Chlorinated polyethylene
「ELASLEN ™」

Application for Wire and Cable

SHOWA DENKO

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昭和電工株式会社

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About us

昭和電工株式会社

Company Name	Showa Denko K.K.
Head office	13-9, Shiba Daimon 1-Chome, Minato-ku, Tokyo 105-8518 Japan
Type of Industry	Diversified Chemical Company
Founded	June 1939
Capital	140,564 million yen (US$ 1,278 million)
Employees	Consolidated: 10,634 Parent: 3,347
Sales	992.1 billion yen (US$ 9 billion) Unconsolidated: 576.8 billion yen (US$ 5.2 billion)
Business sectors	Petrochemical, chemicals, inorganics, aluminum, electronics and others(building materials etc.)

Global Locations

昭和電工株式会社

- Head office: Tokyo (Japan)
- Plant Location: Kawasaki City (Japan)
- Sales Offices: Munich (Germany), New York (USA), Singapore (Singapore)
  Shanghai (China), Seoul (Korea)

CPE Business

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Product name	Elaslen™
Chemical name	Chlorinated Polyethylene
HS code number	3901.90.10
Start of Sales	October 1968
Production Capacity	3,000MT/Y
Quality Control Program	ISO 9001
Environmental Control Program	ISO 14001

What is ELASLEN™ ?

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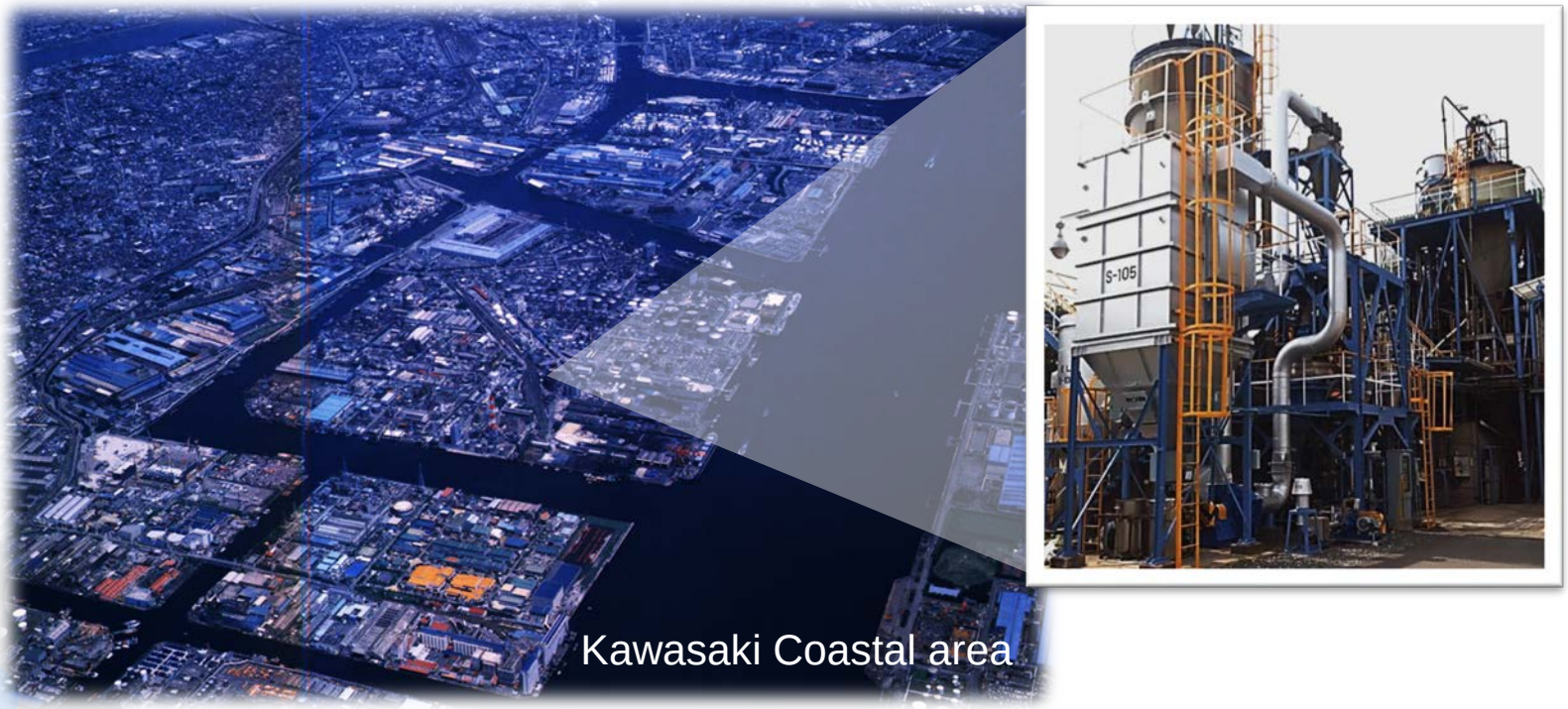
- Product name of **Chlorinated Polyethylene** made by Showa Denko
- Thermoplastic polymer chlorinating HDPE(high density polyethylene)
- Advantage: Flexibility, Weatherability, Heat aging resistance
  Flame retardancy and Chemical resistance



Applications

as Modifier

- Soft & Rigid PVC
- FR-ABS
- FR-PE (Wire & Cable)

Rubber

- Wire & Cable Jacket
- Hose & Boots for Automotive
- Rubber for Construction
- Magnetic rubber

