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BONDING

Bonding

Dryflex® A thermoplastic elastomer (TPE) bondable grades, primarily based on SBS and SEBS, increase freedom of design and open up a vast range of application opportunities.

It used to be a complex and costly affair producing details made of thermoplastics that showed soft-touch qualities or had integrated seals. With Dryflex® A TPEs, since the materials are bonded together at the production stage, no separate primer or adhesive is needed. This makes the process faster and more cost-effective than if the two parts were assembled together after each had been produced separately, or bonded mechanically, which often requires some modification to the design.

Primarily a TPE is used as the soft component. Dryflex® A bondable grades can be co-extruded or overmoulded with a variety of engineering plastics.

Dryflex® A grades are available in black or natural and can easily be coloured. These thermoplastic elastomers form excellent bonds onto PP, PE, PA, ABS, PC, PS, PMMA, ASA, SAN and their blends. Polyamides and ABS may be either reinforced or non-reinforced yet still bond extremely well to Dryflex®. It is easy to achieve excellent bonding to PP, even using standard TPE materials, while other thermoplastics require some modification of the TPE material to optimise bonding.

A1 series	Adhesion to Polyamide
A01 series	Adhesion to Polyamide – lower temperature processing
A2 series	Adhesion to ABS and Polycarbonate
A3 series	Adhesion to Polystyrene

Tailor made for you

In this guide we show typical properties for our most common grades, these tables are not exhaustive, and by no means list all available properties and materials. Our aim is to supply material that precisely matches application requirements and where an existing grade cannot satisfy the specific demands, we have the proven expertise to customise a material that will.

We have developed endless formulations to fulfil different properties and application requirements to optimise the finished component. Use this guide as an introduction to our Dryflex® A series and contact us to discuss your specific requirements.

How is Bonding achieved?

When co-extruding or overmoulding with soft components, the surface of the hard component softens and a diffusion of the molecules in the outer layer takes place. This stage is critical for the quality of the bonding between the soft and hard material, and is called cohesive bonding. The polarities of the two materials are also critical for the bonding strength, and generally the bonding strength depends on the two chosen materials. Another important factor in optimising the bond is to ensure the right processing temperature is used. The VTC TPE Group gauges bonding strength, or peel force, according to ASTM D 903 with a 90° peel angle.

Bonding benefits

Dryflex® A grades enable a cohesive bond with many engineering plastics, to offer a wide range of materials with many different physical properties and virtually unlimited part design opportunities:

- Soft touch
- Rubber feel
- Flexibility
- Excellent sealing performance
- Good colourability
- Cost savings
- Elimination of primers and adhesives
- Simplified production
- Fewer assembly steps
- New design opportunities
- Service temperature -40°C to +125°C
- UV, ozone and weather resistant

Applications

Thanks to the great ease of colouring Dryflex® A grades, the materials offer virtually unlimited possibilities for the end product. The materials are ideal in applications where an engineering plastic is already used, such as PP, PE, PA, ABS, PC, etc., and where a soft touch or a seal is required. Dryflex® A grades can be used in a vast array of applications in the automotive, household, construction, medical device, electronics and sport markets. Typical examples include handles for screwdrivers, bicycles and skiing poles, as well as various types of wheels and seals.

Processing

Dryflex® A bondable grades can easily be overmoulded or co-extruded with different engineering plastics. However, there are some particular aspects to consider to achieve the best possible processing of these materials. The following recommendations will improve the bond between the engineering plastic and the Dryflex® A compound.

The parameters are applicable when the TPE compound is injection moulded or extruded onto the engineering plastic, but are also applicable if the procedure is reversed.

1. High melt temperature for the TPE, please see the detail for each material series.
2. The mould temperature of the TPE part should be in the range of 20 – 60°C.
3. Dry and clean surfaces of the engineering plastic.
4. Sufficient thickness (at least 1.5 mm) of the TPE part.
5. Location and design of the gate.
6. Smooth surface on the plastic part.

For further information, please see our processing guide on bonding.

All Dryflex® A grades are 100% recyclable.

Polyamide

There are many advantages in using polyamide in an application, including high temperature resistance, very high strength, a matt surface and excellent stiffness and impact resistance. When combined with Dryflex® A grades, customers enjoy the properties of both materials in one and the same product.

