

# LG Chem Introduction of EVA(Ethylene Vinyl Acetate)

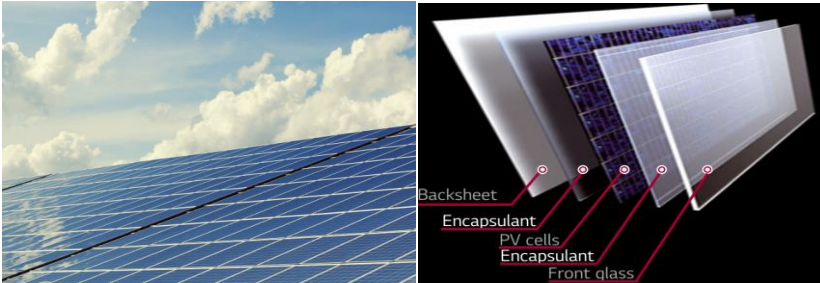


# Introduction

— LG Chem has developed family of high content vinyl acetate EVA copolymers, ranging up to 40%. Our high EVA products can be applied for the various applications, such as sheet for photovoltaic encapsulation, hot melt adhesive, foam for footwear soles.

## Main Applications

### Photovoltaic Encapsulant (PVEN)



### Hot Melt Adhesive (HMA)



### Footwear/Foam



### Wire & Cable



# Ethylene Vinyl Acetate Monomer

## Ethylene Vinyl Acetate (EVA)

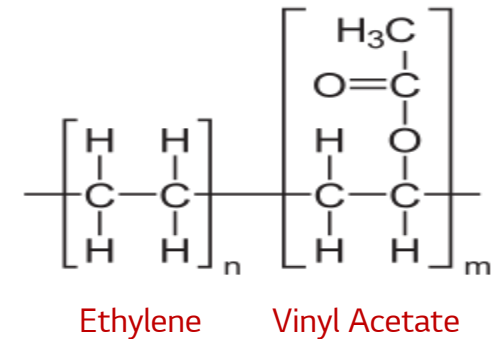
Ethylene vinyl acetate (also known as EVA) is the copolymer of ethylene and vinyl acetate. The weight percent vinyl acetate usually varies from 10 to 40%

### Characteristics of EVA

EVA is produced by copolymerization of ethylene and vinyl acetate.

With increasing proportion of the polar co-monomer VA, the products change from modified PE to rubber-like products.

- Density : 0.935 ~ 0.970 g/cc
- Melt index : 2 ~ 400



### Advantages of EVA

Compared with LDPE,

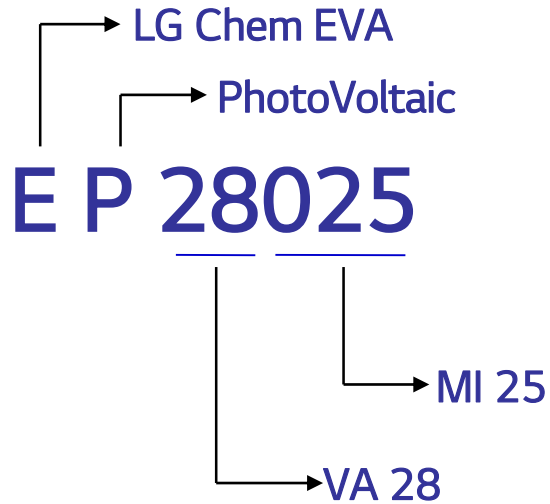
EVA is less crystalline and more polar due to the acetate groups.

- Optical clarity(Transparent)
- Coefficient of Friction
- More Flexible and Softer.
- Environment Stress Crack resistance

# Ethylene Vinyl Acetate Monomer



## Ethylene Vinyl Acetate (EVA)



.1<sup>st</sup> Character : LG Chem EVA

.2<sup>nd</sup> Character : Application

P : PhotoVoltaic, A : Hot Melt Adhesive,

C : Cable, S : Foam Compound

.3<sup>rd</sup> Figure : VA Contents

.4<sup>th</sup> Figure : Melt Index

### | PVEN |

Grade	VA %	Melt Index
EP28015	28	18
EP28025	28	25

### | W&C |

Grade	VA %	Melt Index
EC28003	28	3
EC28005	28	5
EC33018	28	3

### | HMA |

Grade	VA %	Melt Index
EA19150	19	150
EA19400	19	400
EA28015	28	18
EA28025	28	25
EA28150	28	150
EA28400	28	400
EA33045	33	45
EA33400	33	400
EA40055	40	55

