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Grade Series of **DURACON®**

Acetal Copolymer

DURACON®

SW-01

(High Slide Grade)

Polyplastics

CONTENTS

NOTES TO USERS

• All property values shown in this brochure are the typical values obtained under varying 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.
• It is the users' responsibility to investigate patent rights, service life and potentiality of applications introduced in this brochure. Materials we supply are not intended for the implant applications in the medical and dental fields, and therefore are not recommended for such uses.
• For all works done properly, it is advised to refer to the appropriate **"Technical Catalog"** for specific material processing.
• For safe handling of materials we supply, it is advised to refer to the Material Safety Data Sheet **"MSDS"** of the proper material.
• This brochure is edited based on reference literatures, information and data currently available to us. So the contents of this brochure are subject to change without notice due to new data.
• Please contact our office for any questions about products we supply, descriptive literatures or any description in this brochure.

Introduction

Demands for friction and wear resistance improvements go ever higher standards for **Duracon** every year. The ultimate goal of these demands is the "greaseless" application. we have developed a wide variety of grades to expand the range of greaseless applications to fully satisfy such a severe demand.
However, it is true that there still remain such subjects of study left unanswered as ;
1) Creaking noise in operation, and
2) Malfunction of parts by the increasing friction.

Therefore, a "greaseless" material available for a wider application range is hoped to be developed. Now we have developed **Duracon SW-01**, which is able to decrease the creaking noise and friction under high surface pressure applications and is considered at present to be a most potential greaseless grade.
Duracon SW-01 has following characteristics and is quite useful for cams, sliders and other parts used under high torque conditions.

Characteristics

1. No creaking noise under a broad range of surface pressure conditions.
2. Very little wear under high surface pressure.
3. Low coefficient of friction regardless of the mate material.
4. A slide grade having rigidity equal to that of **Duracon** general purpose grades.

1. Sliding Characteristics

1.1 Creaking Noise in Friction

Shown here is the creaking noise generation under varying conditions of surface pressure on **SW-01** parts.

It is noticed that no creaking noise is made under the high surface pressure condition as compared with the conventional sliding grade AW-01.

Fig. 1-1 Creaking Noise Generation
(Against M90 parts)

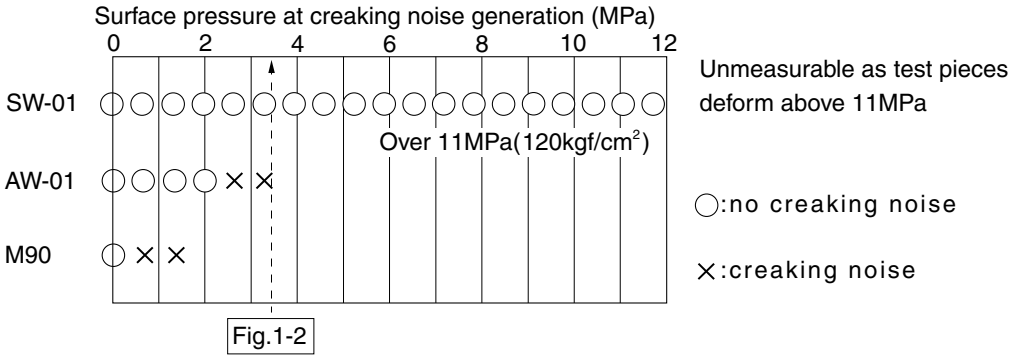
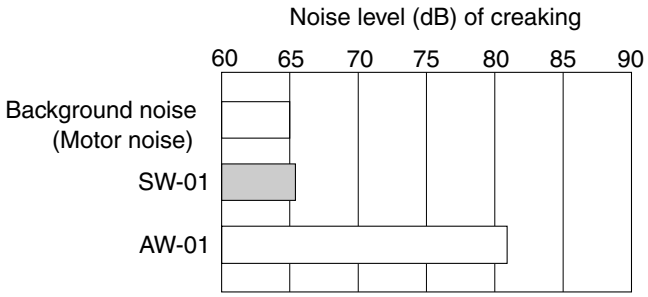


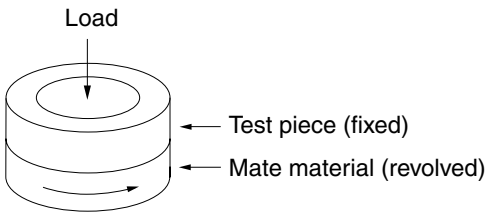
Fig. 1-2 Noise Level of Creaking
[at 3.4 MPa level in Fig.1-1]



Test conditions at measurement
Surface pressure : 3.4MPa
Speed : 1cm/s

Test Method
With the speed kept at constant, the surface pressure is increased by 0.09MPa every minute.

