

# Functional Additives

for thermoplastic resins

**MODIPER<sup>®</sup> A series**

**MODIPER<sup>®</sup> C series**

Technical Data Sheets



**NOF CORPORATION**

## 1 Introduction

**MODIPER® A series** and **MODIPER® C series** are innovative type graft copolymers, consisting of polyolefin as a main-chain and polyvinyl as a branch polymer, which is exclusively manufactured by **NOF CORPORATION** utilizing grafting technology that originally developed by it. **MODIPER® A series** and **MODIPER® C series** can make it possible to improve the mechanical property, surface property, compatibility and other features of thermoplastic resins.

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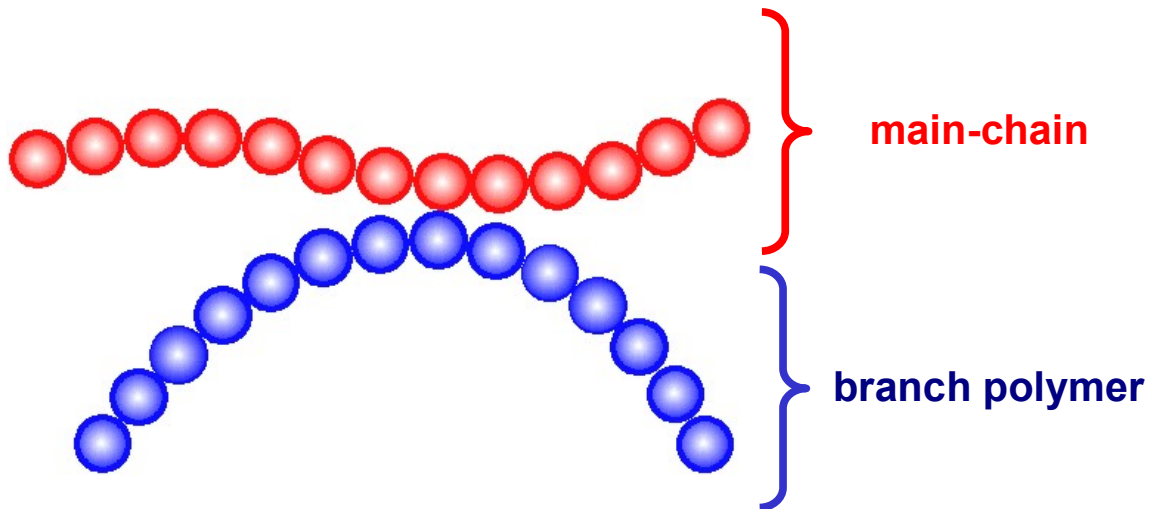


Figure 1 Structure of MODIPER<sup>®</sup> A series and MODIPER<sup>®</sup> C series

- MODIPER<sup>®</sup> A series are graft copolymers, consisting of polyolefin as a main-chain and polyvinyl as a branch polymer.
- MODIPER<sup>®</sup> C series are graft copolymers, consisting of polycarbonate as a main-chain and polyvinyl as a branch polymer.
- MODIPER<sup>®</sup> A series and MODIPER<sup>®</sup> C series can make it possible to improve the mechanical property, surface property, compatibility and others of thermoplastic resins by the addition of 1~10%.
- MODIPER<sup>®</sup> A series and MODIPER<sup>®</sup> C series are an additive with high molecular weight, so they can make it possible to keep the mechanical, thermal, molding properties of any resins. Furthermore, they do not also cause migration and evaporation from the resin.
- MODIPER<sup>®</sup> A series and MODIPER<sup>®</sup> C series are environmentally friendly and eco-friendly because they contain no halogen compounds.

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Table 1 Overview of **MODIPER® A series** and **MODIPER® C series**

Product name	Main chain polymer	Branch polymer	Appearance	CAS No.
<b>MODIPER® A1100</b>	PE	PS	White Pellet	106826-12-4
<b>MODIPER® A1401</b>		AS	Slight yellowish Pellet	106826-13-5
<b>MODIPER® A3400</b>	PP	AS	Slight yellowish Pellet	115180-57-9
<b>MODIPER® A4100</b>	EGMA	PS	White Pellet	117091-81-3
<b>MODIPER® A4300</b>		P(BA/MMA)	White Pellet	118497-17-9
<b>MODIPER® A4400</b>		AS	Slight yellowish Pellet	118497-09-9
<b>MODIPER® A5300</b>	EEA	P(BA/MMA)	White Pellet	118497-18-0
<b>MODIPER® A5400</b>		AS	Slight yellowish Pellet	118497-12-4
<b>MODIPER® CL130D</b>	PC	PS	White Pellet	1470303-78-6
<b>MODIPER® CL430-G</b>		P(GMA/AS)	White Pellet	103598-77-2