TPE

- FR-TPE

Superiority of CPE

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- ✓ CPE has well balanced properties
- ✓ CPE can compensate other polymers' weaknesses by blending

Item	CPE	CR	EPDM	PVC (flexible)	XLPE (cross-linked PE)	Q (Silicon rubber)
Flexibility	Good	Excellent	Excellent	Good	Poor	Excellent
Flame Retardancy	Excellent	Good	Poor	Good	Poor	Excellent
Oil Resistance	Excellent	Good	Poor	Good	Poor	Good
Ozone Resistance	Excellent	Fair	Good	Excellent	Excellent	Excellent
Weather Resistance	Excellent	Fair	Good	Poor	Excellent	Excellent
Heat Resistance	Good	Fair	Excellent	Fair	Excellent	Excellent
Electrical Insulation	Good	Fair	Excellent	Fair	Excellent	Excellent
Strength	Good	Excellent	Good	Good	Good	Poor
Coloring	Excellent	Poor	Fair	Good	Excellent	Excellent
Cost	Good	Good	Good	Excellent	Good	Poor

A Wide Variety of Elaslen™ Grades

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Three key factors determine Elaslen™ characters
- You can choose suitable grade by balancing those aspects

	Flame retardancy	Chemical resistance	Mechanical strength	Heat aging resistance
Chlorine Content ~variation from 23% to 45%~	↗	↗	↘	↘
Molecular Weight ~diversity from very low to extremely high~	–	↗	↗	↗
Crystallinity ~contrast amorphous to high crystallinity~	–	–	↗	↗

*↗ : higher, better or improved
↘ : decreased or reduced

Grade List of ELASLEN™ - Non Crystallinity-

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Non Crystallinity

Items	Unit	Test Method	301MA	301AS	351AYS	401AY	302NAC	402NA	303A	353AY
Chlorine content	%	SDK method	32	31	35	40	28	40	31	35
Crystallinty	J/g	SDK method	<2	<2	<2	<2	<2	<2	<2	<2
Specific Gravity	-	JIS K7112	1.12	1.12	1.16	1.20	1.11	1.20	1.12	1.16
Melt Flow Rate(*)	g/10min	JIS K7210	0.1	1.7	1.8	1.6	12	8	120	65
Mooney Viscosity	ML1+4(121℃)	JIS K6300	-	85	90	105	45	65	20	20
Tensile Strength	Mpa	JIS K6251	11.8	11.1	10.5	9.9	9.8	6.9	6.9	5.2
Elongation	%	JIS K6251	900	950	1000	800	1100	700	800	1200
100% Modulas	Mpa	JIS K6251	1.0	1.0	0.9	0.9	1.1	0.9	1.5	0.8
Brittle Temp	℃	JIS K6261	<-70	<-70	<-70	<-70	<-70	-55	<-70	<-70
Hardness	JIS-A	JIS K6253	60	58	56	58	58	58	60	50
Volume Resistivity	Ω-cm	ASTM D257	2×10^{15}	3×10^{15}	2×10^{15}	1×10^{15}	3×10^{15}	1×10^{15}	3×10^{15}	2×10^{15}

(*)Measured at 180℃ under the load of 21.6kgf.

Application									
M: Most suitable A: Applicable	Cable Jacket			A	M		M		A
	Rigid PVC Modifier	A	M	M	A				A
	Flexible PVC Modifier			A	M		A		
	TPE								
	FR ABS Modifier							A	A
	Rubber	M	A		A	M	A	M	M
	Magnetic Rubber	A	M	M		A	A		

Grade List of ELASLEN™ - Semi Crystallinity-

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Semi Crystallinity

Specialty

Items	Unit	Test Method	252B	303BS	303C	301MB	352GB	404B	451MB	202KB	402B
Chlorine content	%	SDK method	23	32	31	30	35	40	45	23	40
Crystallinty	J/g	SDK method	20	50	84	20	20	29	7	23	10
Specific Gravity	-	JIS K7112	1.07	1.12	1.15	1.14	1.18	1.20	1.27	1.07	1.21
Melt Flow Rate(*)	g/10min	JIS K7210	3	25	20	0.1	0.8	25	0.1	8	1.2
Mooney Viscosity	ML1+4(121℃)	JIS K6300	-	-	-	-	-	-	-	-	-
Tensile Strength	Mpa	JIS K6251	14.0	11.1	13.0	15.0	12.7	16.7	25.0	11.0	15.0
Elongation	%	JIS K6251	850	800	380	420	400	550	300	710	500
100% Modulas	Mpa	JIS K6251	3.1	2.9	10.0	3.9	2.5	2.5	9.0	3.8	2.5
Brittle Temp	℃	JIS K6261	-60	-60	3	-60	-60	-55	-30	-60	-55
Hardness	JIS-A	JIS K6253	82	78	95	76	76	80	82	82	65
Volume Resistivity	Ω-cm	ASTM D257	4×10^{16}	4×10^{15}	7×10^{16}	4×10^{15}	3×10^{16}	1×10^{16}	2×10^{15}	5×10^{15}	1×10^{16}

(*)Measured at 180℃ under the load of 21.6kgf.

