Polyacetal (POM)

DURACON®

AW-01

CF2001/CD3501

High Sliding

POLYPLASTICS CO., LTD.

General Properties of AW-01

table1-1 General Properties（ISO）

Item	Unit	Test Method	High Sliding
			AW-01
			High Sliding
Color			CF2001/CD3501
ISO(JIS)quality-of-the-material display:		ISO11469 (JIS K6999)	>POM+PE<
Density	g/cm^3	ISO 1183	1.37
Water absorption (23°C,24hrs,1mmt)	%	ISO 62	0.7
MFR (190℃、2.16kg)	g/10min	ISO 1133	9
MVR (190℃, 2.16kg)	cm^3/10min	ISO 1133	8
Tensile strength	MPa	ISO 527-1,2	54
Strain at break	%	ISO 527-1,2	25[*1]
Tensile modulus	MPa	ISO 527-1,2	2,350
Flexural strength	MPa	ISO 178	75
Flexural modulus	MPa	ISO 178	2,200
Charpy notched impact strength (23℃)	kJ/m^2	ISO 179/1eA	5.7
Temperature of deflection under load (1.8MPa)	℃	ISO 75-1,2	80
Coefficient of linear thermal expansion (23 - 55℃、Flow direction)	x10^{-5}/℃	Our standard	13
Coefficient of linear thermal expansion (23 - 55℃、Transverse direction)	x10^{-5}/℃	Our standard	13
Electric strength (3mmt)	kV/mm	IEC 60243-1	20
Volume resistivity	Ω･cm	IEC 60093	3×10^{14}
Surface resistivity	Ω	IEC 60093	3×10^{14}
Volume resistivity (Our standard)	Ω･cm		-
Surface resistivity (Our standard)	Ω		-
Mold Shrinkage (60×60×2mmt, Flow direction, Cavity Pressure 60 MPa)	%	ISO 294-4	2.3
Mold Shrinkage (60×60×2mmt, Transverse direction, Cavity Pressure 60 MPa)	%	ISO 294-4	2.0
Rockwell hardness	M(Scale)	ISO2039-2	70
Specific wear amount (Thrust, vs C-Steel, material side, pressure 0.98MPa, 30cm/s)	x10^{-3}mm^3/(N･km)	JIS K7218	0.20
Specific wear amount (Thrust, vs C-Steel, steel side, pressure 0.98MPa, 30cm/s)	x10^{-3}mm^3/(N･km)	JIS K7218	0.01>
Coefficient of Dynamic Friction (Thrust, vs C-Steel, pressure 0.98MPa, 30cm/s)		JIS K7218	0.16
Specific wear amount (Thrust, vs M90-44, material side, pressure 0.06MPa, 15cm/s)	x10^{-3}mm^3/(N･km)	JIS K7218	7.0

Item	Unit	Test Method	High Sliding
			AW-01
			High Sliding
Specific wear amount (Thrust, vs M90-44, M90-44 side, pressure 0.06MPa, 15cm/s)	$x10^{-3}mm^3/(N \cdot km)$	JIS K7218	14.0
Coefficient of Dynamic Friction (Thrust, vs M90-44, pressure0.06MPa, 15cm/s)		JIS K7218	0.30
Flammability		UL94	HB
The yellow card File No.			E45034
Appropriate List number of Ministerial Ordinance for Export Trade Control			Item 16 of Appendix -1

*1) Nominal strain at break

All figures in the table are the typical values of the material and not the minimum values of the material specifications.

Introduction

DURACON® POM is widely used in wear applications to take advantage of its excellent friction and abrasion characteristics. For applications that demand a high degree of friction and abrasion resistance performance, many grades hava been developed to meet the requirements of each application.
These newly developed grades include **DURACON AW-01**, which features good wear resistance against parts also made of **DURACON**.

