

Chlorinated polyethylene 「ELASLEN™」

SHOWA
DENKO

Application for Wire and Cable



About the company



Company Name	:	SHOWA DENKO K.K.	
Type of Industry	:	Diversified Chemical Company	
Formed	:	June 1, 1939	
Employee	:	10,577 (in December 31, 2014)	
Capital	:	141 billion JPY (as of December 31, 2014) *1.0 billion Euro, 1.2 billion US\$	
Net Sales	:	878 billion JPY (in 2014) *6.5 billion Euro, 7.6 billion US\$	
Business Sectors	:	Petrochemicals, <u>Chemicals</u> , Inorganic Materials, Aluminum, Electronics	

Our CPE Business

Product Name	:	ELASLEN™
Chemical Name	:	Chlorinated Polyethylene
HS Code Number	:	3901.90.10
Start of Sales	:	Oct. 1968
Production Capacity	:	5000MT/Y
Quality Control Program	:	ISO 9001
Environmental Control Program	:	ISO 14001



Global Locations

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



What is ELASLEN™ ?

- ELASLEN is the product name of our Chlorinated Polyethylene.
- ELASLEN is a thermoplastic polymer, manufactured by chlorinating high density polyethylene.
- ELASLEN has excellent flexibility, weatherability, heat aging resistance, flame retardancy and chemical resistance.