Application										
	Cable Jacket	M	A	M		A	M		M	M
	Rigid PVC Modifier		A				A			
	Flexible PVC Modifier	A			A	M		A	A	A
	TPE	A	A	A	M	M	A	M	A	A
	FR ABS Modifier	M	M						M	
	Rubber									
	Magnetic Rubber									

M: Most suitable

A: Applicable

Grade Map -1

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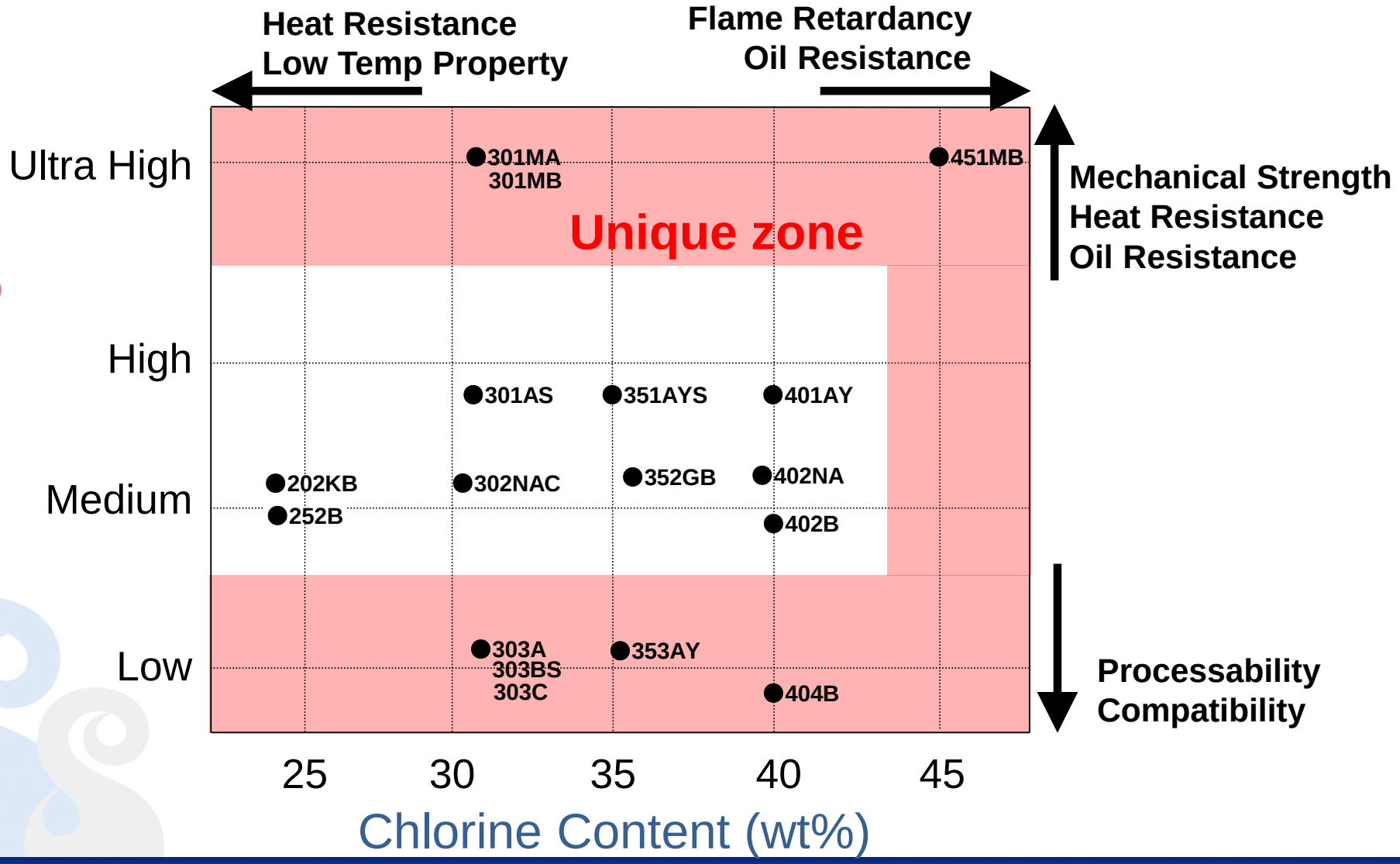
Chlorine content vs Molecular Weight