Bonding strength to Polyamide

Internal tests, in optimum conditions and with most polyamides, indicate a peel force in excess of the material's tensile strength, which means the bonding strength is greater than the tensile strength.

There are many different polyamides available on the market and the bonding strength can vary depending on the type and brand chosen. We recommend sending the polyamide to us before starting a project, so that the bonding strength can be tested internally in order to gauge suitability.

Properties of Dryflex® A1 bondable grades on Polyamide

In the following tables, typical properties of Dryflex® A1 and A01 bondable grades are shown. The A1 series has good compression set values and has been developed to be cost-effective, but to achieve the optimum bond the material has to be processed at a slightly higher temperature than the A01 series.

Properties common to both series are:

Weather resistance, ageing in air:	Excellent
Chemical resistance:	Good (exceptions: organic solvents, aromatic and vegetable oils)
Service temperature:	-50°C - 125°C (unstressed material)

Dryflex® A1 series

Material	Hardness Shore A	Colour	Tensile Strength MPa	Specific Gravity g/cm ³	Elongation at Break %	Tear Strength kN/mm	Modulus 100% MPa	Modulus 300% MPa	MFR 5kg/190°C g/10 min	Peel Force N/mm
Test Method	ASTM D 2240 ¹		ASTM D 638	ASTM D 792	ASTM D 638	ASTM D 624	ASTM D 638	ASTM D 638	ASTM D 1238	ASTM D 903 ²
A1 600301	30	Natural	3.0	1.16	590	15.0	0.8	2.0	23.0	Cohesive ³
A1 602301	30	Black	3.0	1.16	590	15.0	0.8	2.0	23.0	Cohesive ³
A1 600401	40	Natural	3.5	1.16	440	21.0	1.0	2.7	7.0	Cohesive ³
A1 602401	40	Black	3.5	1.16	440	21.0	1.0	2.7	7.0	Cohesive ³
A1 600501	50	Natural	4.5	1.16	480	26.0	1.4	3.5	6.0	Cohesive ³
A1 602501	50	Black	4.5	1.16	480	26.0	1.4	3.5	6.0	Cohesive ³
A1 600601	60	Natural	5.5	1.16	420	29.0	2.0	4.5	4.0	Cohesive ³
A1 602601	60	Black	5.5	1.16	420	29.0	2.0	4.5	4.0	Cohesive ³
A1 600701	70	Natural	7.0	1.16	490	34.0	2.7	5.5	3.0	Cohesive ³
A1 602701	70	Black	7.0	1.16	490	34.0	2.7	5.5	3.0	Cohesive ³
A1 600801	80	Natural	9.2	1.16	460	46.0	4.3	7.6	7.0	Cohesive ³
A1 602801	80	Black	9.2	1.16	460	46.0	4.3	7.6	7.0	Cohesive ³
A1 600901	90	Natural	12.0	1.16	510	57.0	6.0	9.0	10.0	Cohesive ³
A1 602901	90	Black	12.0	1.16	510	57.0	6.0	9.0	10.0	Cohesive ³

1) 4mm

2) Tests conducted on overmoulded test specimens, 2.5mm thick with a 90° peel angle

3) Cohesive = the bonding strength is greater than the tensile strength

Figures are indicative and can vary depending on the specific grade selected.

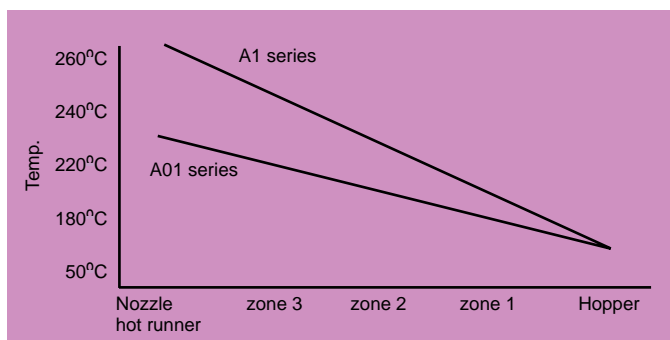
A01 series – can be processed at lower temperature