**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

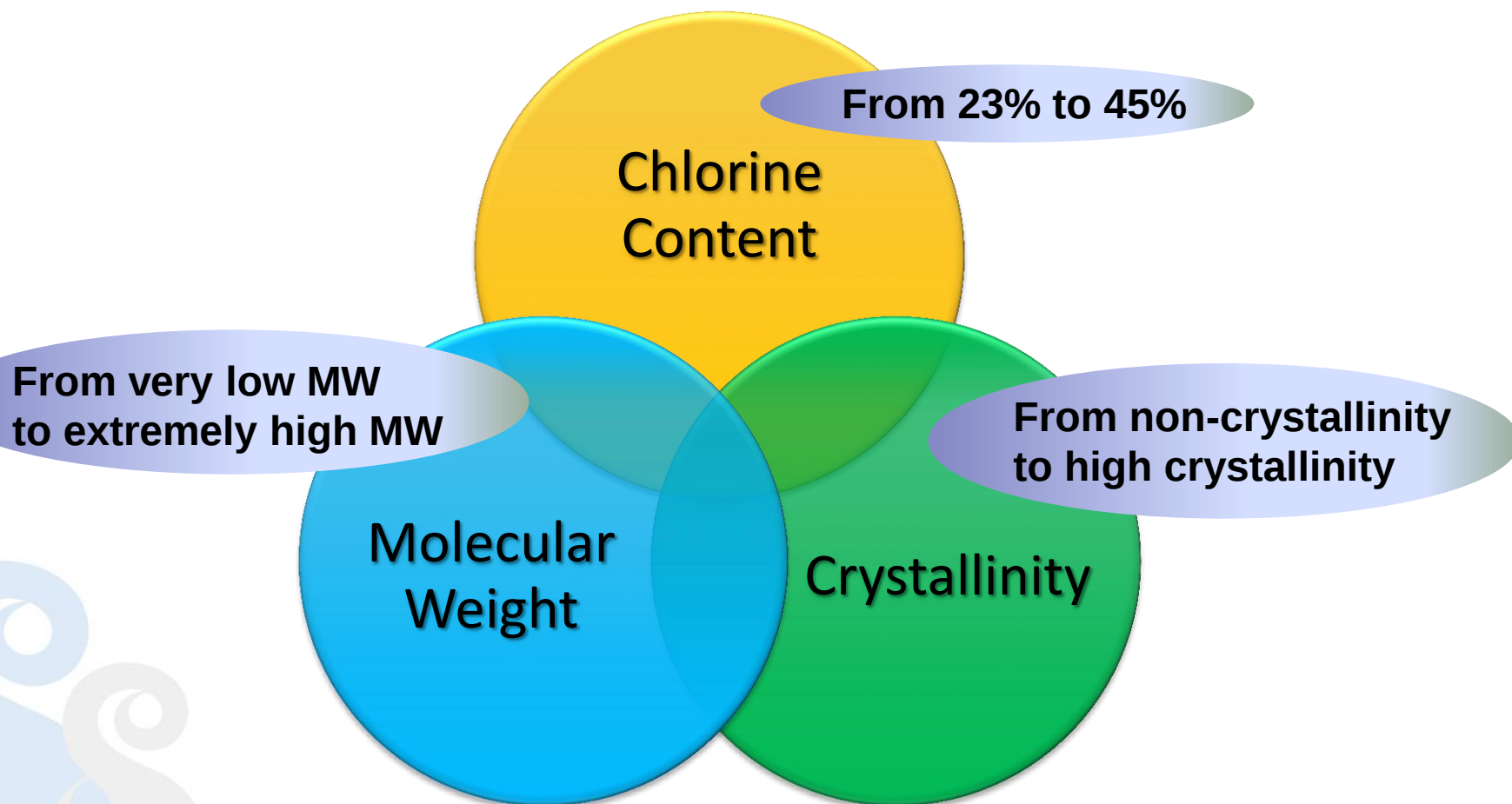


Comparison with Other Rubbers

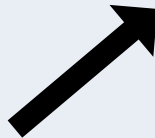
Item	CPE	CSM	CR	EPDM	NBR
Flame Retardancy	Excellent	Good	Good	Poor	Poor
Oil Resistance	Excellent	Good	Good	Poor	Excellent
Ozone Resistance	Excellent	Excellent	Fair	Excellent	Poor
Weather Resistance	Excellent	Excellent	Fair	Excellent	Poor
Heat Resistance	Good	Good	Fair	Excellent	Fair
Electrical Insulation	Excellent	Good	Fair	Excellent	Fair
Coloring	Excellent	Excellent	Poor	Fair	Poor