Test conditions
Equipment : Thrust type friction and abrasion tester
Mate : M90 (general purpose grade)
Speed : 1cm/s



1.2 Limit PV Value

Table 1-1 Limit PV Value

Unit : $\times 10^{-1}$MPa • cm/s

Mate	SW-01	AW-01	M90
S55C	1,030	850	500
M90	63	39	39

Test conditions
Equipment : Thrust type friction and abrasion tester
Mate : S55C M90
Speed : 30cm/s 15cm/s
Time : 30min

1.3 Sliding Characteristics Under a Broad Range of Sliding Conditions

Shown here are the abrasion volume and coefficient of dynamic friction of **SW-01** parts when slid under many different conditions. Both the **SW-01** and AW-01 parts show outstanding friction and wear characteristics under a broad range of sliding conditions regardless of the mate material.

It is also noticed that **SW-01** is more advantageous in the higher pressure side in most cases, although it is necessary to note that this is reversed in the lower surface pressure side with M90 as the mate.

Fig. 1-4 Abrasion Volume Against M90

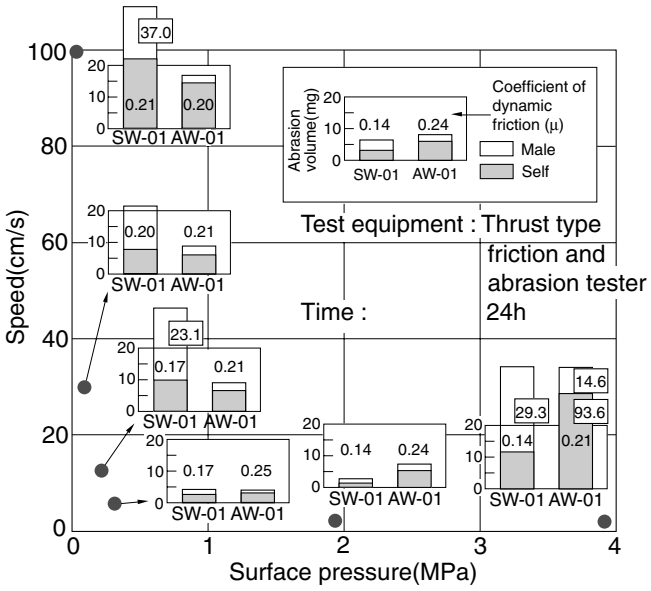


Fig. 1-3 Abrasion Volume Against S55C

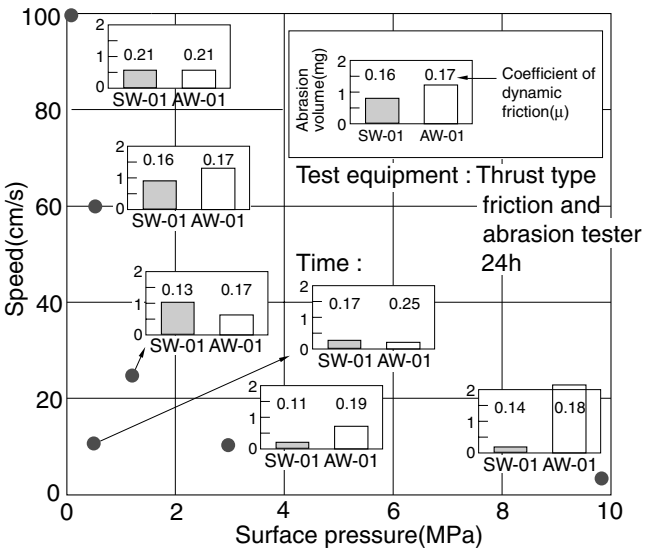
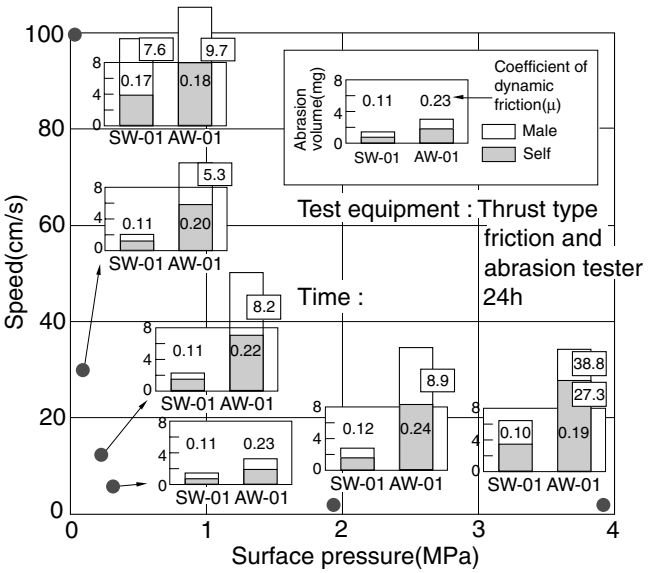