DURACON AW-02 is a higher flow version of **AW-01.**
DURACON AW-01 and **AW-02** have also made it possible to prevent parts made of **DURACON** from sticking together by cohesion and maintain wear performance stably over a long period of time.
DURACON AW-01 and **AW-02** feature the characteristics described below.

Characteristics

1. **DURACON AW-01** and **AW-02** have excellent friction and abrasion resistance over a wide variety of environments.
2. **DURACON AW-01** and **AW-02** have excellent wear properties against other **DURACON** parts, as well as other materials, such as metals.
   Yet, they offer the following advantages;
   - Stable coefficient of dynamic friction
   - Low degree of abrasion
   - Low (Creaking) noise generation
3. **DURACON AW-01** and **AW-02** have excellent mechanical properties.
   The mechanical properties are comparable to those of general purpose **DURACON** grades despite the fact that they contain lubricants.
4. These grades have good moldability, comparable to that of general purpose **DURACON** grades.

1. Wear Characteristics

1.1 Friction and Abrasion Characteristics by the Suzuki Method

When parts of the same kind of material wear against each other, the parts tend to stick together in the contact area, which causes peeling. This causes the coefficient of dynamic friction to become unstable, thus increasing the amount of abrasion. How well the wear properties have been improved in these **AW-01** and **AW-02** grades is described here in comparison with that of M90, a general purpose purpose grade.

It is noteworthy that **AW-01** has a stable coefficient of dynamic friction, and a low level of abrasion against parts made of **DURACON® POM,** as well as most other materials.

1.1.1 Vs. DURACON

When parts of M90 wear against each other, the coefficient of dynamic friction is unstable and the degree of abrasion is higt. However,by using **AW-01** the coefficient of friction becomes stable, and the abrasion is greatly reduced **(Figs. 1-1,1-2).**

Fig 1-1 Coefficient of Dynamic Friction against DURACON® POM

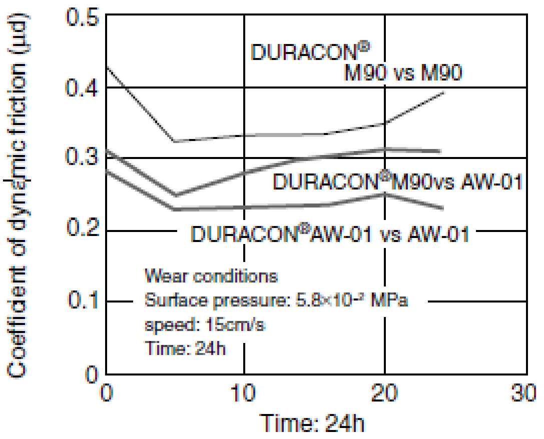
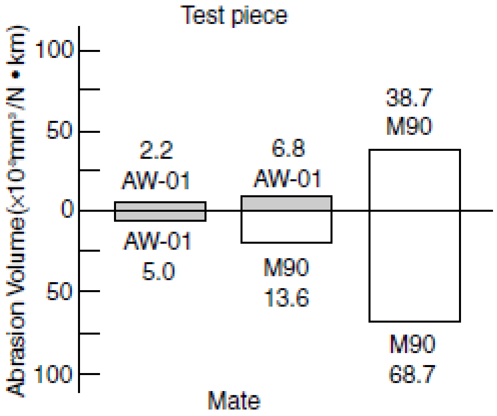


Fig. 1-2 Abrasion Volume against DURACON® POM



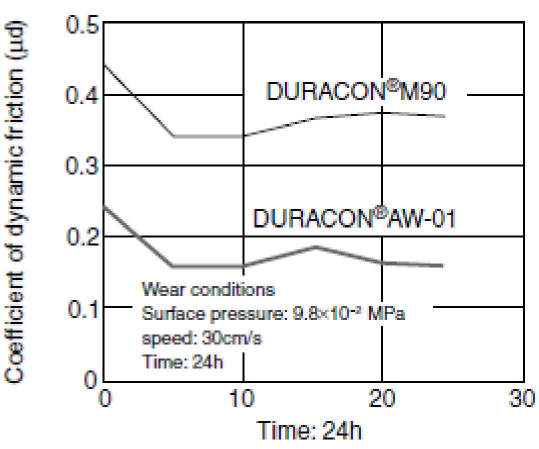
1.1.2 Vs. Carbon Steel

Against Carbon Steel,**AW-01** has a stable coefficient of friction, and under the wear conditions described in **Figs. 1-3** and **1-4,** the volume of abrasion product is small.