### | Foam |

Grade	VA %	Melt Index
EC28003	28	3
ES28005	28	5
EA40055	40	55

# Certificate of Approvals for LG EVA

| Quality |

| Environment |

| Safety |

| Energy |



## CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

**LG Chem, Ltd.**  
**54, Dokgot 1-ro, Daesan-eup**  
**Seosan-si, Chungnam, Korea**

has been approved by Lloyd's Register Quality Assurance to the following Quality Management System Standards:

**ISO 9001:2008**

The Quality Management System is applicable to:

Manufacture of monomer products including ethylene, propylene, benzene, toluene, mixed xylene, butadiene, styrene monomer, ethylene glycol, methyl tertiary butyl ether, butene-1, vinyl chloride monomer, phenol, acetone, o-methyl styrene and bisphenol-A. Manufacture of polymer products including low density polyethylene, ethylene vinyl acetate, PE compound, linear low density polyethylene, polyolefin elastomer, high density polyethylene, polyethylene raised temperature, polypropylene and polyvinyl chloride. Manufacture of synthetic rubber products including butadiene rubber, acrylonitrile butadiene rubber, styrene butadiene rubber and solution styrene butadiene rubber.

Approval Certificate No: SE00929289 Original Approval: 21 December 1993  
 Current Certificate: 1 December 2014  
 Certificate Expiry: 30 November 2017

*Sanghaem 100*

Issued by: LRQA (Korea) Ltd. for and on behalf of Lloyd's Register Quality Assurance Limited



17th Floor, Singong Bldg. 67, Yeosuaru-ro, Yeongdeunggo-gu, Seoul, 150-923, Korea  
 For and on behalf of Singong Office Village, Sun Chok, Coventry, CV2 4EL, United Kingdom  
 The approval is issued on the condition that the LRQA certificate holder complies with the conditions of the Accreditation Certificate Number 001  
 The use of the UKAS Accreditation Mark indicates Accreditation in respect of those activities covered by the Accreditation Certificate Number 001



## CERTIFICATE OF APPROVAL

This is to certify that the Environmental Management System of:

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**Seosan-si, Chungnam, Korea**

has been approved by Lloyd's Register Quality Assurance to the following Environmental Management System Standard:

**ISO 14001:2004**

The Environmental Management System is applicable to:

Manufacture of monomer products including ethylene, propylene, BTX, butadiene, styrene monomer, ethylene glycol, methyl tertiary butyl ether, butene-1, vinyl chloride, phenol, acetone, bisphenol-A, alpha methyl styrene and polymer products including low density polyethylene, linear low density polyethylene, polyolefin elastomer, high density polyethylene, polyethylene raised temperature, polypropylene, PE compound, ethylene vinyl acetate and polyvinyl chloride, and synthetic rubber products including butadiene rubber, acrylonitrile butadiene rubber, styrene butadiene rubber and solution styrene butadiene rubber.

Approval Certificate No: SE00771506 Original Approval: 23 May 1997  
 Current Certificate: 1 June 2015  
 Certificate Expiry: 31 May 2018

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This is to certify that the Occupational Health & Safety Management System of:

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**54, Dokgot 1-ro, Daesan-eup, Seosan-si**  
**Chungnam, Korea**

has been approved by Lloyd's Register Quality Assurance to the following standard:

**OHSAS 18001:2007**

The Occupational Health & Safety Management System is applicable to:

Manufacture of monomer products including ethylene, propylene, benzene, toluene, mixed xylene, butadiene, styrene monomer, ethylene glycol, methyl tertiary butyl ether, butene-1, vinyl chloride monomer, phenol, acetone, o-methyl styrene and bisphenol-A. Manufacture of polymer products including low density polyethylene, ethylene vinyl acetate, PE compound, linear low density polyethylene, polyolefin elastomer, high density polyethylene, polyethylene raised temperature, polypropylene and polyvinyl chloride. Manufacture of synthetic rubber products including butadiene rubber, acrylonitrile butadiene rubber, styrene butadiene rubber and solution styrene butadiene rubber.

