Polybutylene Terephthalate (PBT)

DURANEX®

353RA

EF2001/ED3002

Resin adhesion improved for multiple injection molding

POLYPLASTICS CO., LTD.

Introduction

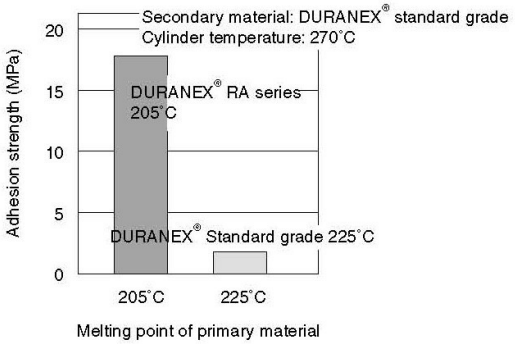
What can be done with the RA series

Multi-component molding is an injection molding process in which the surface of the first (primary) molded component is melted using the melt heat of the second (secondary) material, thereby creating an adherence or bonding between the first component and the second component.
However, when undertaking multicomponent molding, many cases are seen in which there are problems with the adhesion strength between the first and second components.
In order to achieve this adhesion strength, better results are achievable when the respective materials are as close as possible in terms of properties to each other. Moreover, if the same materials are used, the coefficient of thermal expansion can be the same, so there are benefits to be derived in environmental durability.
For this reason, when the first material or the second material is PBT that has been selected for its electrical properties, stiffness, and durability, it is preferable that the other material is also PBT.
However, when multi-component molding is carried out using standard grades of PBT, sufficient adhesion or bonding strength could not be realized.
To this end, we have developed the **Duranex RA series**, which is comprised of adhesion-enhanced grades for multi-component molding. This series utilizes "Lowered Melting Point PBT" base resins, a proprietory technology of our company, and enables resin adhesion to air tightness to be enhanced.

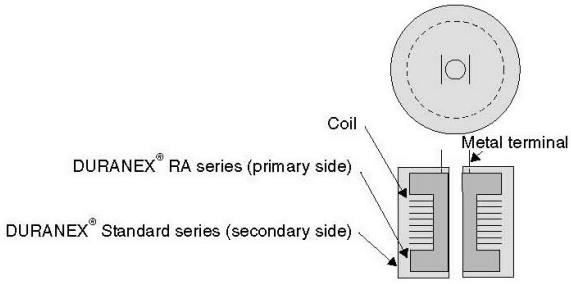
Why is multi-component molding necessary?

"A coil wrapped with conducting wire is protected by encapsulation with PBT."
"A connector incorporating pins is insert molded to double as part of a PBT housing."
"The part is too complex for single-shot injection, so molding is carried out in two steps. In other words, a portion of the part is molded first, and then this portion is inserted into a mold where the second portion is molded."
Through carrying out such multi-component molding processes, certain types of assembled parts can be encapsulated, products can be insert-molded for protection, and other functionalities can be given.

Adhesion strength of DURANEX® RA series



Example of multi-component molded part (Coil bobbin)



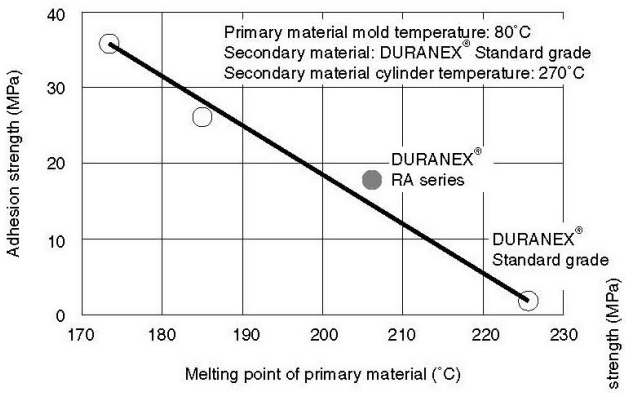
Why do RA series grades adhere?

Duranex RA series resins use "Lowered Melting Point PBT," which is based on our proprietory technology, as a base resin.