PE : Polyethylene  
 PP : Polypropylene  
 EGMA : Ethylene-Glycidyl Methacrylate copolymer  
 EEA : Ethylene-Ethyl Acrylate copolymer  
 PC : Polycarbonate  
 PS : Polystyrene  
 AS : Acrylonitrile-Styrene copolymer  
 P(BA/MMA) copolymer : Butyl Acrylate-Methyl Methacrylate  
 P(GMA/AS) : Glycidyl Methacrylate-Acrylonitrile-Styrene copolymer



Figure 2 Appearance of **MODIPER® A series**

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## 4 Basic Properties of MODIPER® A series and MODIPER® C series

Table 2 Basic properties of MODIPER® A series and MODIPER® C series

Test item			Test method	Unit	Product name of MODIPER®					
					A1100	A1401	A3400	A4100	A4300	A4400
Mechanical properties	Tensile	Strength	ISO 527-1 (JIS K 7161)	MPa	15	17	30	14	6	13
		Elongation		%	60	13	8	60	120	80
	Flexural	Strength	ISO 178 (JIS K 7171)	MPa	14	19	45	-	-	-
		Modulus		MPa	400	600	1700	-	-	-
	Izod impact(notched specimen)		ISO 180 (JIS K 7110)	kJ/m <sup>2</sup>	26	4.3	1.8	NB	NB	NB
MFR <sup>1)</sup>		ISO 1133 (JIS K 7210)	g/10 min	1.2	0.9	6	0.7	0.1	0.3	
Thermal properties	TGA <sup>2)</sup>	1% weight loss temperature	JIS K 7120	°C	337	306	302	308	282	291
		5% weight loss temperature			397	371	375	381	354	384
	DSC <sup>3)</sup>	Melting temperature	JIS K 7121	°C	111	110	165	97	98	100
	DMA <sup>4)</sup>	Glass temperature	ISO 6721 (JIS K 7244)	°C	85	90	110	0	0	-10

1)Melt Flow Rate(230°C: MODIPER®A3400、190°C: Others、2.16kgf)

2)Thermo Gravimetric Analysis[Rate of temperature rise: 10°C/min (in a nitrogen atmosphere)]

3)Differential Scanning Calorimetry[Rate of temperature rise: 10°C/min (in a nitrogen atmosphere)]

4)Dynamic Mechanical Analysis

[Mode: Tension mode, Frequency: 1Hz, Rate of temperature rise: 10°C/min (in a nitrogen atmosphere)]

JIS: Japan Industrial Standard method

Table 3 Basic properties of MODIPER® A series and MODIPER® C series

Test item			Test method	Unit	Product name of MODIPER®			
					A5300	A5400	CL130D	CL430-G
Mechanical properties	Tensile	Strength	ISO 527-1 (JIS K 7161)	MPa	6	10	55	73
		Elongation		%	120	280	1	8
	Flexural	Strength	ISO 178 (JIS K 7171)	MPa	-	-	78	97
		Modulus		MPa	-	-	2200	2300
	Izod impact(notched specimen)		ISO 180 (JIS K 7110)	kJ/m <sup>2</sup>	NB	NB	1.1	3.1
MFR <sup>1)</sup>		ISO 1133 (JIS K 7210)	g/10min	0.1	1.3	13	5	
Thermal properties	TGA <sup>2)</sup>	1% weight loss temperature	JIS K 7120	°C	279	317	270	260
		5% weight loss temperature			357	386	337	352
	DSC <sup>3)</sup>	Melting temperature	JIS K 7121	°C	97	97	-	-
	DMA <sup>4)</sup>	Glass temperature	ISO 6721 (JIS K 7244)	°C	0	-25	110	100

1)Melt Flow Rate(230°C: MODIPER®CL130D, MODIPER®CL430-G、190°C: Others、2.16kgf)

2)Thermo Gravimetric Analysis[Rate of temperature rise: 10°C/min (in a nitrogen atmosphere)]

3)Differential Scanning Calorimetry[Rate of temperature rise: 10°C/min (in a nitrogen atmosphere)]

4)Dynamic Mechanical Analysis

[Mode: Tension mode, Frequency: 1Hz, Rate of temperature rise: 10°C/min (in a nitrogen atmosphere)]

JIS: Japan Industrial Standard method

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## 5 Performances of MODIPER® A series and MODIPER® C series