Approval Certificate No: SE0 6006332 Original Approval: 04 June 2010  
 Current Certificate: 04 June 2016  
 Certificate Expiry: 03 June 2019

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## MANAGEMENT SYSTEM CERTIFICATE

Site Certificate No: 166926CC2-2014-AE-KOR-RVA Initial certification date: 24 November 2014 Valid: 4 December 2015 - 24 November 2017  
 Main Certificate No: 166926-2014-AE-KOR-RVA

This is to certify that the management system of:

**LG Chem, Ltd. Daesan Complex**  
 Dokgot 1-ro 54, Seosan-si, Chungcheongnam-do, Korea

has been found to conform to the Energy Management System standard: **ISO 50001:2011**

This certificate is valid for the following scope:  
**Manufacture of monomer products including ethylene, propylene, benzene, toluene, mixed xylene, butadiene, styrene monomer, ethylene glycol, ethylene oxide, methyl tertiary butyl ether, butene-1, bisphenol A (BPA), acetone, phenol and vinyl chloride monomer, polymer products including low density polyethylene, ethylene vinyl acetate, linear low density polyethylene, wire & cable polyethylene, high density polyethylene, polypropylene and poly vinyl chloride, synthetic rubber products including butadiene rubber, solution styrene-butadiene rubber, acrylonitrile butadiene rubber and styrene butadiene rubber.**

Place and date: Barendrecht, 4 December 2015



For the issuing office:  
**DNV GL - Business Assurance**  
 Zuiderweg 1, 2994 CA, Barendrecht,  
 Netherlands  
 D.P. Nijek  
 Head of Business Assurance

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.  
 LIC0001701007-1001-D, Business Assurance B.V., PO Box 20010, 1100 CA, Amsterdam, The Netherlands, Tel: +31(0)202949110, www.dnvgl.com

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# EVA for PVEN

## Photovoltaic Encapsulants (PVEN)

The EVA encapsulants can be used as adhesion layers on glass or backsheet with cells inside the photovoltaic module. It delivers decades of service life with good transparency and adhesion property.

### | Performance |

- Low gel(=fish eye) level and strict contaminant control
- Uniform VA content and MI
- Excellent optical property
- Good adhesion property in the solar module

### | Strict Contaminant Control |

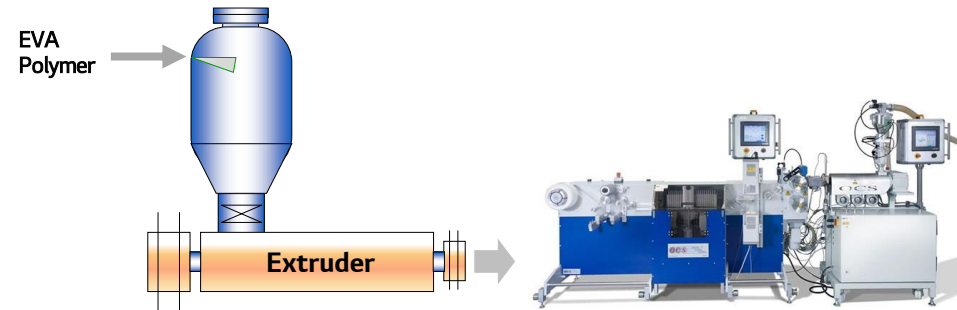
- EVA Bagging / Warehouse



### | Gel Analyzing |

#### 1<sup>st</sup> Gel Online analyzing

- EVA production team analyzes the gel of PVEN EVA film.

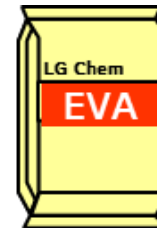


#### 2<sup>nd</sup> Gel Analyzing

- QA(Quality Assurance) team analyzes every 2 hour

#### 3<sup>rd</sup> Final Gel Analyzing

- QA team lastly checks the gel before bagging.