Grade Map -2

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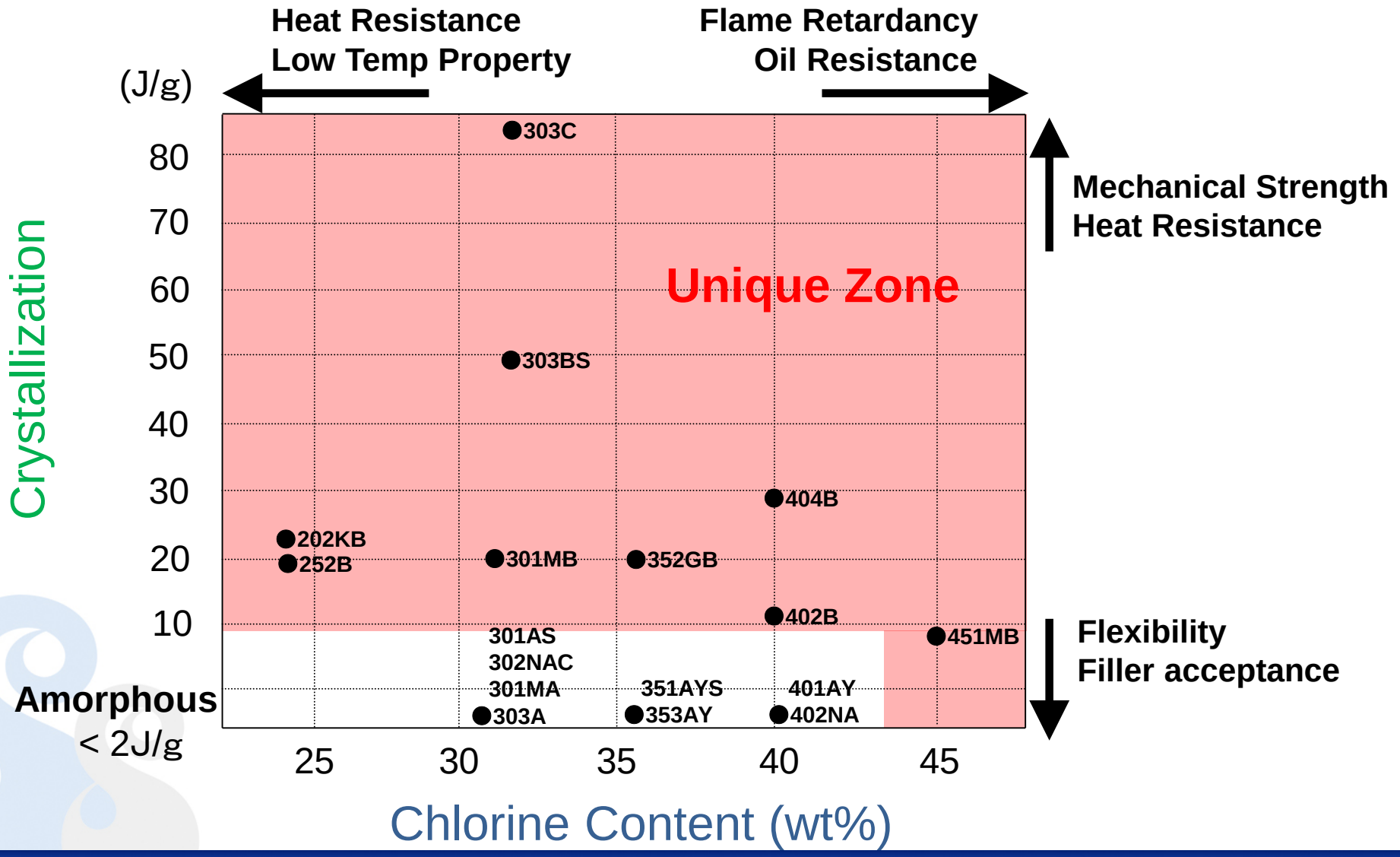
Chlorine content vs Crystallization



CPE usage for Wire & Cable application

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ELASLEN™ has been used for various applications of Wire & Cable.

- Jacket/Seath of rubber Wire & Cable jacket
  - Effective: Oil resistance, Heat resistance and Flame retardancy
- Jacket/Seath of Insulated (Crosslinked) PE for Wire & Cable jacket
  - Effective: Flame retardancy, Anti-drip and Electrical properties after water immersion

	Field	Application	Composition	Elaslen Grade	Blendable Polymer	Elaslen Function
cross-linked	Cabtyre/flexible cable	Transportation cable	Jacket: CPE (Insulation: EPDM)	401AY, 402B	EPDM	FR, Oil resistance, Flexibility
	Power cable	Semiconductive layer of power cable	CPE blended PE incl. Carbon	401AY	EVA	Strippability
	Electric appliance	Vehicle cable	Jacket: CPE (Insulation: XLPE)	202KB, 402B 404B	LDPE	FR, Chemical resistance, Flexibility
		Power cable Lead wire	CPE single layer	401AY, 402NA 351AYS	EPDM, EVA	FR, Oil resistance, Flexibility
		Portable cord	CPE single layer	401AY, 402NA 351AYS	EPDM, EVA	FR, Heat resistance, Flexibility
	Industrial	Electronic wire	CPE Blended FR-XLPE Insulation	202KB, 303BS 404B	EVA, LDPE	FR, Electrical property
Non	Communication	Telecommunication cable	CPE Blended FR-PE Insulation	404B	LDPE, HDPE	FR, Flexibility
			CPE Blended PVC Insulation	401AY	PVC	Low temp property, Lower plasticizer
		PMMA optical fiber	CPE Blended FR-PE Insulation	303BS, 404B	LDPE	FR, Zero plasticizer