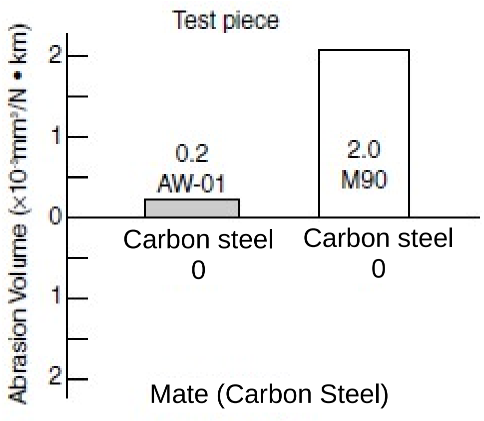
Fig. 1-3 Coefficient of Dynamic Friction

Fig. 1-4 Abrasion Volume

against Carbon Steel



against Carbon Steel



1.1.3 Vs. PBT

(DURANEX® PBT 3300, 30% GF filled)
Against DURANEX 3300, **AW-01** has a stable coefficient of friction and under the wear conditions described in **Figs. 1-5** and **1-6,** the volume of abrasion product is small.

Fig. 1-5 Abrasion Volume against DURANEX® PBT 3300

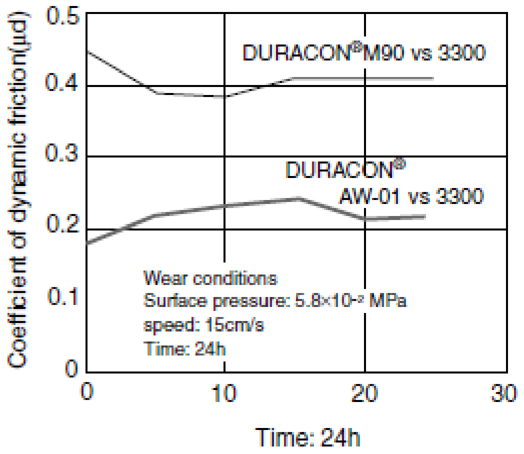
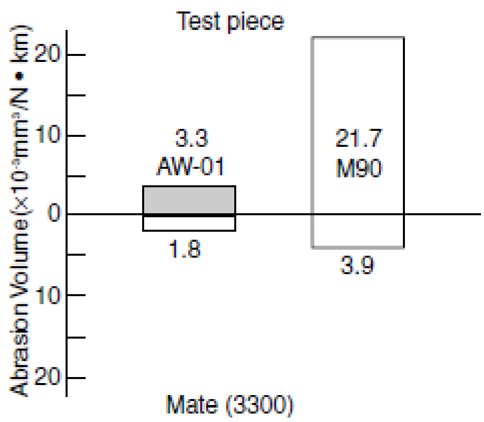


Fig. 1-6 Coefficient of Dynamic Friction against DURANEX® PBT 3300



1.2 Limit PV Value Against Carbon Steel

The limit PV value of **AW-01** is shown in **Table 1-1** in comparision with that of M90.