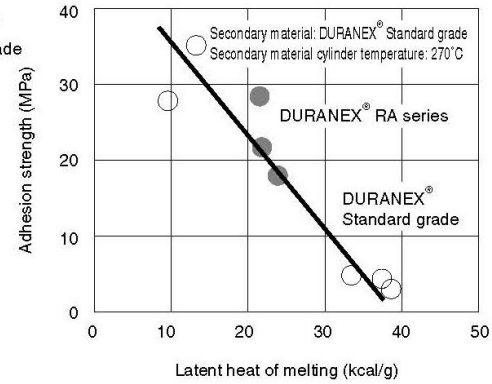
Therefore, by using this **RA series** as the material for the first shot, and a standard grade of the material used in the second shot, the large melting point difference between the two grades can be exploited to melt the surface of the primary part molded from **RA series** grade, and thereby achieve strong adhesion and air tightness.

In addition, as the melting point of the base resin is lowered, the amount of thermal energy needed to melt the **RA series** (latent heat of melting) is lower than that for standard grades, and therefore, the **RA series** is easier to melt.

Melting point of primary material and adhesion strength



Latent heat of melting for primary material and adhesion strength



1. Adhesion properties of DURANEX® RA series

Figure 1-1 Secondary material cylinder temperature and adhesion

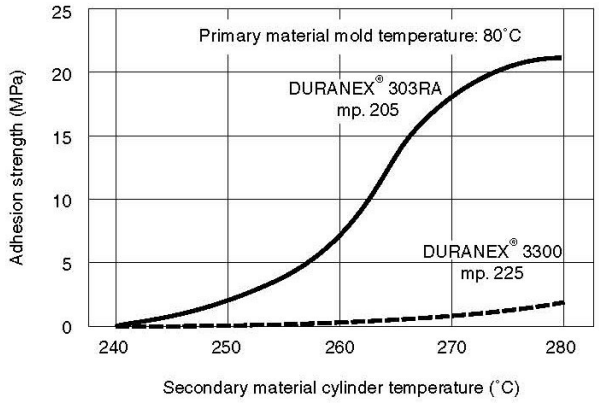


Figure 1-2 Primary material mold temperature and adhesion

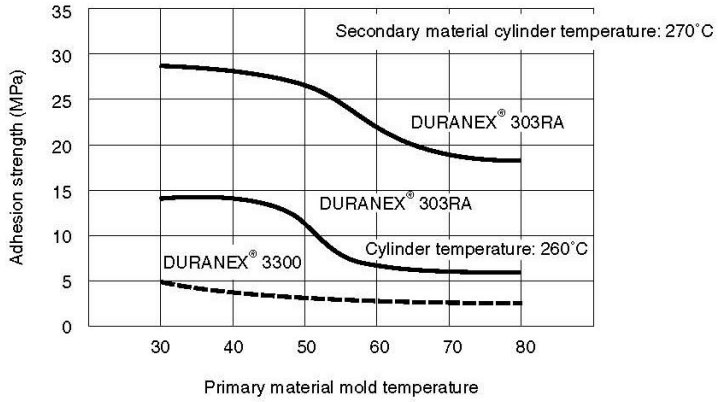
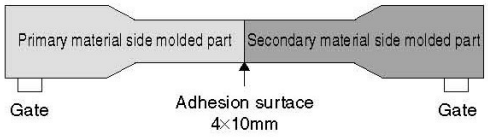


Figure 1-3 Test piece for evaluation of adhesion strength



Molding of test piece for evaluation of adhesion strength
Firstly, half of the dumbbell test piece is molded from the primary material. This half is then inserted into a mold, and the second half is molded is as to bond to the primary part.