Comparison with other polymers for Wire & Cable

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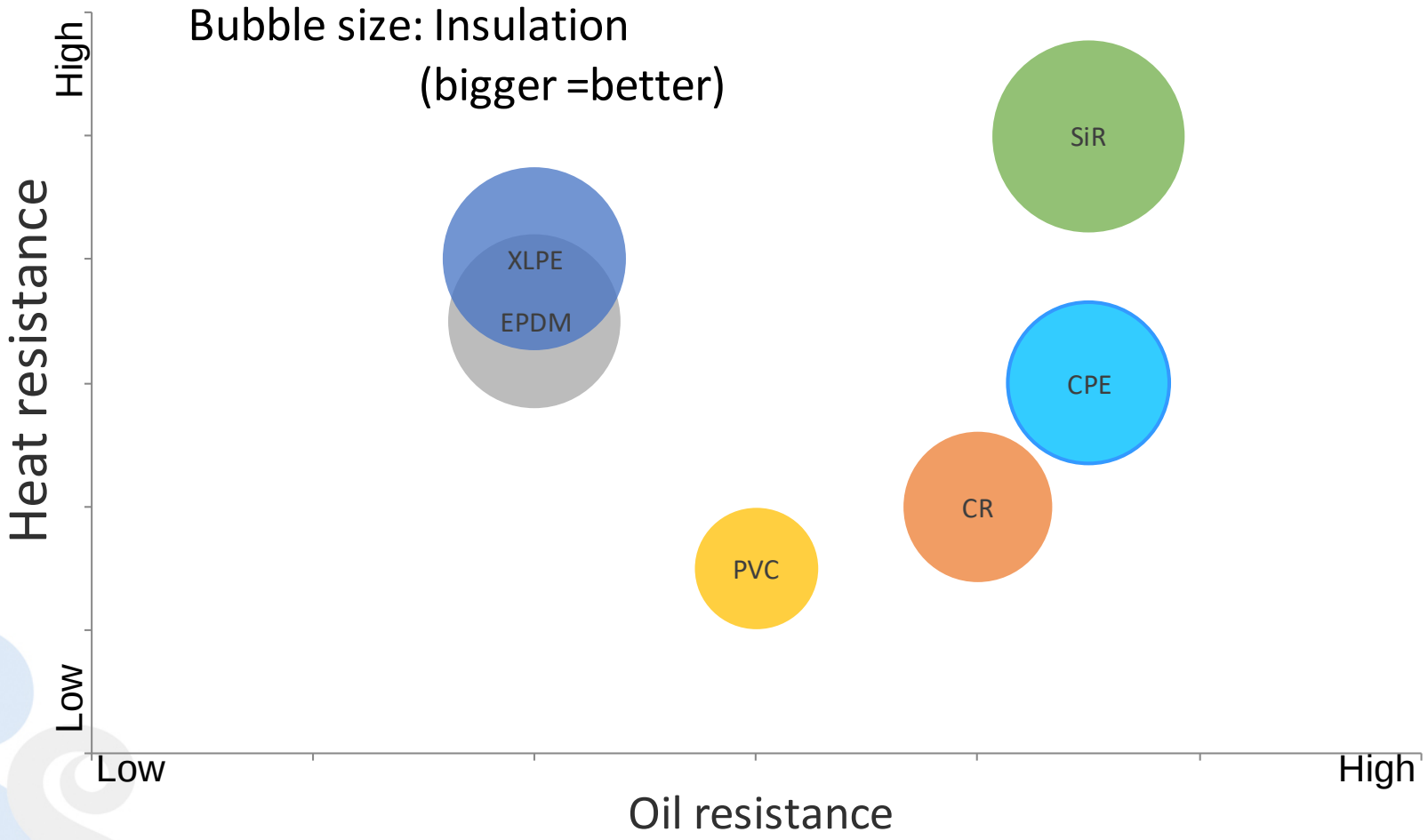
✓ CPE has high oil resistance and good heat resistance



Advantage of Elaslen™ -Metallic Analysis-

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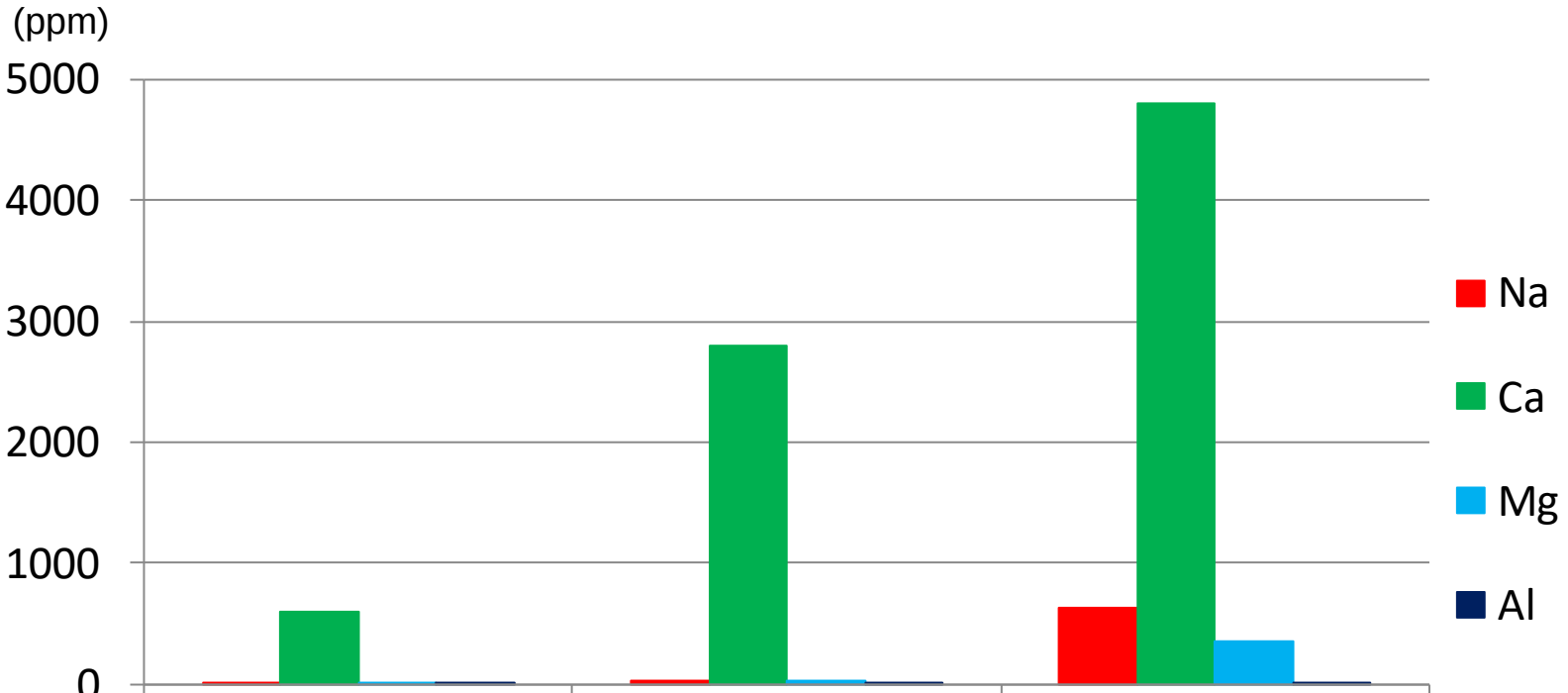
✓ Sodium content in ELASLEN specialty grades is greatly low