Table 1-1 Limit PV Value against Carbon Steel

Unit: ×10^{-1}MPa • cm/s

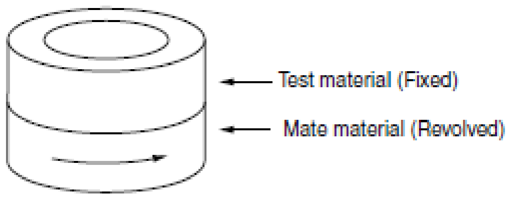
Grade	Limit PV value

The Suzuki Method for Friction and Abrasion Tests

Test sample: Injection molded cylindrical piece,
20.0mm of inside diameter,
25.6mm of outside diameter
and 15.0mm of height

Wear direction: See drawing

DURACON®AW-01	850
DURACON®M90	500



1.3 Low Noise Characteristics

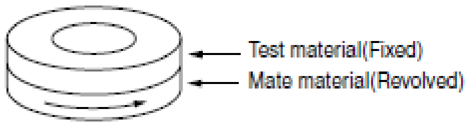
When parts made of the same sort of material wear against each other it is common to hear noise caused by the parts sticking together. These noise cause problems. **AW-01** is capable of reducing this noise. Characteristics of this property, concerning gear and friction related noise are described in comparison with those of M90.

Test Piece for Slide Noise Testing
Injection molded cylindrical piece
Size: Inside diameter 10.0mm
Outside diameter 30.0mm
Thickness 1.5mm
Contact area 6.3cm^2

1.3.1 Wear noise

In **Fig. 1-7** and **Table 1-2,** noises generated during a wear test using a thrust type friction and abrasion tester are described.
Looking over **Fig. 1-7,** the frequency analysis of M90 parts wearing against each other, it is found that annoying squeaky noises are generated at frequencies from 12,000 to 16,000Hz.
By replacing one or both of the parts with parts of **AW-01,** the noise level is reduced to nearly that of M90 parts that are lubricated with grease.

Fig. 1-7 Frequency Analysis of DURACON® POM to DURACON® POM Wear Noise



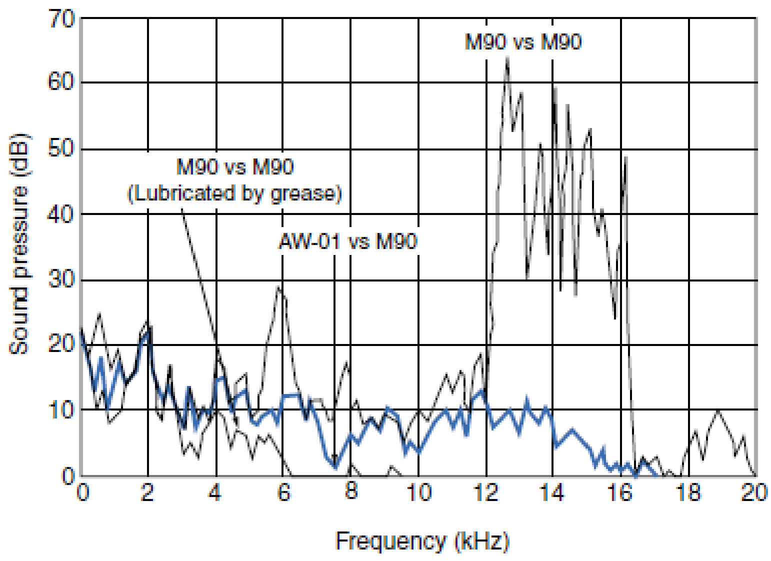


Table 1-2 Wear Noise Level (Background noise adjusted)

Wear parts	Noise level(dB)
AW-01 vs M90	37
M90 vs M90	73
M90 vs M90 (Lubricated by grease)	31

Wear conditions

Surface pressure: 4.9×10^{-2}MPa
Speed: 2.4cm/s
Time: 10min

1.3.2 Gear noise

Gears made of the same material can often cause a squeaky noise during operation. In **Figs. 1-8** and **1-9, Tables 1-4** and **1-5** the noise generated by gears, both made of **DURACON,** is discussed. The analytical results of frequencies, shown in **Figs. 1-8** and **1-9,** show that the use of **AW-01** to replace one of the gears nearly eliminates noise above 8,000 Hz.