Fig. 1-5 Abrasion Volume Against Same Material



1.4 Sliding Characteristics Under Standard Conditions

Shown here are the test results of **SW-01** parts under the standard conditions on a thrust type friction and abrasion tester.

When the mate material are M90, a general purpose grade of **Duracon** and Duranex 3300, a 30% GF filled PBT resin, **SW-01** shows a far lower level of friction as compared with that of AW-01. Against a steel (S55C) mate, the abrasion volume increases, however, as described before it is reversed under the high surface pressure condition, and the abrasion volume of **SW-01** will be less. Meanwhile, regarding the coefficient of dynamic friction, **SW-01** has a lower level than that of both mate materials.

Test conditions

Equipment	: Thrust type friction and abrasion tester	
Mate	: M90, 3300	Self : S55c
Surf. pressure	: 0.05MPa	0.98MPa
Speed	: 15cm/s	30cm/s
Time	: 24h	24h

Fig. 1-6 Friction and Abrasion Characteristics Against M90

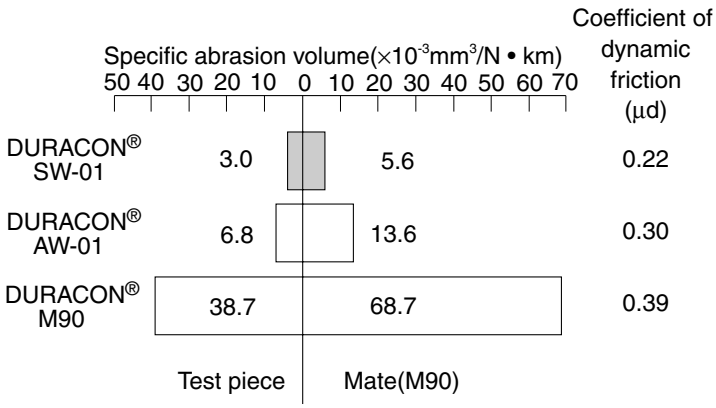


Fig. 1-7 Friction and Abrasion Characteristics Against S55C(Metal)