A Wide Variety of Grades

We can produce any custom-made grade by adjusting these 3 factors

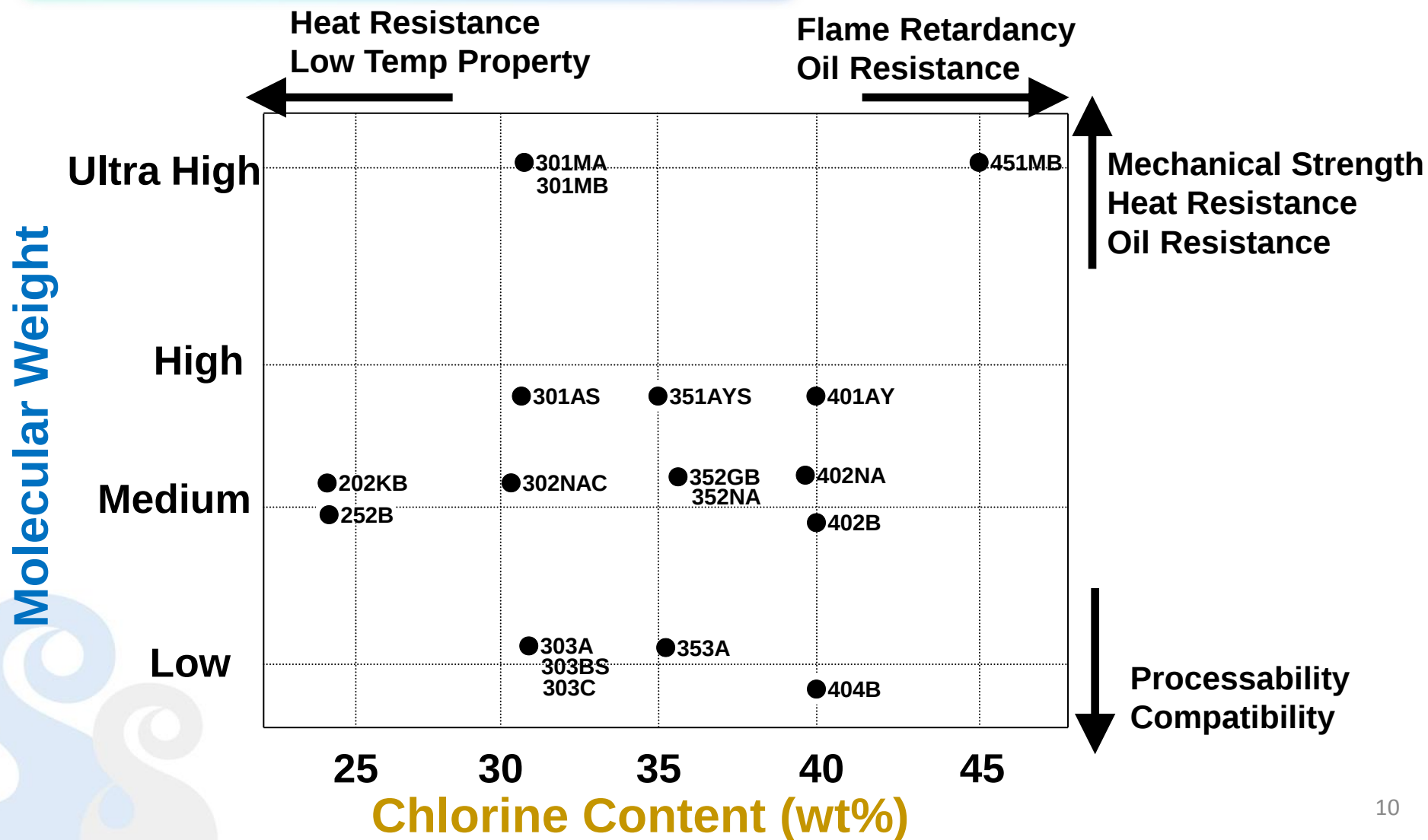


Three Factors of ELASLEN™

	Flame retardancy	Chemical resistance	Mechanical strength	Heat aging resistance
Chlorine Content 				
Molecular Weight 				
Crystallinity 				