Table 1-3 Shape of Gear Test Piece

Pressure angle	Module	Number of teeth	Width of teeth	JJGMA intermeshing angle
20˚	0.5	40	3mm	Grade 3

Fig.1-8 Frequency Analysis of Gear Noise, DURACON® POM vs. DURACON® POM(150rpm, 3.9×10^{-2}N • m)

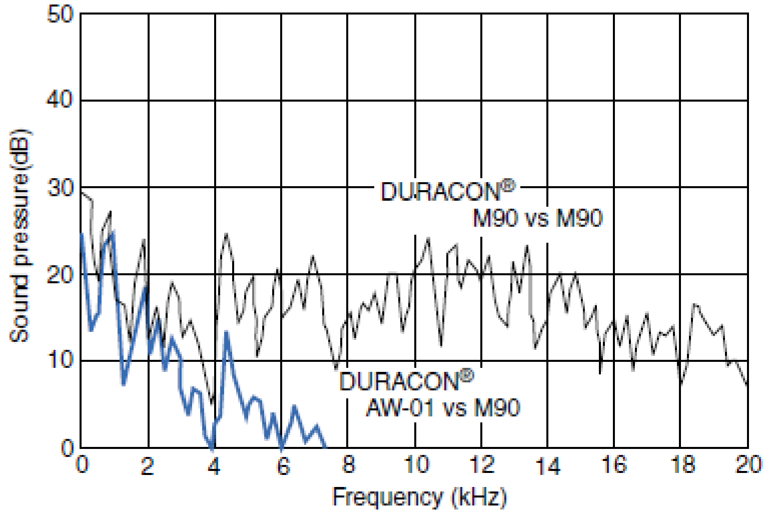


Table 1-4 Gear Noise Level
(150rpm, 3.9×10^{-2}N • m)

Gear materials	Gear noise level(dB)
AW-01 vs M90	35
M90 vs M90	47

(Background noise adjusted)

Driving conditions
Revolving speed: 150rpm
Torque: 3.9×10^{-2}N • m
Backrush: 0mm

Fig.1-9 Frequency Analysis of Gear Noise, DURACON® POM vs. DURACON® POM(400rpm, 1.9×10^{-2}N • m)

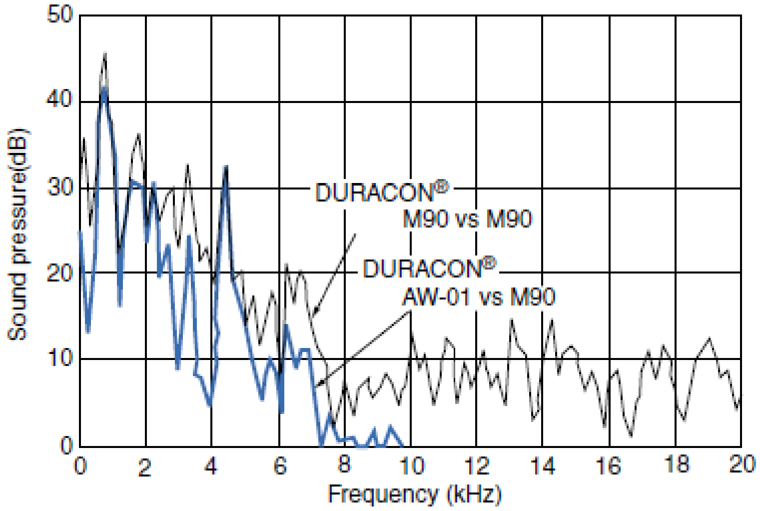


Table 1-5 Gear Noise Level
(400rpm, 1.9×10^{-2}N • m)

Grase of gears	Gear noise level(dB)
AW-01 vs M90	48
M90 vs M90	51

(Background noise adjusted)

