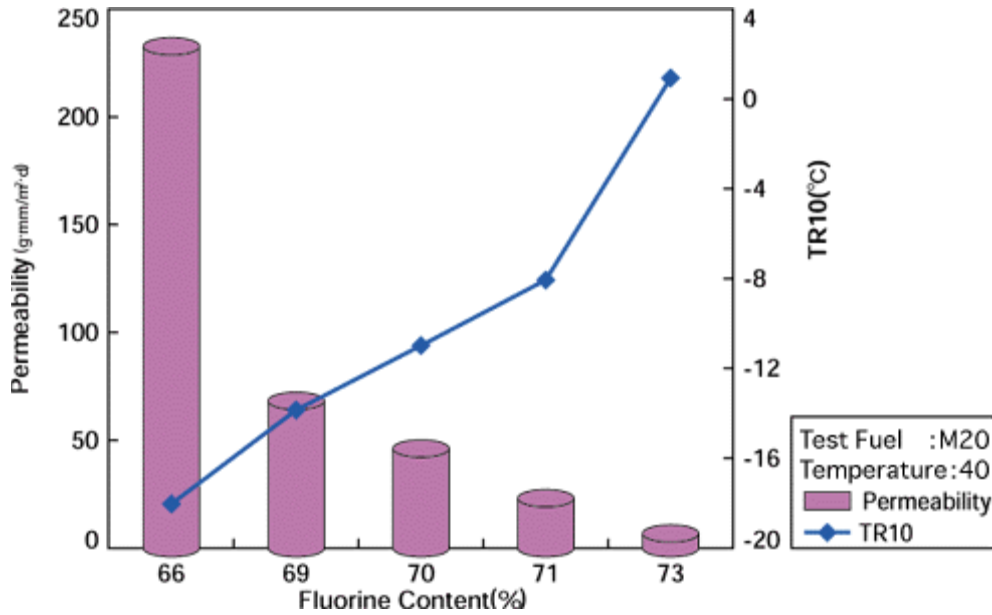
Specialty Products

Application	Dispersions	Mold Cleaning	HNBR	Specialty FKM
Product	Cri-Spersions®	Cri-Clean	HNBR	FKX, LS
Description	Dispersion of activators or other rubber chemical on a FKM base.	Mold cleaning compound for injection-compression, transfer, or compression molds.	General purpose, black reinforced, medium ACN	FKX-High viscosity, high green strength, HAV cure ability LS-Part-shrinkage and post-curing like NBR
Benefits	Short mixing cycle. Cleaner, speedy, production at lower costs.	Clean a mold without taking it apart and lower maintenance costs.	Improved productivity and convenience.	Ability to meet special requirements and shorter time to commercialization.

Cri-Tech, Inc. formulates and supplies all brands and types of FKM compounds for numerous applications in the automotive, aerospace, pneumatics, oil field, medical, pollution control, roller, diesel, small engine, plumbing, and chemical processing industries.

Appendix 1: DAI-EL™ for Fuel Hoses

DAI-EL are vinylidene fluoride base fluoroelastomers which provide good processability of hoses and good fuel resistance (permeability). DAI-EL has various fluorine content (from 66% such as DAI-EL G-755 to 73%) fluoroelastomer which suitable for hoses.



Safe Handling*

1. Compounding agent and facility
The common fillers and facilities for commodity rubber can be used for DAI-EL. The mixing mill needs to be cooled. Finely divided metallic powder or filler, such as aluminum and magnesium, or amine compounds of more than 10% should not be used as compounding agents for DAI-EL because such materials are known to decompose vigorously elevated temperature.
2. Storage and remixing
Store the compound in a tightly closed package in a cool and dry place. Another milling before use is recommended when the compound is left for more than three days. Too tight a nip between the rolls in the mixing mill may cause scorching. Be sure to cool the rolls well whenever the compound is milled with tight nip.
3. Molding / Curing
The work are should be adequately ventilated at all times because a small amount of toxic gasses (e.g. HF, acetone, methanol, acetaldehyde, methyl iodide and carbon monoxide) may be evolved during curing.
4. Material handling
A slight amount of hydrogen fluoride vapor may be produced during use at high temperatures (above 200C°). The room should be well ventilated. Do not smoke in the work area as harmful vapors may be inhaled when cigarettes are exposed to the powder of DAI-EL. After handling the powder of DAI-EL, knock off any dust from your hair or clothing and wash your face and hands thoroughly before smoking.
5. Disposal
Do not incinerate DAI-EL as this can produce harmful vapors. Disposal should be done in accordance with local laws and regulations.

* Please read the Material Safety Data Sheet (MSDS) before use.

IMPORTANT NOTICE: All statements, information and data given herein are believed to be accurate and reliable, but are presented without guarantee, warranty or responsibility of any kind, expressed or implied. Statements or suggestions concerning possible use of our products are made without representation or warranty that any such use is free of patent infringement, and are not recommendations to infringe any patent. The user should not assume that all safety measures are indicated, or that other measures may not be required.

MEDICAL USE: This product is not specifically designed or manufactured for use in implantable medical and/or dental devices. We have not tested it for such application and will only sell it for such use pursuant to contract containing specific terms and conditions required by DAIKIN.

TRADEMARKS: DAI-EL is a registered trademark of Daikin Industries, Ltd.



DAIKIN AMERICA, INC
20 Olympic Drive,
Orangeburg, NY 10962, U.S.A.
Phone: +1-845-365-9500
Toll-Free: +1-800-365-9570
Facsimile: +1-845-365-9598
URL: www.daikin-america.com

CRI-TECH, INC
85 Winter Street,
Hanover, MA 02339, U.S.A.
Phone: +1-800-826-5699
Toll-Free: +1-781-826-5770
e-mail: info@critechinc.com
URL: www.critechinc.com

DAIKIN INDUSTRIES, LTD
Umeda Center Bldg.,
2-4-12, Nakazaki-Nishi, Kita-ku,
Osaka 530-8323, Japan
Phone: +81-6-6374-9355
Facsimile: +81-6-6373-4281
URL: www.daikin.co.jp/chm

DAIKIN CHEMICAL EUROPE
Immermannstr. 65D,
40210 Dusseldorf, Germany
Phone: +49-211-1792250
Facsimile: +49-211-1640732