# EVA for HMA (Hot-Melt Adhesive)

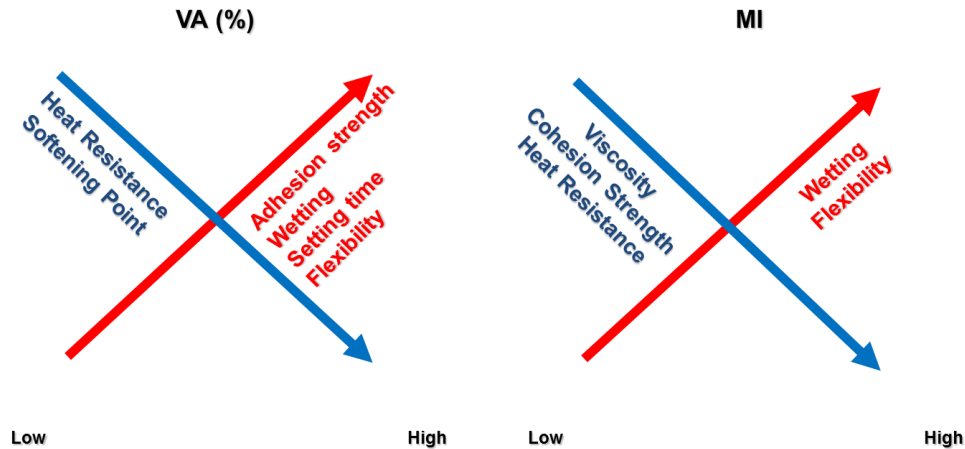
## Hot Melt Adhesive (HMA)

The EVA copolymers can be used as base polymer in the HMA product to control the viscosity, cohesive & adhesive strength and flexibility. High vinyl acetate content improves adhesion & flexibility and the speed of operation gets faster with higher MI. The main applications are packaging, wood veneering and bookbinding.

## Role of EVA Polymer in HMA

- Contributes strength and toughness
- EVA is colorless flexible solids (Stable thermoplastics)
- EVA exhibits miscibility in the melt with a wide range of tackifying Resin and waxes
  - : These attributes provide a wide range of formulating latitude to Produce customized adhesives

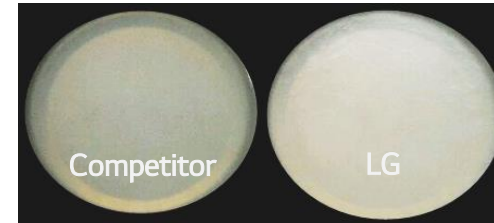
## Grade Selection Guide(HMA)



## Advantage of LG Chem EVA

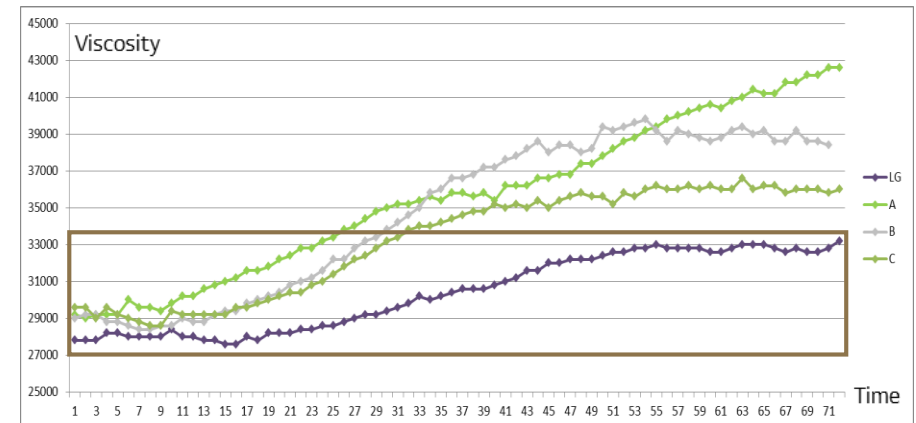
-LG Chem has a better Heat resistance & Viscosity stability to competitors.