	ELASLEN Specialty	ELASLEN Standard	Other
Na	2	29	630
Ca	600	2800	4800
Mg	18	31	360
Al	15	15	16

Advantage of Elaslen™ -Insulation Properties-

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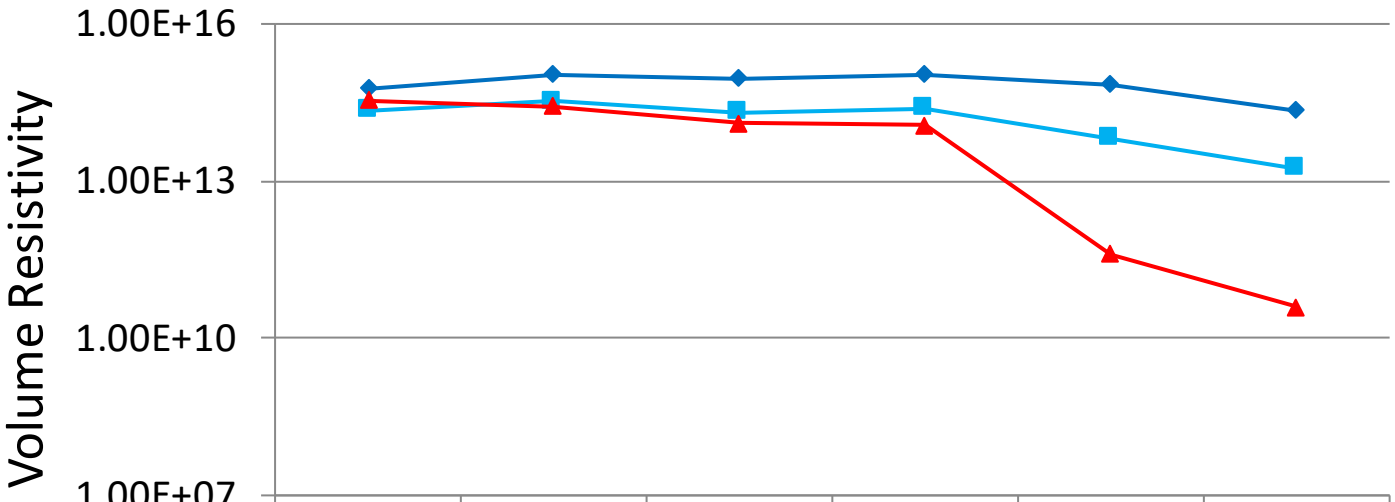
Elaslen grades keep high insulation properties after immersion

⇒Suitable for electric wire soaked in water (e.g. ship, submarine cable…)

Formulation

Ingredient	phr
CPE	**80**
EVA	20
Stabilizer	22
Flame Retardant	55
Plasticizer	15
Antioxidant	3
Others	20
TOTAL	215

Test Method : Immersion in 75℃ hot water × 0 ~ 2100Hr (500V)



	0 hr	168 hr	336hr	504hr	1344hr	2100hr
ELASLEN Specialty	6.10E+14	1.10E+15	9.20E+14	1.10E+15	7.20E+14	2.30E+14
ELASLEN Standard	2.30E+14	3.40E+14	2.10E+14	2.50E+14	6.50E+13	1.80E+13
Other	3.60E+14	2.70E+14	1.30E+14	1.20E+14	4.10E+11	3.90E+10

Advantage of Elaslen™ -Surface After Immersion-

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ELASLEN specialty grades do not experience ingredient-bloom issue

- ✓ Good appearance
- ✓ No migration
- ✓ Less accident of firing or discharge

Formulation

Ingredient	phr
CPE	**80**
EVA	20
Stabilizer	22
Flame Retardant	55
Plasticizer	15
Antioxidant	3
Others	20
TOTAL	215

Test Method : Immersion in 75℃ sea water for 750Hr

ELASLEN Specialty grades
No Bloom

Others
White Powder Bloom

Advantage of Elaslen™ -blend with PVC-

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ELASLEN is used as a modifier for semi-rigid PVC wire harness.

- ✓ Improve low temperature properties (Brittle Temp. etc.)
- ✓ Reduce the amount of plasticizer and prevent its bleeding

	#1	#2	#3
PVC (p=1300)	100	100	100
Stabilizer	5	5	5
Plasticizer (TOTM)	20	25	20
ELASLEN 401AY			**10**

Physical Properties

Good!