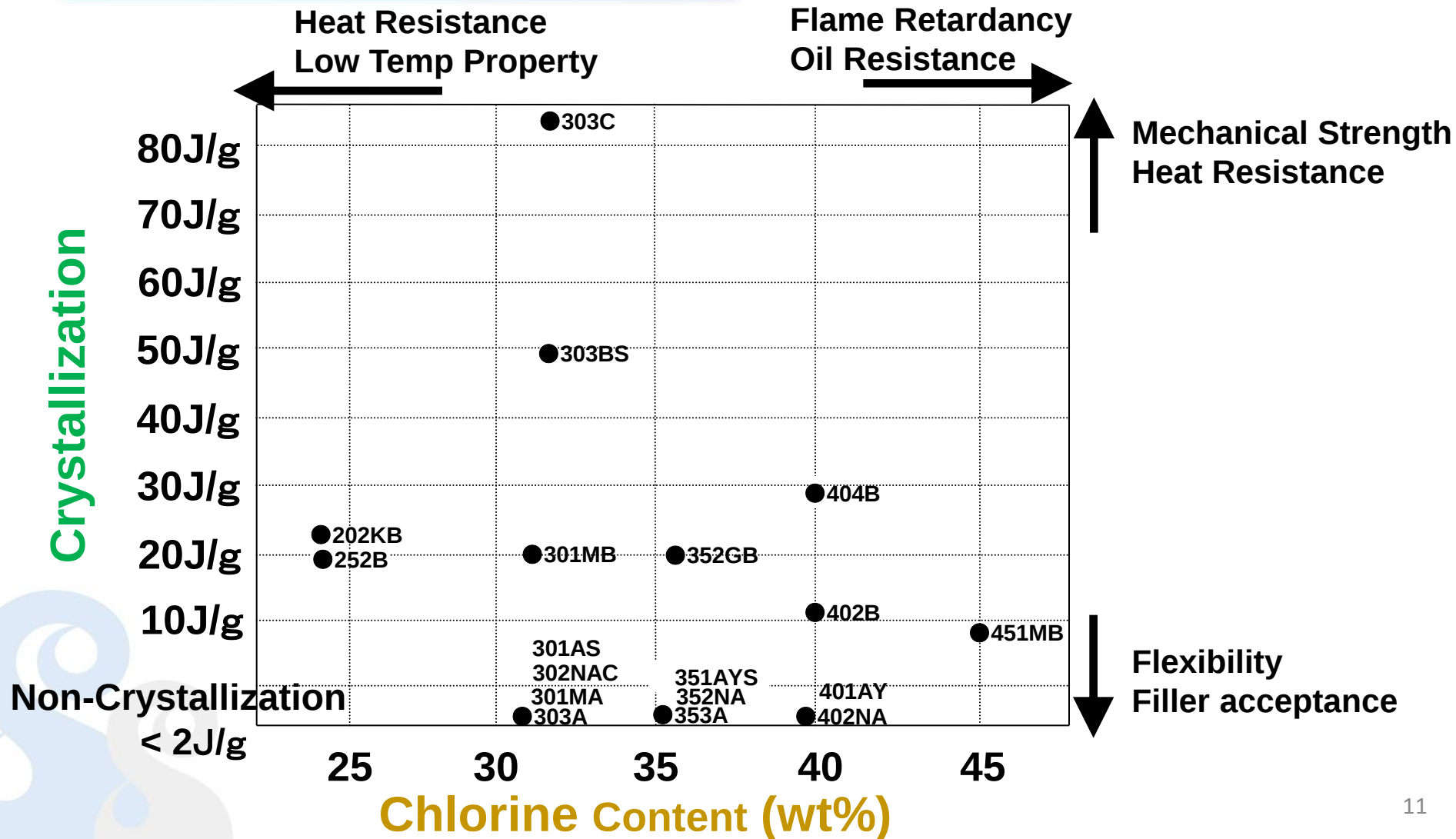
Grade Map of ELASLEN™

Chlorine content vs Molecular Weight



Grade Map of ELASLEN™

Chlorine content vs Crystallization



Grade List of ELASLEN™

Non Crystallinity

Standard

Items	Unit	Test Method	301MA	301AS	351AYS	401AY	302NAC	352NA	402NA	303A	353A
Chlorine content	%	SDK method	32	31	35	40	28	35	40	31	35
Crystallinity	J/g	SDK method	<2	<2	<2	<2	<2	<2	<2	<2	<2
Specific Gravity	-	JIS K7112	1.12	1.12	1.16	1.20	1.11	1.15	1.20	1.12	1.16
Melt Flow Rate(*)	g/10min	JIS K7210	0.1	1.7	1.8	1.6	12	9	8	120	65
Mooney Viscosity	ML1+4(121°C)	JIS K6300	-	85	90	105	45	55	65	20	20
Tensile Strength	Mpa	JIS K6251	11.8	11.1	10.5	9.9	9.8	7.8	6.9	6.9	5.2
Elongation	%	JIS K6251	900	950	1000	800	1100	950	700	800	1200
100% Modulus	Mpa	JIS K6251	1.0	1.0	0.9	0.9	1.1	0.8	0.9	1.5	0.8
Brittle Temp	°C	JIS K6261	<-70	<-70	<-70	<-70	<-70	-65	-55	<-70	<-70
Hardness	JIS-A	JIS K6253	60	58	56	58	58	54	58	60	50
Volume Resistivity	Ω-cm	ASTM D257	2×10 ¹⁵	3×10 ¹⁵	2×10 ¹⁵	1×10 ¹⁵	3×10 ¹⁵	2×10 ¹⁵	1×10 ¹⁵	3×10 ¹⁵	2×10 ¹⁵