Processing parameters for primary material
Cylinder temperature: 240˚C
Mold temperature: 30, 45, 60, 80˚C
Injection speed: 17 mm/sec
Injection pressure: 49 MPa
Cycle: 20 s hold phase/10 s cooling

Processing parameters for secondary material
Cylinder temperature: 240, 250, 260, 270, 280˚C
Mold temperature: 65˚C
Injection speed: 17 mm/sec
Injection pressure: 49 MPa
Cycle: 20 s hold phase/10 s cooling

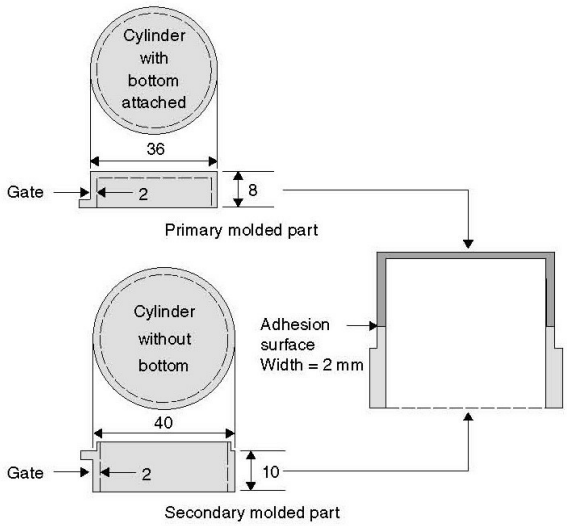
2. Air tightness of DURANEX® RA series

Table 2-1 Processing parameters and air tightness

Air pressure: 0.68 MPa

Primary material		DURANEX® 303RA		DURANEX® 3300	
Primary mold T		30˚C	70˚C	30˚C	70˚C
Secondary cylinder T	250˚C	○	○	○	×
	260˚C	○	○	○	○
	270˚C	○	○	○	○

Figure 2-1 Test piece for evaluation of air tightness



Molding of test piece

As shown in Figure 2-1, a cylinder with lid attached is first molded as the primary part. This part is then inserted into the cavity of a mold, and the secondary part, a cylinder with no bottom, is molded so as to bond to the primary part.
Through this process, an adhesion surface of width 2 mm is formed between the primary and secondary parts.

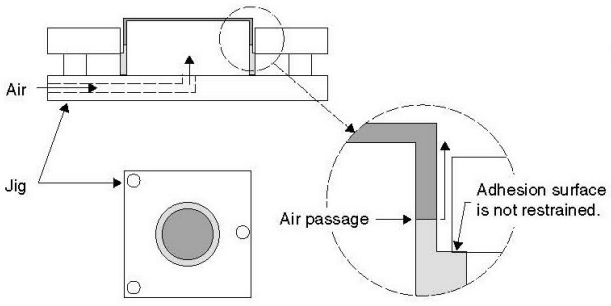
Processing parameters for primary material

Cylinder temperature: 240˚C
Mold temperature: 30, 70˚C
Injection speed: 17 mm/sec
Injection pressure: 49 MPa
Cycle: 20 s hold phase/10 s cooling

Processing parameters for secondary material

Cylinder temperature: 250, 270˚C
Mold temperature: 65˚C
Injection speed: 17 mm/sec
Injection pressure: 49 MPa
Cycle: 20 s hold phase/10 s cooling

Figure 2-2 Evaluation method for air supported.

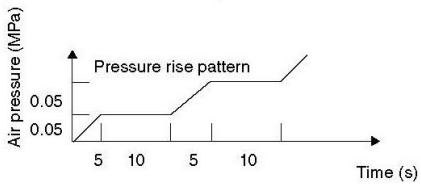


Evaluation method

The multi-component molded test piece show in Figure 2-1 is secured in a jig so that the adhesion surface is not supported. This assembly is then immersed in a water tank.

Pressurized air is applied from the bottom, and the air tightness is verified.

Timing of pressure rises:
An increased of 0.04 MPa in about 5 s, followed by a 10 s holding phase to verify air tightness.Process then repeated over.