Material	Hardness Shore A	Colour	Tensile Strength MPa	Specific Gravity g/cm ³	Elongation at Break %	Tear Strength kN/mm	Modulus 100% MPa	Modulus 300% MPa	MFR 2.16kg/190°C g/10 min	Peel Force N/mm
Test Method	ASTM D 2240 ¹		ASTM D 638	ASTM D 792	ASTM D 638	ASTM D 624	ASTM D 638	ASTM D 638	ASTM D 1238	ASTM D 903 ³
600400 A01	40	Natural	3.0	1.20	400	18.0	1.0	2.0	2.0	Cohesive ⁴
602400 A01	40	Black	3.0	1.20	400	18.0	1.0	2.0	2.0	Cohesive ⁴
600500 A01	50	Natural	3.5	1.18	450	23.0	2.0	3.0	20.0 ²	Cohesive ⁴
602500 A01	50	Black	3.5	1.18	450	23.0	2.0	3.0	20.0 ²	Cohesive ⁴
600600 A01	60	Natural	3.0	1.20	300	22.0	2.0	3.0	9.0	Cohesive ⁴
602600 A01	60	Black	3.0	1.20	300	22.0	2.0	3.0	9.0	Cohesive ⁴
600700 A01	70	Natural	5.0	1.22	200	30.0	4.0	-	10.0 ²	Cohesive ⁴
602700 A01	70	Black	5.0	1.22	200	30.0	4.0	-	10.0 ²	Cohesive ⁴

1) 4mm
 2) Tests conducted on overmoulded test specimens, 2.5mm thick with a 90° peel angle
 3) Cohesive = the bonding strength is greater than the tensile strength
 Figures are indicative and can vary depending on the specific grade selected.

Processing temperatures for the A1 and A01 series

To achieve optimal bonding, it is important that the correct processing temperatures are used. The recommended melt temperature for the A1 series is 250°C – 260°C and the surface temperature of the polyamide should be approximately 100°C. For the A01 series the melt temperature is 220°C – 230°C and the surface temperature of the polyamide approximately 60°C.



Temperature profile for A1 and A01 Series

ABS & Polycarbonate

ABS, Polycarbonate and blends of the two are strong, particularly impact-resistant materials, with transparent options available. When combined with Dryflex® A2 series, it is easy to design products with a soft touch, seal or good grip. In addition to ABS and PC, Dryflex® A2 series also display excellent bonding to PMMA, ASA, SAN and their blends.

Bonding strength to ABS & Polycarbonate

Most materials in the A2 series, in internal tests, show that the peel force is stronger than the material's tensile strength, i.e. the TPE ruptures before the bond.

Properties of Dryflex® A2 bondable grades to ABS & Polycarbonate

In the following tables typical properties of Dryflex® A2 bondable grades to ABS, PC, PC/ABS, PMMA, SAN, ASA and blends of these are shown. These materials are primarily designed for injection moulding, but can also be extruded. There are also grades produced specially for extrusion.

Properties common to all A2 series are:

Chemical resistance: Good (exceptions: organic solvents, aromatic and vegetable oils)
 Service temperature: -50°C - 125°C (unstressed material)

A2 series with improved UV resistance (table 1)

Material	Hardness Shore A	Colour	Tensile Strength MPa	Specific Gravity g/cm ³	Elongation at Break %	Tear Strength kN/mm	Modulus 100% MPa	Modulus 300% MPa	MFR 2.16kg/190°C g/10 min	Peel Force N/mm
Test Method	ASTM D 2240 ¹		ASTM D 638	ASTM D 792	ASTM D 638	ASTM D 624	ASTM D 638	ASTM D 638	ASTM D 1238	ASTM D 903 ²
A2 600501	50	Natural	3.5	1.18	500	20.0	1.8	2.7	10.0	>3
A2 602501	50	Black	3.5	1.18	500	20.0	1.8	2.7	10.0	>3
A2 660501	50	Natural	3.5	1.06	500	20.0	1.8	2.7	10.0	>3
A2 600601	60	Black	4.6	1.19	550	26.0	2.2	3.4	5.0	Cohesive ³
A2 602601	60	Natural	4.6	1.19	550	26.0	2.2	3.4	5.0	Cohesive ³
A2 660601	60	Black	4.6	1.08	550	26.0	2.2	3.4	12.0	Cohesive ³
A2 600701	70	Natural	6.0	1.17	500	34.0	3.0	5.0	5.0	Cohesive ³
A2 602701	70	Black	6.0	1.17	500	34.0	3.0	5.0	5.0	Cohesive ³
A2 660701	70	Natural	6.0	1.10	500	34.0	3.0	5.0	7.0	Cohesive ³

1) 4mm
 2) Tests conducted on overmoulded test specimens, 2.5mm thick with a 90° peel angle
 3) Cohesive = the bonding strength is greater than the tensile strength
 Figures are indicative and can vary depending on the specific grade selected.