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

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

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

Grade List of ELASLEN™

Semi Crystallinity

Standard

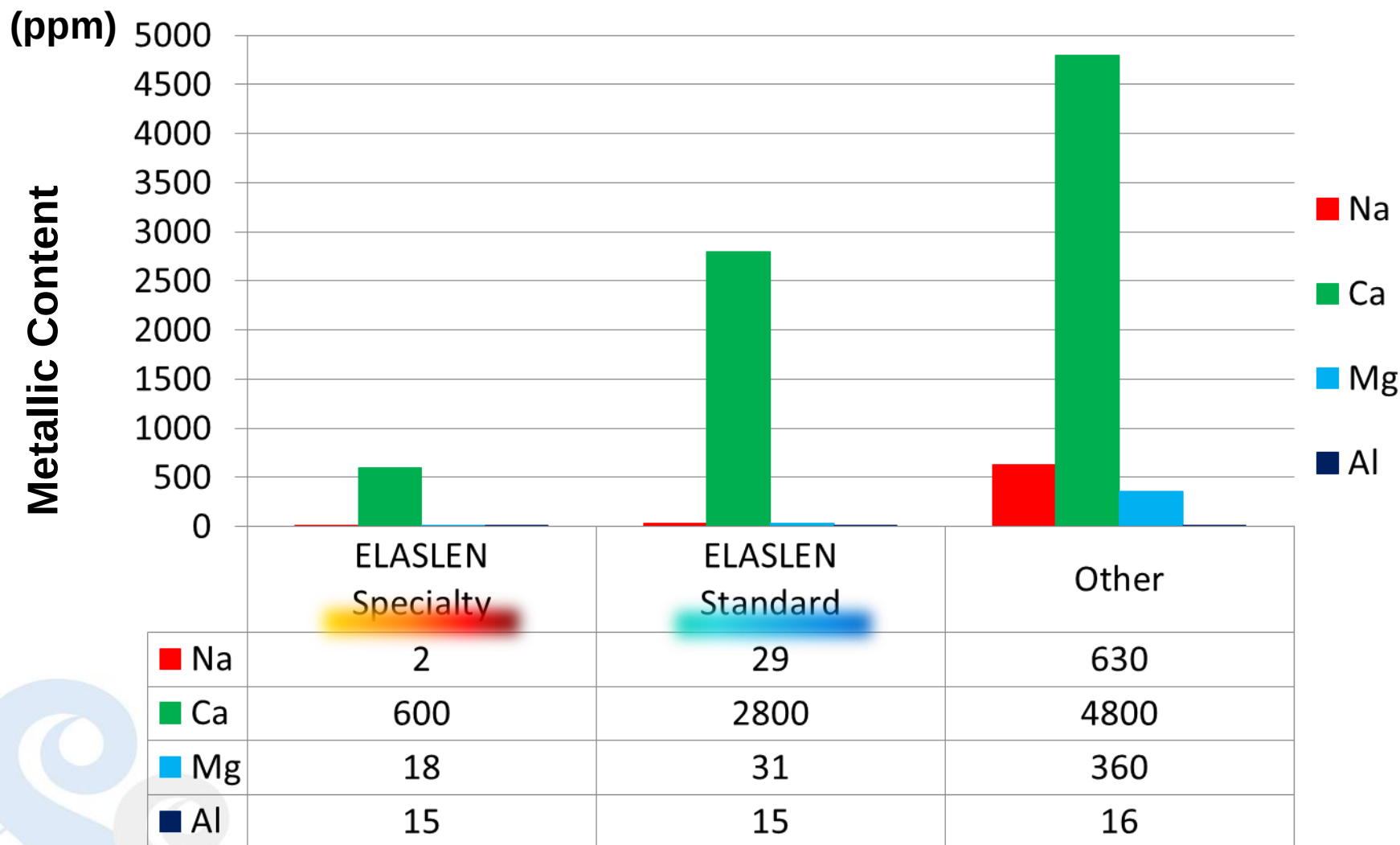
Items	Unit	Test Method	252B	303BS	303C	301MB	352GB	404B	451MB	202KB	402B
Chlorine content	%	SDK method	23	32	31	30	35	40	45	23	40
Crystallinity	J/g	SDK method	20	50	84	20	20	29	7	23	10
Specific Gravity	-	JIS K7112	1.07	1.12	1.15	1.14	1.18	1.20	1.27	1.07	1.21
Melt Flow Rate(*)	g/10min	JIS K7210	3	25	20	0.1	0.8	25	0.1	8	1.2
Mooney Viscosity	ML1+4(121°C)	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% Modulus	Mpa	JIS K6251	3.1	2.9	10.0	3.9	2.5	2.5	9.0	3.8	2.5
Brittle Temp	°C	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°C 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									