General Properties of 353RA

table1-1 General Properties（ISO）

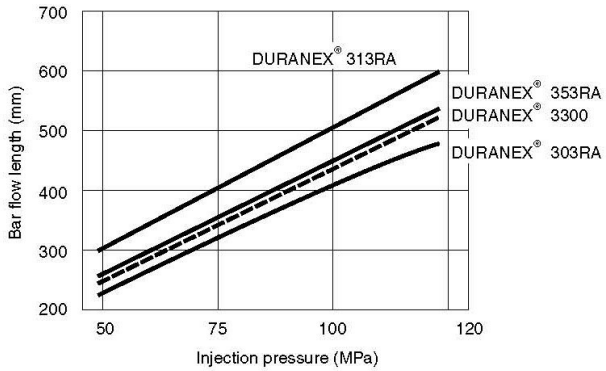
Item	Unit	Test Method	Resin adhesion improved for multiple injection molding
			353RA
			GF30% reinforced, hydrolysis resistance
Color			EF2001/ED3002
ISO(JIS)quality-of-the-material display:		ISO11469 (JIS K6999)	>PBT-GF30FR(17)<
Density	g/cm^3	ISO 1183	1.68
Water absorption (23°C,24hrs,1mmt)	%	ISO 62	0.1
Tensile strength	MPa	ISO 527-1,2	143
Strain at break	%	ISO 527-1,2	2.1
Flexural strength	MPa	ISO 178	221
Flexural modulus	MPa	ISO 178	10,330
Charpy notched impact strength (23℃)	kJ/m^2	ISO 179/1eA	10
Temperature of deflection under load (1.8MPa)	℃	ISO 75-1,2	197
Coefficient of linear thermal expansion (23 - 55℃、Flow direction)	x10^{-5}/℃	Our standard	2
Coefficient of linear thermal expansion (23 - 55℃、Transverse direction)	x10^{-5}/℃	Our standard	7
Electric strength (3mmt)	kV/mm	IEC 60243-1	20
Volume resistivity	Ω·cm	IEC 60093	1 × 10^{16}
Tracking resistance (CTI)	V	IEC 60112	-
Rockwell hardness	M(Scale)	ISO2039-2	90
Flammability		UL94	V-0
The yellow card File No.			E213445
Appropriate List number of Ministerial Ordinance for Export Trade Control			Item 16 of Appendix -1

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

4. Processing characteristics of DURANEX® RA series

4.1 Flow characteristics

Figure 4-1 Bar flow length of DURANEX® RA series HB grades (2 mm*t*)



Processing parameters
Cylinder temperature: 250-250-230-210°C
Mold temperature: 65°C
Injection speed: 67 mm/sec
Mold: Bar flow test mold (2 mm*t*)

4.2 Mold shrinkage ratio of DURANEX® RA series HB grades (120□×2mm*t*)

Figure 4-2 DURANEX® 303RA

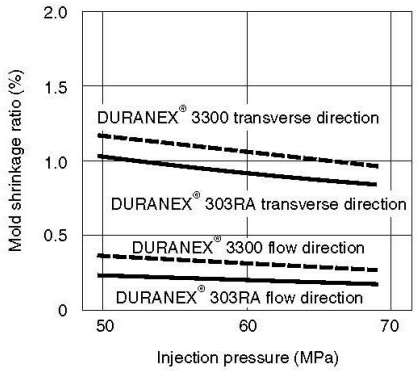
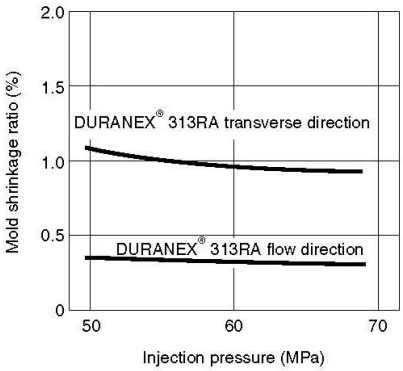
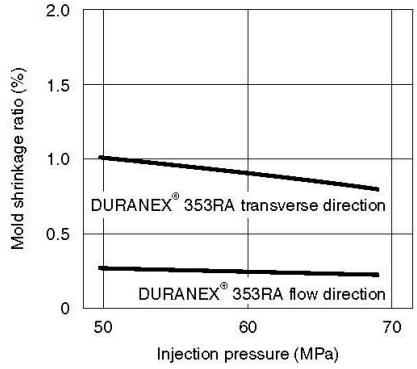