A2 series that comply with food regulations, apart from fatty foods (table 2)

Material	Hardness Shore A	Colour	Tensile Strength MPa	Specific Gravity g/cm ³	Elongation at Break %	Tear Strength kN/mm	Modulus 100% MPa	Modulus 300% MPa	MFR 2.16kg/190°C g/10 min	Peel Force N/mm
Test Method	ASTM D 2240 ¹		ASTM D 638	ASTM D 792	ASTM D 638	ASTM D 624	ASTM D 638	ASTM D 638	ASTM D 1238	ASTM D 903 ²
A2 600509	50	Natural	3.5	1.18	500	20.0	1.8	2.7	10	>3
A2 602509	50	Black	3.5	1.18	500	20.0	1.8	2.7	10	>3
A2 600609	60	Natural	4.7	1.19	520	26.0	2.3	3.4	5.0	Cohesive ³
A2 602609	60	Black	4.7	1.19	520	26.0	2.3	3.4	5.0	Cohesive ³
A2 600709	60	Natural	6.0	1.16	500	34.0	3.0	5.0	5.0	Cohesive ³
A2 602709	70	Black	6.0	1.16	500	34.0	3.0	5.0	5.0	Cohesive ³

1) 4mm
 2) Tests conducted on overmoulded test specimens, 2.5mm thick with a 90° peel angle
 3) Cohesive = the bonding strength is greater than the tensile strength
 Figures are indicative and can vary depending on the specific grade selected.

A2 series with improved UV resistance that comply with food regulations, apart from fatty foods (table 3)

Material	Hardness Shore A	Colour	Tensile Strength MPa	Specific Gravity g/cm ³	Elongation at Break %	Tear Strength kN/mm	Modulus 100% MPa	Modulus 300% MPa	MFR 2.16kg/190°C g/10 min	Peel Force N/mm
Test Method	ASTM D 2240 ¹		ASTM D 638	ASTM D 792	ASTM D 638	ASTM D 624	ASTM D 638	ASTM D 638	ASTM D 1238	ASTM D 903 ²
A2 660502	50	Natural	4.0	1.06	600	21.0	1.5	2.5	7.0	Cohesive ³
A2 662502	50	Black	4.0	1.06	600	21.0	1.5	2.5	7.0	Cohesive
A2 660602	60	Natural	5.0	1.06	600	28.0	2.2	3.5	8.0	Cohesive
A2 662602	60	Black	5.0	1.06	600	28.0	2.2	3.5	8.0	Cohesive

1) 4mm
 2) Tests conducted on overmoulded test specimens, 2.5mm thick with a 90° peel angle
 3) Cohesive = the bonding strength is greater than the tensile strength
 Figures are indicative and can vary depending on the specific grade selected.

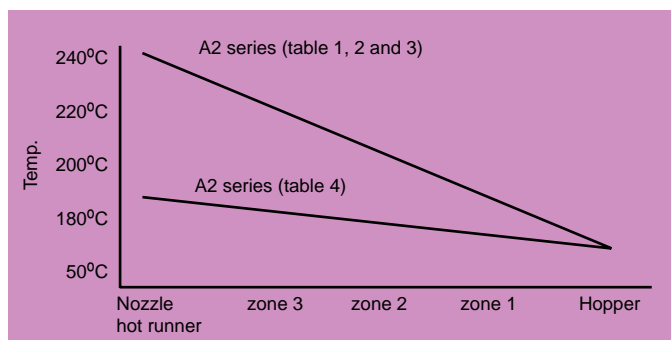
A2 series with good weather resistance that can be processed at lower temperatures (table 4)