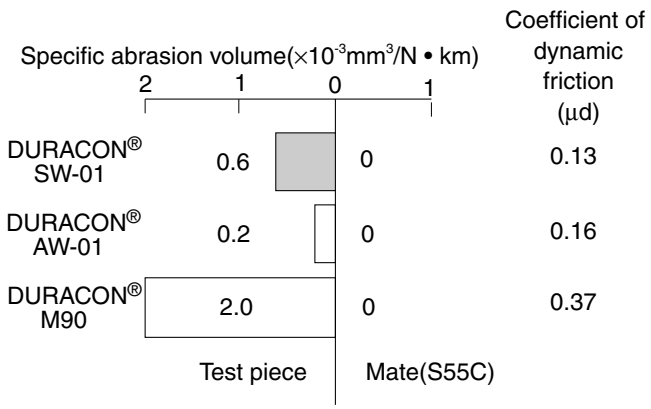


Fig. 1-8 Friction and Abrasion Characteristics Against Same Material

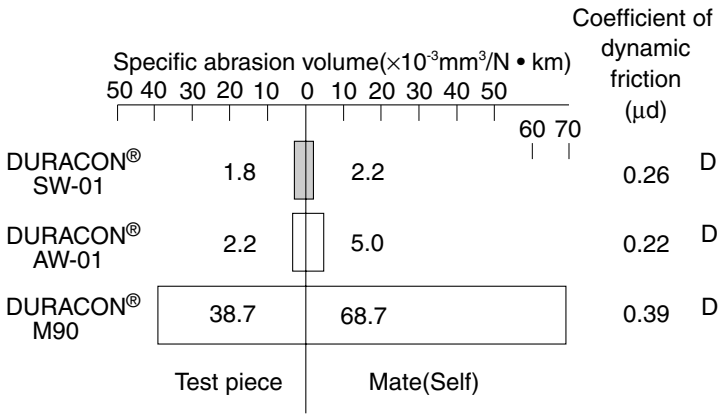
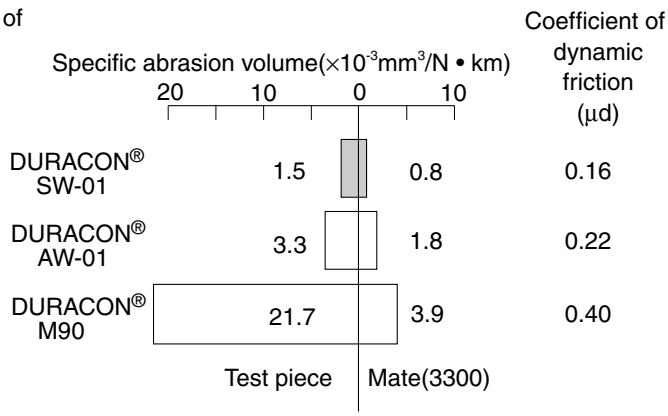


Fig. 1-9 Friction and Abrasion Characteristics Against DURANEX® 3300 (GF30% PBT)



2. General Properties

SW-01 has rigidity comparable with that of M90, a general purpose grade **Duracon** despite of its improved sliding efficiency, so it is readily available for use in all applications now served by M90-44.

Table 2-1 General Properties(ISO)

			High sliding			Standard
Item	Unit	Testing Method	SW-01	AW-01	NW-02	M90S
			Special lubricant, High sliding	Special lubricant, High sliding	Special lubricant, High sliding	General
Density	g/cm^3	ISO 1183	1.42	1.37	1.36	1.41
Tensile strength	MPa	ISO 527-1,2	50	54	52	62
Strain at break	%	ISO 527-1,2	20*	25*	20*	35*
Tensile modulus	MPa	ISO 527-1,2	2,700	2,350	2,350	2,700
Flexural strength	MPa	ISO 178	75	75	72	87
Flexural modulus	MPa	ISO 178	2,500	2,200	2,200	2,500
Charpy notched impact strength	kJ/m^2	ISO 179/1eA	5.4	5.6	5.9	6.0
Temperature of deflection under load (1.8MPa)	˚C	ISO 75-1,2	80	80	85	95
Coefficient of linear thermal expansion (23~55˚C) parallel	×10-5/˚C	ISO 11359-2	14	13	11	12
Coefficient of linear thermal expansion (23~55˚C)transverse	×10-5/˚C	ISO 11359-2	14	13	11	12
Electric strength	kV/mm	IEC 60243-1	18	20	20	19
Volume resistivity	Ω • cm	IEC 60093	2×10^{14}	3×10^{14}	1×10^{14}	1×10^{14}
Surface resistivity	Ω	IEC 60093	–	3×10^{14}	3×10^{15}	1×10^{16}
Flammability		UL94	HB	HB	HB	HB

*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.

• For qualified values of UL (Underwriters Laboratories Inc.) refer to the yellow card (File No.E45034) issued by UL.