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Metallic Analysis



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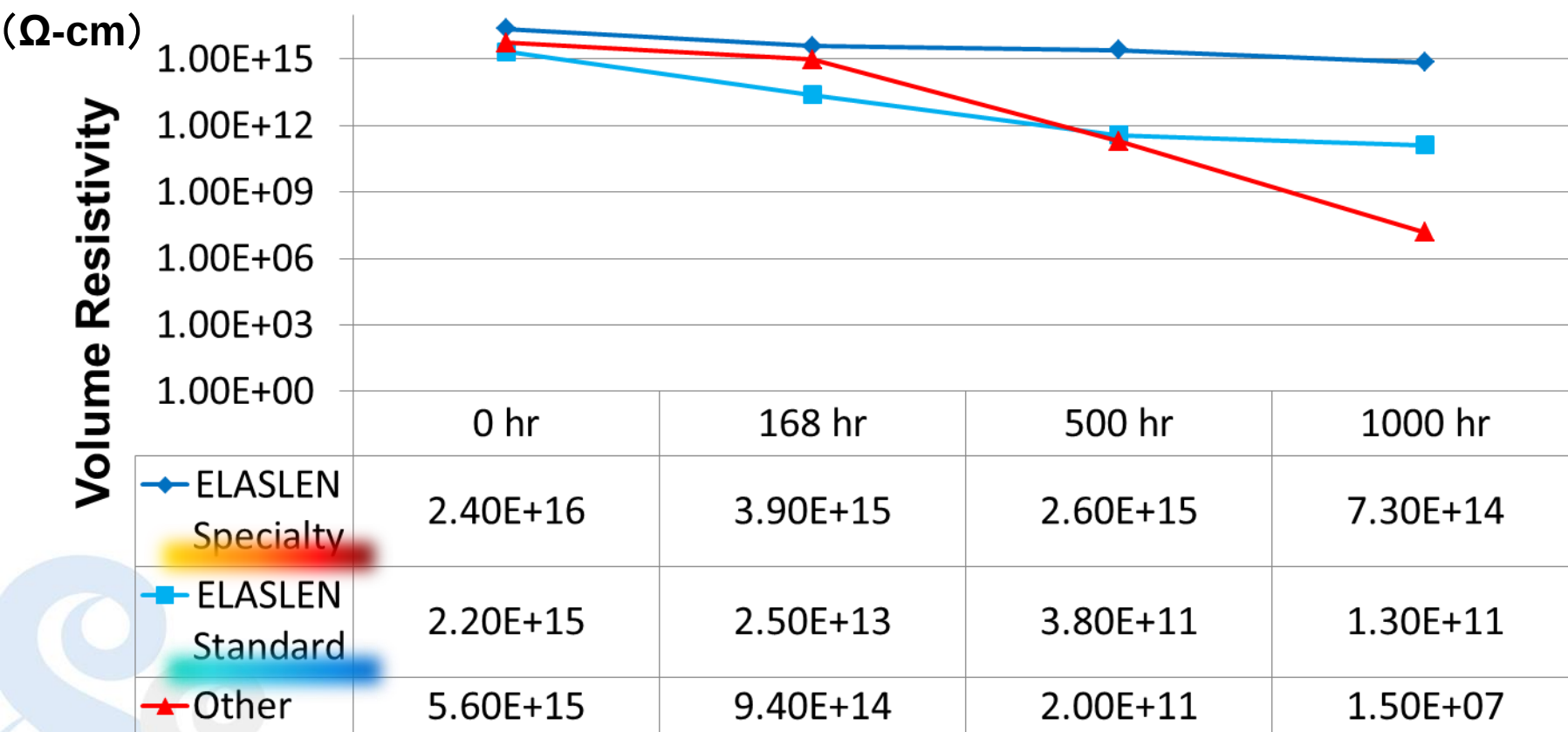
Insulation Properties

Formulation : CPE

Tribasic lead sulphate

100phr
2phr

Test Method : Immersion in 75°C hot water × 0 ~ 1000Hr (500V)



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Application for Wire Harness

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

To improve low temperature properties (Brittle Temp. etc.)

To reduce the amount of plasticizer and prevent bleeding of it

Formulation

	A	B	C
PVC (p=1300)	100	100	100
Stabilizer	5	5	5
Plasticizer (TOTM)	20	25	20
ELASLEN 401AY	10		

Physical Properties

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

ELASLEN has been used for these various wire & cable application

- (1) Rubber wire & cable jacketing requiring oil & heat resistance and flame retardancy
- (2) Insulated (Crosslinked) polyethylene wire & cable jacketing requiring flame retardancy and electrical properties

Application	Composition	Elaslen Grade	Polymer Blended	Requirements for Elaslen
Transportation cable	Insulation : EPDM /Jacket : CPE	401AY, 402B	EPDM	FR, Oil resistance, Flexibility
Vehicle cable	Insulation : LDPE /Jacket : CPE	404B, 202KB, 402B	LDPE	FR, Chemical resistance, Flexibility
Industrial power cable	Single Layer with CPE	401AY, 402NA, 351AYS	EPDM, EVA	FR, Oil resistance, Flexibility
Portable cord	Single Layer with CPE	401AY, 402NA, 351AYS	EPDM, EVA	FR, Heat resistance, Flexibility
Plug cord(for automobile)	Single Layer with CPE	401AY, 402NA	EPDM, EVA	FR, Oil & heat resistance
Telecommunication cable	FR-PE Insulation(CPE Blended)	404B	LDPE, HDPE	FR, Flexibility
Telecommunication cable	PVC Insulation (CPE Blended)	401AY	PVC	Low temp Property, Plasticizer
Power cable/Semi-conductor	PE/CPE/Carbon	401AY	EVA	Strippability
Electronics wire	FR-XLPE Insulation(CPE Blended)	202KB, 303BS, 404B	EVA, LDPE	FR, Electrical property
PMMA optical fiber	Core :PMMA /Jacket :CPE(FR-PE)	404B, 303BS	LDPE	FR, Zero plasticizer