### 1) Heat Resistance



(Condition : 180°C, 12hr)

### 2) Viscosity



(\* Condition : 180°C/72hr, spindle 27, 5RPM Brookfield Rheometer)

# EVA for W&C / Foam

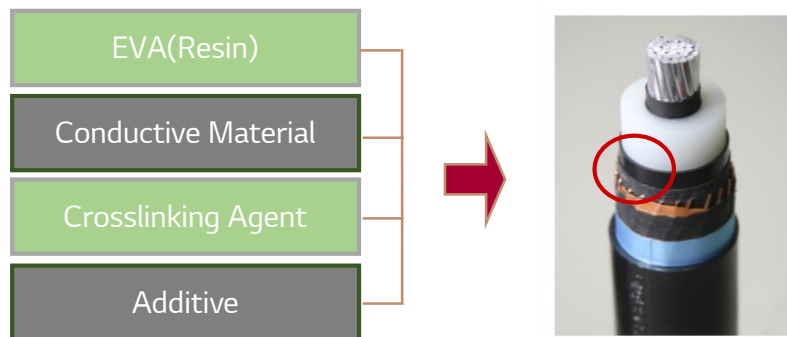
## Wire and Cable (W&C)

The use of EVA copolymers in crosslinked electrical applications can improve processability, the acceptance of higher filler loading, and heat resistance. The blends with applications in wire and cable industry are semi-conductive compounds, black jacket and halogen-free flame retardant (HFFR) formulations after blending with Polyolefins.

### | Role of Semiconductive layer |

- Constant Electric & Magnetic Field
- No Direct Contact (Metal/Material)

### | Consist of Semiconductive comp`d |



### | Advantage of LG Chem EVA |

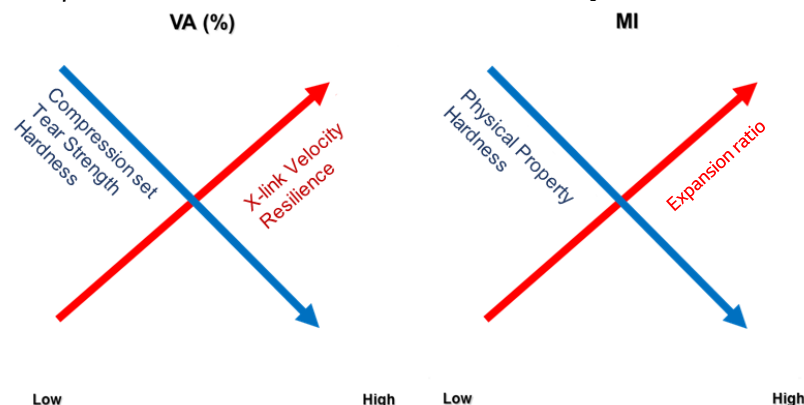
- Reduced Contamination
- Reduced Impurity
- High filler loading (carbon black, flame retardant agent)

## Foam

The EVA foam can offer the elastic nature with softness and resilience, that mainly depends on the high vinyl acetate contents. Ease of crosslinking also rises with increasing vinyl acetate content. The sole of athletic shoes, sponge shoes and many kinds of cushions are the major application for EVA foaming.

### | Performance |

- Excellent mechanical properties
- Strict contaminants control
- Uniform VA content and MI
- Development of new formulation with POE (Polyolefin elastomer)



### | Advantage of LG Chem EVA |

- Various Foam grade
- Excellent mechanical properties
- Strict contaminants control



# Typical Properties of EVA

| PVEN Grade |

Properties	Method (ASTM)	Unit	Value <sup>1)</sup>	
			EP28015	EP28025
<i>Resin Properties</i>				
VA Contents	LG Method	%	28	28
Melt Index	LG Method	g/10 min	18	25
Density	D1505	g/cm <sup>3</sup>	0.950	0.950
<i>Mechanical Properties<sup>2)</sup></i>				
Tensile Strength	D638	MPa	11.0	9.5
Elongation	D638	%	950	850
<i>Physical Properties</i>				
Hardness(Shore A)	D2240	-	78	76
<i>Thermal Properties</i>				
Melting Point	LG Method	°C	71	69