Table 4 Performance of **MODIPER® A series** and **MODIPER® C series**

Performance	Product name of MODIPER®	Resin													
		PE	PP	ABS	PMMA	EVA	PLA	POM	PA	PET	PBT	PC	mPPE	PPS	TPE
Tribological properties improve	A1100			○				◎	◎		○	○	○	○	
	A1401			○				◎	◎		○	○	○	○	
	A4100								○		○				
Scratch properties improve	A1100			○	○							○			
	A1401			○	○							○			
Impact properties improve	A4300				○				○	◎	◎			○	
	A4400								○	◎	◎			◎	
Thermal shock improve	A5300								○	◎	◎			○	
Application properties of paint improve	A3400		○												
	A5400		○						○						
Melt flow properties improve	A1100												○		
	A3400		○	◎											○
	CL130D											◎			
Organic filler dispersibilities improve	A4100						○		○	◎	○			○	
Inorganic filler dispersibilities improve	A4300				○		○		○	○	○				
	CL430-G											◎			
Chemical resistance improve	A3400			◎											
Matting	A4400		○	◎											

◎ : High performance, ○ : good

PE : Polyethylene  
 PP : Polypropylene  
 ABS : Acrylonitrile butadiene styrene  
 PMMA : Poly(methyl methacrylate)  
 EVA : Ethylene-Vinyl Acetate  
 PLA : Polylactic acid  
 POM : Polyacetal  
 PA : Polyamide  
 PET : Polyethylene terephthalate  
 PBT : Polybutylene terephthalate  
 PC : Polycarbonate  
 mPPE : modified-Polyphenyleneether  
 PPS : Polyphenylenesulfide  
 TPO : Thermoplastic polyolefin

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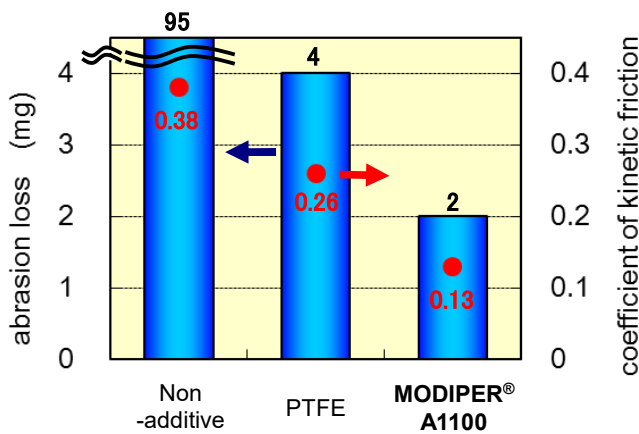
## 6 Application as a Functionality Improver

### Improvement of Tribological property

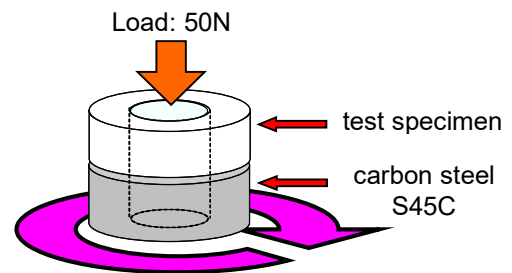
#### Effect of improvement

Evaluation of POM contained **MODIPER® A1100** or PTFE shows as follows. **MODIPER® A1100** can make it possible to improve the Tribological property (abrasion loss and coefficient of kinetic friction).

The tribological property of **MODIPER® A1100** is superior to that of PTFE.



※additive amount: 10wt. %  
Figure 4 Result of sliding test



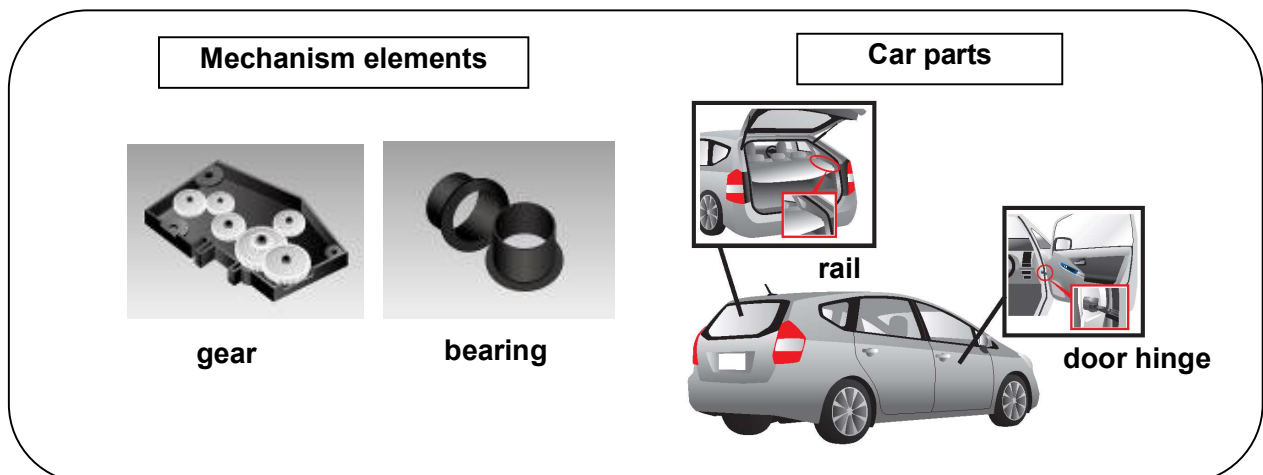
Evaluation method: JIS K 7218  
Test condition  
•load=50N  
•rotation velocity =50cm/s  
•test time=100min