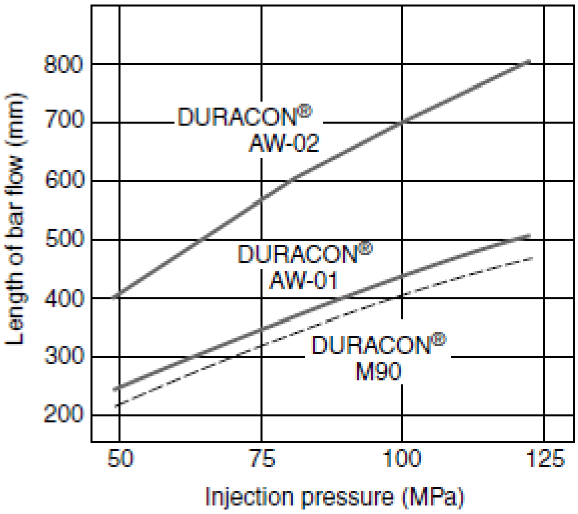
Driving conditions
Revolving speed:400rpm
Torque: 1.9×10^{-2}N • m
Backrush: 0mm

2.Moldability

2.1 Flowability

Flowability of **AW-01** and **AW-02** as obtained from a bar flow test mold is shown in **Fig. 2-1** in comparison with that of M90.

Fig. 2-1 Length of Bar Flow (2mmt)



Cavity width : 50mm
Thickness : 2mm
Gate size : 50w×4tmm

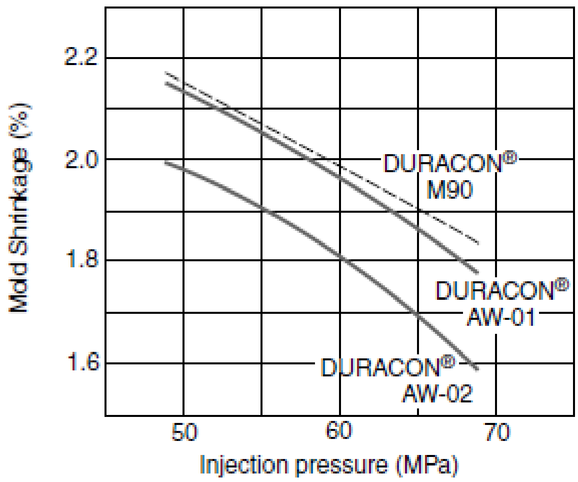
Molding conditions
Cylinder temp. : 190-190-170-150°C
Mold temp. : 80°C
Injection speed : 67mm/s

2. Mold Shrinkage

2.2.1 On side-gated mold (2mmt)

The mold shrinkage rates of **AW-01** and **AW-02** on a side-gated flat plate mold are shown in **Fig. 2-2** in comparison with that of M90.

Fig. 2-2 Mold Shrinkage (2mmt)



Test sample : 120×120×2mm
Gate sizu : 4w×2tmm

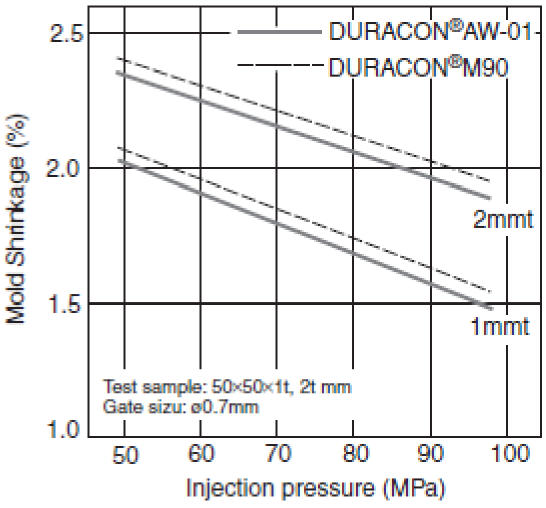
Moiding conditions
Cylinder temp. : 190-190-170-150°C
Mold temp. : 80°C
Injection speed : 25mm/s

2.2.2 On pin-point gated mold

The mold shrinkage rate of **AW-01** on a pin point gated flat plate mold is shown in **Figs. 2-3～2-5** in comparison with that of M90.