Table 2-2 General properties(ASTM)

Item		Unit	Testing Method	High sliding			Standard
				SW-01	AW-01	NW-02	M90S
				Special lubricant, High sliding	Special lubricant, High sliding	Special Lubricant, High sliding	General
Specific gravity		g/cm^3	D 792	1.42	1.37	1.36	1.41
Tensile strength		MPa	D 638	49	52	52	60
Tensile elongation		%	D 638	35	70	35	60
Flexural strength		MPa	D 790	78	75	77	90
Flexural modulus		MPa	D 790	2,590	2,150	2,300	2,580
Izod impact strength (with notch)	Notch side	J/m	D 256	49	53	58	63
	Reversed notch	J/m	D 256	530	880	880	760
Deflection temperature under load (1.82MPa)		˚C	D 648	110	100	117	110
Coefficient of linear thermal expansion (Room temperature)		×10-5/˚C	–	10	10	–	10
Dielectric breakdown strength (Short-time test: 2mmt)		MV/m	D 149	23	22	–	24
Volume resistivity (3mmt)		Ω • cm	D257	2×10^{14}	3×10^{14}	–	1×10^{14}
Surface resistivity		Ω	D257	–	–	–	1×10^{16}
Flammability (UL94)		–	(UL94)	HB	HB	HB	HB

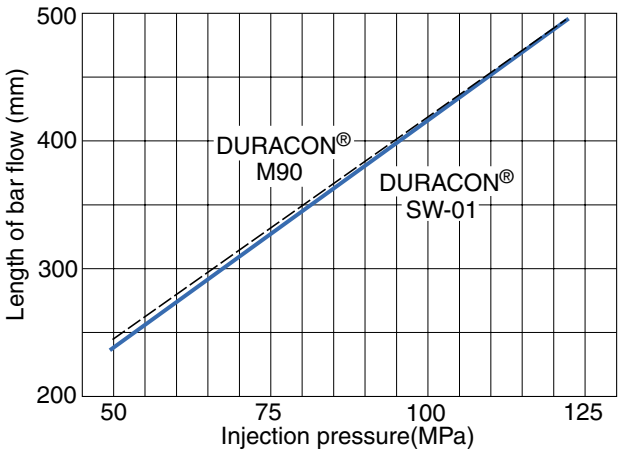
• All figures in the table are the typical values of the material and not the minimum values of the material specifications.
• For qualified values of UL (Underwriters Laboratories Inc.) refer to the yellow card (File No.E45034) issued by UL.

3.Moldability

3.1 Flowability

Flowability of **SW-01** is almost as excellent as that of M90 general purpose grade **Duracon**.

Fig. 3-1 Length of Bar Flow (2mmt)

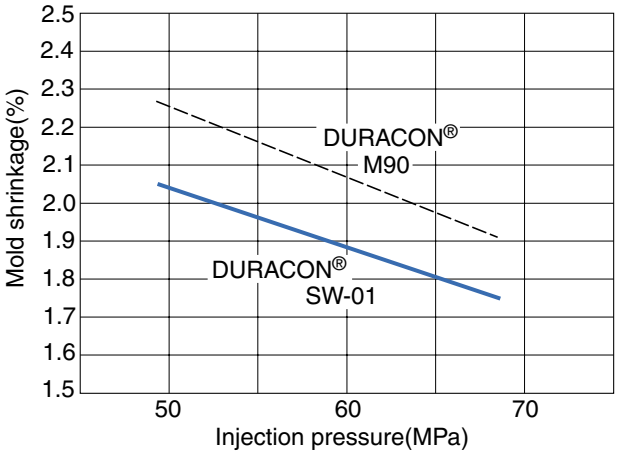


Molding conditions
Cylinder temp. : 190-190-170-150˚C
Mold temp. : 80˚C
Injection speed : 67mm/s
Mold : 2mmt bar flow mold

3.2 Mold Shrinkage

Mold shrinkage rate of **SW-01** is lower by about 10% than that of M90 general purpose grade **Duracon**.

Fig. 3-2 Mold Shrinkage (2mmt)



Molding conditions
Cylinder temp. : 190-190-170-150˚C
Mold temp. : 80˚C
Injection speed : 25mm/s
Molding cycle : Holding pressure 20s/cooling 10s
Mold : 120sq.×2mmt flat plate,
side gated 4w×2t

3.3 Notes for Successful Molding

Duracon SW-01 has the moldability comparable with that of general purpose grades ; however, it contains 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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