Figure 4-3 DURANEX® 313RA



4.3 Mold shrinkage ratio of DURANEX® RA series V-O grade (120□×2mm*t*)

Figure 4-4 DURANEX® 353RA



Processing parameters
Cylinder temperature: 250-250-230-210°C
Mold temperature: 65°C
Injection speed: 17 mm/sec
Test piece: 120×120×2 mm*t* flat plate
(4 (*W*)×2*t* side gate)

5. Heat stability of DURANEX® RA series when molding (limits of cylinder residence time)

Table 5-1 Limits of cylinder residence time

		DURANEX® 303RA	DURANEX® 353RA	DURANEX® 3300
Cylinder T	260˚C	○	○	○
	270˚C	○	15min	○
	280˚C	15min	5min	15min

5.1 Cylinder residence time limits as seen from tensile properties

Figure 5-1 DURANEX® 303RA

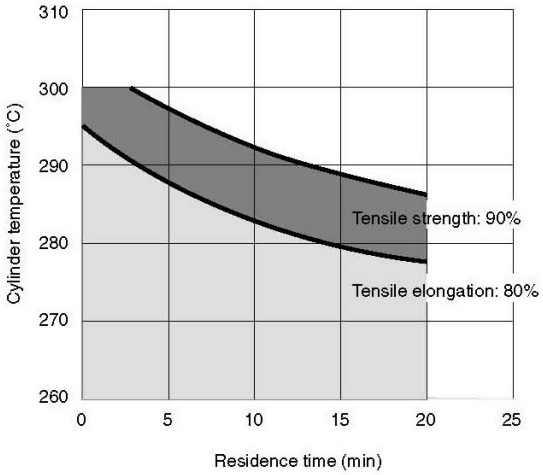


Figure 5-2 DURANEX® 3300

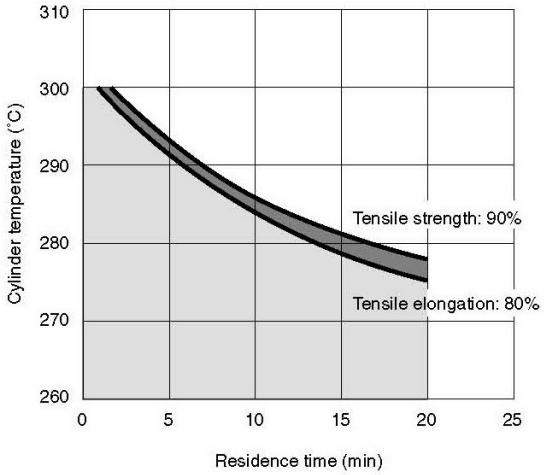
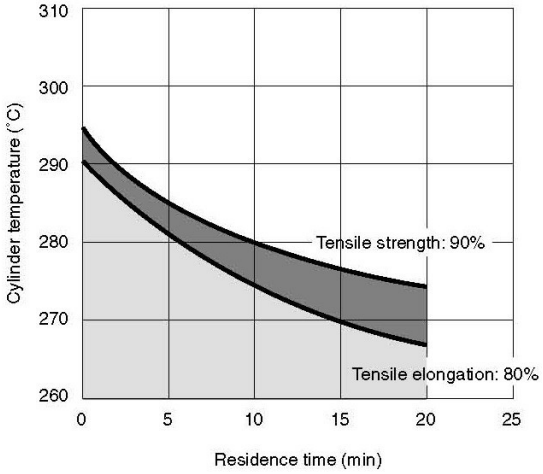


Figure 5-3 DURANEX® 353RA



Polyplastics

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.
- 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 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.
- This brochure is edited based on reference literature, information and data available to us at the time of creation. The contents of this brochure are subject to change without notice upon achievement of new data.
- Please contact our office for any questions about products we supply, descriptive literatures or any description in this brochure.

POLYPLASTICS CO., LTD.

JR Shinagawa East Bidg.,
18-1, Konan 2-chome, Minato-ku, Tokyo, 108-8280 Japan
Tel: +81-3-6711-8610 Fax: +81-3-6711-8618

http://www.polyplastics.com/en/

(R190507-1917)