Fig. 2-3 Mold Shrinkage
(on ø0.7 pin-point gated mold)

Fig. 2-5 Mold Shrinkage
(on ø1.5 pin-point gated mold)



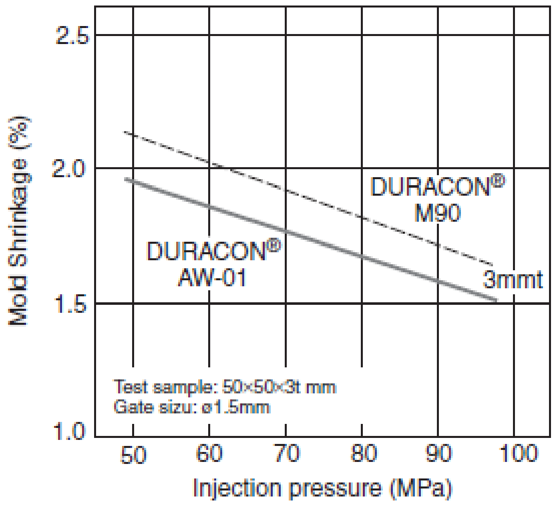
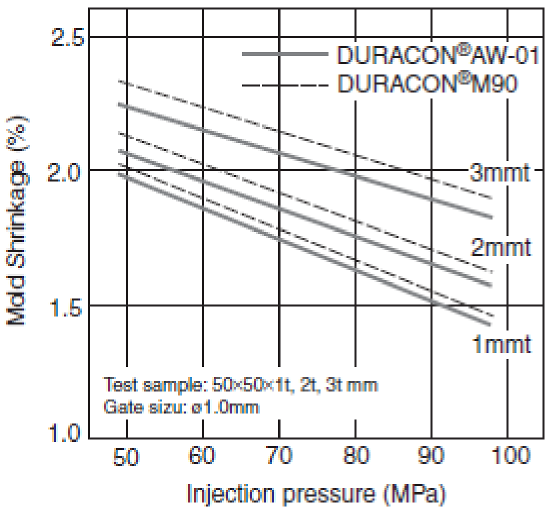


Fig. 2-4 Mold Shrinkage
(on ø1.0 pin-point gated mold)



Moiding conditions
Cylinder temp. : 190-190-170-150˚C
Mold temp. : 80˚C
Injection speed : 17mm/s

2.3 Notes for Successful Molding

DURACON AW-01 and **AW-02** have the moldability comparable with that of general purpose grades; however, they contain a high performance lubricant, therefore special attentions should be directed to the following;

- A mold temperature setting above 60°C is recommended. If the mold temperature is Low, the lubricant may sometimes stick to the mold. In such a case, the lubricant must be wiped off with a waste cloth.
- When the molding operation is continued for a prolonged period of time, the mold must be cleaned from time to time depending on the amount of the lubricant stuck.
- When the appearance of molded parts is stressed, the balance of gate size and injection speed must be taken into consideration. If the shear rate is too fast at the gate section, the lubricant may sometimes be separated.

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NOTES TO USERS

- All property values shown in this brochure are the typical values obtained under conditions prescribed by applicable standards and test methods.
- This brochure has been prepared based on our own experiences and laboratory test data, and therefore all data shown here are not always applicable to parts used under different conditions. We do not guarantee that these data are directly applicable to the application conditions of users and we ask each user to make his own decision on the application.
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- For all works done properly, it is advised to refer to appropriate technical catalogs for specific material processing.
- For safe handling of materials we supply, it is advised to refer to the Safety Data Sheet "**SDS**" of the proper material.
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