(1) The data in this table are considered as typical values, and not guaranteed specification from LG Chem

(2) Typical resin property values are measured on a standard compression molded specimens, Speed of 50mm/min

# Typical Properties of EVA

| HMA Grade |

Properties	Method (ASTM)	Unit	Value <sup>1)</sup>								
			EA19150	EA19400	EA28015	EA28025	EA28150	EA28400	EA33045	EA33400	EA40055
<i>Resin Properties</i>											
VA Contents	LG Method	%	19	19	28	28	28	28	33	33	40
Melt Index	LG Method	g/10 min	150	400	18	25	150	400	45	400	55
Density	D1505	g/cm <sup>3</sup>	0.940	0.939	0.950	0.951	0.946	0.945	0.960	0.955	0.967
<i>Mechanical Properties<sup>2)</sup></i>											
Tensile Strength	D638	MPa	7.0	5.0	13.0	9.5	4.5	2.0	4.5	1.5	4.8
Elongation	D638	%	800	850	900	850	900	900	950	1,000	1,350
<i>Physical Properties</i>											
Hardness (Shore A)	D2240	-	88	85	78	76	74	68	62	57	46
<i>Thermal Properties</i>											
Melting Point	LG Method	°C	80	78	71	69	70	68	62	60	53

(1) The data in this table are considered as typical values, and not guaranteed specification from LG Chem

(2) Typical resin property values are measured on a standard compression molded specimens, Speed of 50mm/min

# Typical Properties of EVA

| W&C, Foam Grade |

Properties	Method (ASTM)	Unit	Value <sup>1)</sup>			
			EC28003	EC28005 ES28005	EC33018	EA40055
<i>Resin Properties</i>						
VA Contents	LG Method	%	28	28	33	40
Melt Index	LG Method	g/10 min	3	5	18	55
Density	D1505	g/cm <sup>3</sup>	0.951	0.951	0.960	0.967
<i>Mechanical Properties<sup>2)</sup></i>						
Tensile Strength	D638	MPa	16.0	12.0	10.0	3.5
Elongation	D638	%	800	800	850	1,350
<i>Physical Properties</i>						
Hardness(Shore A)	D2240	-	80	78	76	46
<i>Thermal Properties</i>						
Melting Point	LG Method	°C	74	72	62	53

(1) The data in this table are considered as typical values, and not guaranteed specification from LG Chem

(2) Typical resin property values are measured on a standard compression molded specimens, Speed of 50mm/min

# Guide

## | Storage and Handling |

- 1) Avoid direct solar radiation, store in cool, dry and ventilated area
- 2) Keep away from the heat, spark, and flame
- 3) Do not inhale gas emitted from the heated resin
- 4) Direct contact with the melted resin may cause severe burns
- 5) The workshop floor should be kept clean in order to prevent accident associated with loose pellets or films
- 6) Avoid inhaling pellet or dust in packaging bags
- 7) Ensure the pellets and packaging bags are disposed or properly and in compliance with local/state regulations
- 8) Lifting of heavy bags can cause damage to your spine if not done correctly
- 9) Care should be taken to avoid accident when loading, unloading or stacking the product
- 10) This bag is strictly forbidden to use except for packaging purpose
- 11) Please refer to the material, safety data sheet(MSDS) for more details

## | MSDS |

- 1) Precautions for safe handling
  - Avoids direct physical contact / Comply with all applicable laws and regulations for handling
  - Do not handle until all safety precautions have been read and understood
  - Operators should wear antistatic footwear and clothing
- 2) Condition for safe storage, Including any incompatibilities
  - Check regularly for leaks / Do not use damaged containers
  - Do not apply direct heat / Save applicable laws and regulations
  - Avoid double-stack pallets to minimize the potential effect of static load.
  - The storage temperature is recommended at between 10~25°C (50~77°F).
  - Store the resin in the warehouse to protect from exposure to elevated temperatures, not to exceed 35 °C (95°F).
  - Consume the resins on a “first-in, first-out” basis.
  - Contact your LG Chem representative if you encounter any trouble.