Brittle Temp.	Celsius degree	22	13	-22
Hardness (Durometer D)	-	80	78	78
Specific Gravity	-	1.34	1.32	1.32
Yield Strength	MPa	55	35	40
Tensile Strength	MPa	27	34	24
Elongation	%	120	240	160

Standard Formulation 1/7 -General-

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for crosslinked rubber wire & cable

Standard formulation

Ingredients	Details	Parts
Elaslen(CPE)	Chlorine Content 34～40wt%	50 ~ 100
Polymer Blended	EPDM, EVA etc	0 ~ 50
Inorganic filler	Talc, Clay etc	30 ~ 100
Flame Retardant aid	$Al(OH)_3$,$Mg(OH)_2$	20 ~ 100
Inorganic FR	Sb_2O_3 (Antimony trioxide)	3 ~ 8
Organic FR	Chlorinated paraffin	2 ~ 5
Plasticizer	Esters (DOP,DIDP,TOTM,etc)	10 ~ 35
Stabilizer	Magnesium oxide, Hydrotalcite	5 ~ 10
Antioxidant	Thioethers, Hindered phenols	0.3 ~ 1.5
Lubricant	Fatty acids,Fatty acid amides	0.2 ~ 1.0
Crosslinking co-agent	TAIC, TAC	1.5 ~ 3.0
Crosslinking agent	Peroxide	1.5 ~ 3.0

***Zinc and red iron oxide should not be used in this formulation.**

Physical properties

Test items	Unit	Measurements
Mooney viscosity(ML100℃$_{1+4}$)	Point	30 ~ 55
Scorch time (ML125℃$_{1+4}$)	min	10 ~ 30
Tensile strength	Mpa	100 ~ 180
Elongation	%	＞300
Hardness(JIS-A)	Point	65 ~ 85
Heat aging resistance 100℃×96Hr～150℃×96Hr		
Tensile strength retention	%	＞ 80
Elongation retention	%	＞ 80
Change in hardness	Point	＜+10
Oil resistance tested with ASTM No.2 20℃×18Hr		
Tensile strength retention	%	＞ 80
Elongation retention	%	＞ 80
Change in hardness	Point	＜+10
Oxygen index	Point	25 ~ 30
Volume resistivity	Ω･cm	5xE13~8xE14
Specific gravity		1.2 ~ 1.6

Standard Formulation 2/7 -Vehicle Cable-

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✓ High mechanical strength and heat resistance

Standard formulation		
Ingredients	**Details**	**Parts**
CPE: Elaslen 401AY	Chlorine Content 40wt%	**32**
CPE: Elaslen 402NA	Chlorine Content 40wt%	**8**
EVA		**40**
EPDM		**20**
Inorganic filler	Talc	**26**
Inorganic FR	Antimony Trioxide	**8**
Stabilizer	Magnesium oxide Hydrotalcite	**4**
	Antioxidants	**1.5**
	Epoxy Plasticizers	**2**
Lubricant	Fatty acid amides	**1**
Crosslinking agent	Peroxide	**1.5**
Crosslinking co-agent	Taic	**1.2**
Carbon Black	HAF Carbon	**3**

Physical properties		
Test items	Unit	**Measurements**
Tensile strength	MPa	**22.0**
100% Modulas	MPa	**6.0**
Elongation	%	**325**
Hardness(JIS-A)	Point	**85**
Heat aging resistance 150℃×96Hr		
Tensile strength retention	%	**90**
Elongation retention	%	**90**
Change in hardness	Point	**+2**
Oxygen Index	Point	**27**
Volume resistivity(500V,23℃)	Ω･cm	**1.0×E14**

***Zinc and red iron oxide should not be used in this formulation.**

Standard Formulation 3/7 -Portable cord-

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✓ Flexibility and heat resistance

Standard formulation		
Ingredients	**Details**	**Parts**
CPE: Elaslen 401AY	Chlorine Content 40wt%	**70**
EPDM		**30**
Plasticizer	TOTM	**20**
Inorganic filler	Talc	**65**
Inorganic FR	Antimony Trioxide	**8**
Stabilizer	Hydrotalcite	**10**
	Metal Oxide	**8**
	Antioxidants	**3**
Lubricant	Fatty acid amides	**2**
Crosslinking agent	Peroxide	**6**
Crosslinking co-agent	Taic	**3**
Carbon Black	HAF Carbon	**5**

Physical properties		
Test items	Unit	**Measurements**
Tensile strength	MPa	**16.2**
100% Modulas	MPa	**3.0**
Elongation	%	**540**
Hardness(JIS-A)	Point	**70**
Heat aging resistance 150℃×96Hr		
Tensile strength retention	%	**100**
Elongation retention	%	**85**
Change in hardness	Point	**+10**
Oxygen Index	Point	**28**
Volume resistivity(500V,23℃)	Ω·cm	**1.0×E13**

***Zinc and red iron oxide should not be used in this formulation.**

Standard Formulation 4/7 -Transit/Industrial Cable-

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✓ High heat resistance & insulation after water immersion

Standard formulation		
Ingredients	**Details**	**Parts**
CPE: Elaslen 202KB	Chlorine Content 23wt%	**50**
EVA		**50**
Inorganic filler	Talc	**26**
Inorganic FR	Antimony Trioxide	**10**
Stabilizer	Hydrotalcite, Metal Oxide	**15**
	Antioxidants	**4**
Lubricant	Fatty acid amides	**1**
Crosslinking agent	Peroxide	**1.5**
Crosslinking co-agent	Taic	**2**
Carbon Black	HAF Carbon	**3**

Physical properties		
Test items	Unit	**Measurements**
Tensile strength	MPa	**15.0**
100% Modulas	MPa	**7.4**
Elongation	%	**570**
Hardness(JIS-A)	Point	**91**
Heat aging resistance 150℃×96Hr		
Tensile strength retention	%	**91**
Elongation retention	%	**87**
Change in hardness	Point	**+1**
Oxygen Index	Point	**24**
Volume resistivity(500V,23℃)	Ω･cm	**2.0×E14**

*Zinc and red iron oxide should not be used in this formulation.