Figure 5 Evaluation method

#### Application

**MODIPER® A series** are applied to mechanism elements(gear, bearing), door hinge, rail and others made by POM, PA and PPS.

### Application



### NOTICE

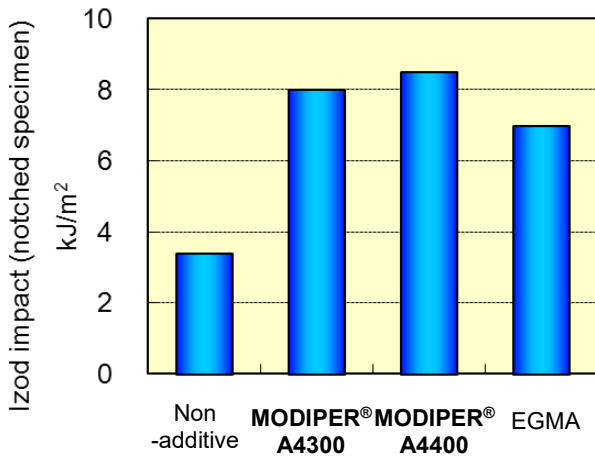
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■ Improve of impact resistance

•Effect of improvement

Evaluation of PBT contained **MODIPER® A4300**, **MODIPER® A4400** or EGMA shows as follows. **MODIPER® A4300** and **MODIPER® A4400** can make it possible to improve the impact resistance of PBT.

The impact resistance of **MODIPER® A4300** and **MODIPER® A4400** are superior to that of EGMA.

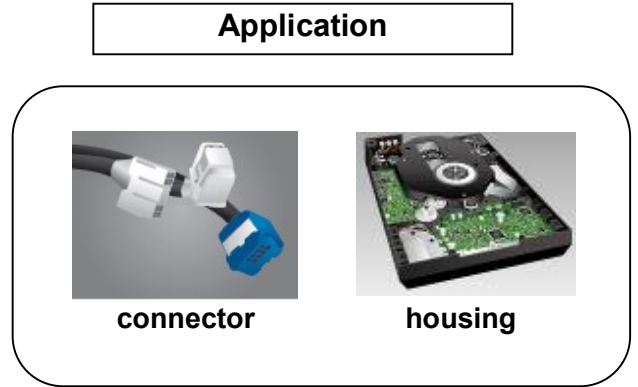


Evaluation method: ISO180(JIS K 7110)  
 additive amount: 10wt. %

Figure 6 Result of Izod impact test

•Application

**MODIPER® A series** are applied to electronic parts(connector, housing) and others made by PBT, PA, PPS.



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## 7 Improvement of Compatibility by MODIPER® A series and MODIPER® C series

Table 5 Improvement of Compatibility by MODIPER® A series and MODIPER® C series

		Resin B (Product name of MODIPER®)									
		poly olefin	PS	ABS	PMMA	PLA	PA	PET	PBT	PC	mPPE
Resin A(Product name of MODIPER®)	poly olefin		A1100 A3400	A1401 A3400 A4400		A1401 A4300		A4400	A4300 A4400	A1401 A3400	A1100
	PS	A1100 A3400				A4100	A4100		A4100	A4100 CL130D	
	ABS	A1401 A3400 A4400				A4300 A4400	CL430-G		CL430-G	A4400 CL130D CL430-G	A4400
	PMMA							A4400	A4300	A4300 CL430-G	
	PLA	A1401 A4300	A4100	A4300 A4400			A4400		A4400	A4400 CL430-G	
	PA		A4100	CL430-G		A4400		A4400	A4300 A4400	A4300 A4400 CL430-G	A4100
	PET	A4400			A4400		A4400			A4300 A4400 CL430-G	
	PBT	A4300 A4400	A4100	CL430-G	A4300	A4400	A4300 A4400			A4300 A4400 CL430-G	A4100
	PC	A1401 A3400	A4100 CL130D	A4400 CL130D CL430-G	A4300 CL430-G	A4400 CL430-G	A4300 A4400 CL430-G	A4300 A4400 CL430-G	A4300 A4400 CL430-G		CL130D
	mPPE	A1100		A4400			A4100		A4100	CL130D	