For crosslinked rubber wire & cable with ELASLEN

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 ₂ O ₃ (Antimony trioxide)	3~ 8
Organic FR	Chlorinated paraffin	2~ 5
Plasticizer	Esters (DOP,DIDP,TOTM,etc)	10~ 35
Stabilizer	Magnesium oxide,Hydrotalcite, Lead compounds,	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 formulation.		

Physical properties		
Test items	Unit	Measurements
Mooney viscosity(ML100°C ₁₊₄)	Point	30~ 55
Scorch time (ML125°C ₁₊₄)	min	10~ 30
Tensile strength	Mpa	100~180
Elongation	%	>300
Hardness(JIS-A)	Point	65~85
<u>Heat aging resistance 100°C×96Hr~150°C×96Hr</u>		
Tensile strength retention	%	> 80
Elongation retention	%	> 80
Change in hardness	Point	< +10
<u>Oil resistance tested with ASTM No.2 20°C×18Hr</u>		
Tensile strength retention	%	> 80
Elongation retention	%	> 80
Change in hardness	Point	< +10
Oxygen index	Point	25~30
Volume resistivity	Ω·cm	5×E13~8×E14
Specific gravity		1.2~1.6

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Starting Formulation

For 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	Hydrotalcite or Lead Stabilizers	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% Modulus	MPa	6.0
Elongation	%	325
Hardness(JIS-A)	Point	85
<u>Heat aging resistance 150°C×96Hr</u>		
Tensile strength retention	%	90
Elongation retention	%	90
Change in hardness	Point	+2
Oxygen Index	Point	27
Volume resistivity(500V,23°C)	Ω·cm	1.0×E14

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

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For flexibility & heat resistance (Portable Cord)

Standard formulation		
Ingredients	Details	Parts
CPE: Elaslen 401AY	Chlorine Content 40wt%	70
EPDM		30
Plasticizer		20
Inorganic filler	Talc	65
Inorganic FR	Antimony Trioxide	8
Stabilizer	Hydrotalcite or Lead Stabilizers	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% Modulus	MPa	3.0
Elongation	%	540
Hardness(JIS-A)	Point	70
<u>Heat aging resistance 150°C×96Hr</u>		
Tensile strength retention	%	100
Elongation retention	%	85
Change in hardness	Point	+10
Oxygen Index	Point	28
Volume resistivity(500V,23°C)	Ω·cm	1.0×E13

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For high heat resistance (Transit Cable)

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% Modulus	MPa	7.4
Elongation	%	570
Hardness(JIS-A)	Point	91
<u>Heat aging resistance 150°C×96Hr</u>		
Tensile strength retention	%	91
Elongation retention	%	87
Change in hardness	Point	+1
Oxygen Index	Point	24
Volume resistivity(500V,23°C)	Ω·cm	2.0×E14

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

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Starting Formulation

For 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 ₂ O ₃ (Antimony trioxide)	8
Stabilizer	Tribasic lead sulphate	5
//	Pb-st	0.3
Antioxidant	Hindered phenols	0.5
Crosslinking co-agent	TAIC	1.5
Crosslinking agent	Peroxide:1min half-valued period	3
	175 ~ 185°C	
Carbon Black	HAF Carbon	3

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

Physical properties		
Test items	Unit	Measurements
Tensile strength	Mpa	19.0
100% Modulus	Mpa	7.0
Elongation	%	400
Hardness(JIS-A)	Point	87
<u>Heat aging resistance 150°C×96Hr</u>		
Tensile strength retention	%	90
Elongation retention	%	90
Change in hardness	Point	+3
<u>Oil resistance (ASTM No2oil 70°C×4Hr)</u>		
Tensile strength retention	%	97
Elongation retention	%	97
Change in hardness	Point	-7
Oxygen Index	-	30
Volume resistivity(500V,23°C)	Ω·cm	2.0×E14

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