Standard Formulation 5/7 -Transit/Industrial Cable2-

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✓ High flame-retardant & oil resistance

Standard formulation		
Ingredients	**Details**	**Parts**
CPE: Elaslen 402B	Chlorine Content 40wt%	**70**
EVA	VA contents 25%	**30**
Inorganic filler	Clay	**25**
Inorganic FR	Sb_2O_3 (Antimony trioxide)	**8**
Stabilizer	Hydrotalcite	**5**
Lubricant	Fatty acid amides	**0.3**
Antioxidant	Hindered phenols	**0.5**
Crosslinking co-agent	TAIC	**1.5**
Crosslinking agent	Peroxide:1min half-valued period 175 ~ 185℃	**3**
Carbon Black	HAF Carbon	**3**

***Zinc and red iron oxide should not be used in this formulation.**

Physical properties		
Test items	Unit	**Measurements**
Tensile strength	Mpa	**19.0**
100% Modulas	Mpa	**7.0**
Elongation	%	**400**
Hardness(JIS-A)	Point	**87**
Heat aging resistance 150℃×96Hr		
Tensile strength retention	%	**90**
Elongation retention	%	**90**
Change in hardness	Point	**+3**
0il resistance (ASTM No2oil 70℃×4Hr)		
Tensile strength retention	%	**97**
Elongation retention	%	**97**
Change in hardness	Point	**-7**
Oxygen Index	-	**30**
Volume resistivity(500V,23℃)	Ω･cm	**2.0×E14**

Standard Formulation 6/7 -Telecommunication Cable-

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- ✓ For flame retardant thermoplastic cable
- ✓ Non crosslinked PE

Standard formulation		
Ingredients	**Details**	**Parts**
CPE: Elaslen 202KB	Chlorine Content 23wt%	**40**
HDPE	MFR = 0.3	**30**
LLDPE	MFR = 15	**30**
Inorganic FR	Magnesium Hydroxide	**50**
Stabilizer	Hydrotalcite, Metal Oxide	**4**
	Antioxidants	**0.5**
Lubricant	Magnesium stearate	**0.5**
Carbon	HAF	**1.0**
Antimony Trioxide	Taic	**10**
Br-Flame Retardant	FG#3100	**25**

Physical properties		
Test item	Unit	**Measurements**
Yield strength	MPa	**12.7**
Tensile Strength	MPa	**15.4**
Elongation	%	**580**
Hardness(JIS-A)	Point	**98**
Electrical Properties		
Volume resistivity(500V, 23℃)	Ω·cm	**2.0×E14**
Dielectric Strength(JIS C3005)	KV/mm	**19.3**
Arc-resistance(JIS C3005)	sec	**120**
Brittle Temperature	℃	**-10**
Oxygen Index	—	**33.5**

***Zinc and red iron oxide should not be used in this formulation.**

Standard Formulation 7/7 -Telecommunication Cable2-

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✓For flame retardant PVC cable

Standard formulation		
Ingredients	**Details**	**Parts**
PVC	P = 1450	**100**
CPE: Elaslen 401AY	Chlorine Content 40wt%	**10**
Inorganic filler	Calcined Clay	**10**
	Talc	**10**
Stabilizer	Hydrotalcite	**5**
Antioxidant	DLTDP	**0.5**
Lubricant	Calsium Stearate	**0.5**
Plasticizer	TOTM	**47**
Inorganic FR	Sb_2O_3 (Antimony trioxide)	**10**

Physical properties		
Test items	Unit	**Measurements**
Tensile strength	Mpa	**24**
100% Modulas	Mpa	**16**
Elongation	%	**320**
Hardness(JIS-A)	Point	**87**
Heat aging resistance 136℃×7days		
Tensile strength retention	%	**95**
Elongation retention	%	**93**
Change in Weight	%	**-2.2**
0il resistance (ASTM No2oil 120℃×8Hr)		
Tensile strength retention	%	**98**
Elongation retention	%	**52**
Volume resistivity (500V)		
23℃	Ω･cm	**2.0×E15**
80℃		**8.0×E12**

***Zinc and red iron oxide should not be used in this formulation.**

Instruction of Elaslen™ handling

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- ✓ Elaslen is powder form elastomer.
- ✓ Sheeted package is also available for easier handling.

Notice for Creating Formulation

- Elaslen is chlorinated elastomer. You have to put stabilizer(acid acceptor, anti-aging agent) to prevent dehydrochlorination.
- Choose crosslinker depends on molding and crosslinking method; type of molding machine or vulcanizing temperature.
- Don’t add heavy metal compounds like Iron or Zinc that accelerates degradation.

Notice for Processing (Mixing and Molding)

- We recommend to use rubber kneader(pressurized kneader or banbury mixer) for mixing. Use mixer equipped to elevate temperature when blending Elaslen™ and Polyethylene resin.
- Since this is powder form, mind not to contaminate compound with it and clean inside of blending and molding machine after production.
- Knead polymers first if you blend Elaslen™ with them for production efficiency.

Note

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*The information provided herein is believed to be reliable but no representations, guarantees or warranties of any kinds are made as to its accuracy, suitability for particular applications or the results to be obtained therefrom.

Contact

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