**Blue:**High performance

Composition : ResinA > ResinB

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## 8 Application as a Compatibility Improver

### ■ Improve of compatibility

#### ·Effect of improvement

Evaluation of PC/PET contained **MODIPER® A4400**, **MODIPER® CL430-G** or EGMA shows as follows. **MODIPER® A4400** and **MODIPER® CL430-G** can make it possible to improve the compatibility of PC/ABS as this will improve impact resistance without any negative effect on mechanical properties.

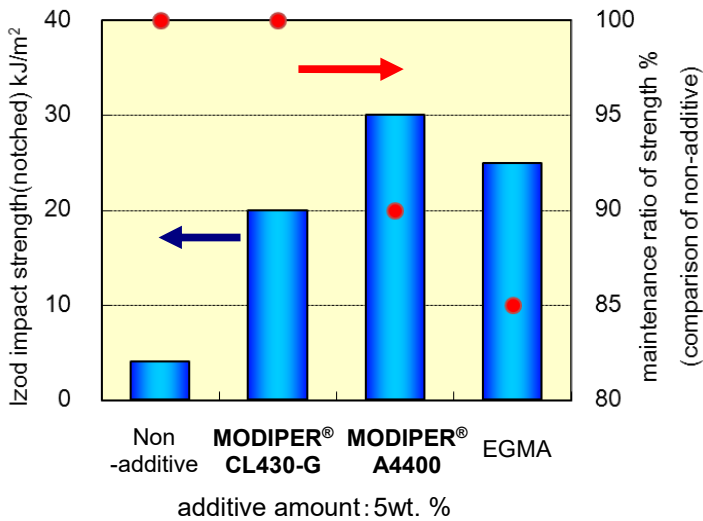
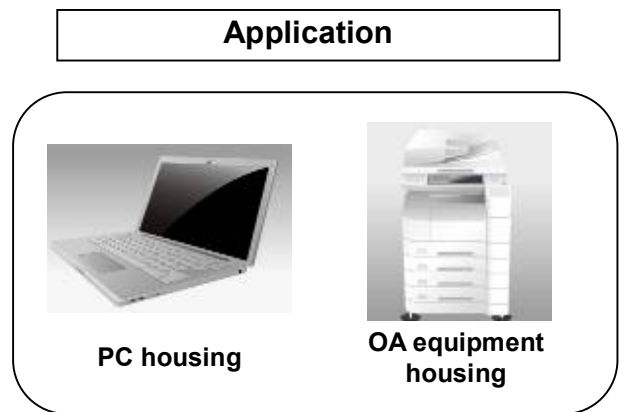


Figure 7 Result of mechanical property test

#### ·Application

**MODIPER® A series** are applied to electronic parts(connector, chassis) and others made by PBT, PA and PPS.



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## 9 Shape, Package & Storage

- Shape and Package: 20kg contained in a paper bag
- Storage: Store in a dark, cool and well ventilated place

## 10 Notes

- Although Research Department of **NOF CORPORATION** has compiled the figures in this Technical Data Sheets, **NOF CORPORATION** does not guarantee the results in independent tests or experiments.
- All precautionary labels and notices should be fully read and understood by all supervisory personnel and employees before using.
- For further safety and health information, please inquire with **NOF CORPORATION**.
- **NOF CORPORATION** does not guarantee any rights on utilizing **MODIPER® A series** and **MODIPER® C series**.
- The contents of this Technical Data Sheets are based on materials, information, and data available as of March 2015 when this Technical Data Sheets was published. However, the descriptions about data, evaluation, hazard, toxicity, and other characteristics are not proof of any guarantee. The contents describe only ordinary handling procedures for **MODIPER® A series** and **MODIPER® C series**. When using or handling such substances in special ways, adequate safety measures for the specific usage and applications are required.

Furthermore, **NOF CORPORATION** would encourage our customers or potential customers to experiment with **MODIPER® A series** and **MODIPER® C series** exceptional properties to discover your solution. Please inquire with **NOF CORPORATION** about our sampling program.

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