Material	Hardness Shore A	Colour	Tensile Strength MPa	Specific Gravity g/cm ³	Elongation at Break %	Tear Strength kN/mm	Modulus 100% MPa	Modulus 300% MPa	MFR 2.16kg/190°C g/10 min	Peel Force N/mm
Test Method	ASTM D 2240 ¹		ASTM D 638	ASTM D 792	ASTM D 638	ASTM D 624	ASTM D 638	ASTM D 638	ASTM D 1238	ASTM D 903 ²
A2 600450	45	Natural	3.0	1.07	400	22.0	1.0	2.5	6.0	>3
A2 602450	45	Black	3.0	1.07	400	22.0	1.0	2.5	6.0	>3
A2 600600	60	Natural	7.0	1.07	500	30.0	2.0	3.0	5.0	Cohesive ³
A2 602600	60	Black	7.0	1.07	500	30.0	2.0	3.0	5.0	Cohesive ³

1) 4mm
 2) Tests conducted on overmoulded test specimens, 2.5mm thick with a 90° peel angle
 3) Cohesive = the bonding strength is greater than the tensile strength
 Figures are indicative and can vary depending on the specific grade selected.

Processing temperatures for the A2 series

To achieve optimal bonding, it is important that the correct processing temperatures are used. The recommended melt temperature for the A2 series is 220°C – 240°C and the surface temperature of the engineering plastic should be approximately 60°C. The recommended melt temperature for the A2 compounds that can be processed at lower temperatures is 180°C – 190°C and the surface temperature of the engineering plastic should be approximately 60°C.



Temperature profile for the A2 Series

Polystyrene

Polystyrene is a crystal clear, stiff, extremely fragile material, but it can be modified to produce impact-resistant grades. Polystyrene is ideal for bonding to Dryflex® A3 series thermoplastic elastomer materials.

Properties of Dryflex® A3 bondable grades to Polystyrene

In the tables below, typical properties of some Dryflex® A3 bondable grades to Polystyrene are shown. The differences between the materials in the two tables are the base materials of the compounds.

A3 series – based on SEBS

The materials of the A3-500 series are based on SEBS and have the following properties:

Weather resistance, ageing in air: Excellent
 Chemical resistance: Good (exceptions: organic solvents, aromatic and vegetable oils)
 Service temperature: -50°C - 125°C (unstressed material)

Material	Hardness Shore A	Colour	Tensile Strength MPa	Specific Gravity g/cm ³	Elongation at Break %	Tear Strength kN/mm	Modulus 100% MPa	Modulus 300% MPa	MFR 2.16kg/190°C g/10 min	Peel Force N/mm
Test Method	ASTM D 2240 ¹		ASTM D 638	ASTM D 792	ASTM D 638	ASTM D 624	ASTM D 638	ASTM D 638	ASTM D 1238	ASTM D 903 ³
A3 500450	45	Natural	3.0	0.92	650	29.0	1.0	1.5	20.0	2.5 - 4.0
A3 500600	60	Natural	7.0	0.89	700	27.0	1.6	2.7	9.0	3.5 - 4.0
A3 500750	75	Natural	4.0	0.95	400	29.0	3.0	4.0	20.0 ²	2.5 - 4.0

1) 4mm
 2) 5kg/190°C
 3) Tests conducted on overmoulded test specimens, 2.5mm thick with a 90° peel angle
 Figures are indicative and can vary depending on the specific grade selected.

A3 series – based on SEBS/SBS

A3 700600 is based on SEBS/SBS and has been developed as a cost-effective option. There are also materials available without BHT content.

Weather resistance, ageing in air: Good
 Chemical resistance: Good (exceptions: organic solvents, aromatic and vegetable oils)
 Service temperature: -50°C to 75°C (unstressed material)

Material	Hardness Shore A	Colour	Tensile Strength MPa	Specific Gravity g/cm ³	Elongation at Break %	Tear Strength kN/mm	Modulus 100% MPa	Modulus 300% MPa	MFR 2.16kg/190°C g/10 min	Peel Force N/mm
Test Method	ASTM D 2240 ¹		ASTM D 638	ASTM D 792	ASTM D 638	ASTM D 624	ASTM D 638	ASTM D 638	ASTM D 1238	ASTM D 903 ⁴
A3 700600	60	Natural	6.0	1.03	700	30.0	1.5	2.0	4.0	3.5 - 4.0
A3 700601 ³	60	Natural	6.0	1.03	700	30.0	1.5	2.0	12.0 ²	3.5 - 4.0

1) 4mm
 2) 5kg/190°C
 3) BHT free
 4) Tests conducted on overmoulded test specimens, 2.5mm thick with a 90° peel angle
 Figures are indicative and can vary depending on the specific grade selected.

Processing temperatures for the A3 series

To achieve optimal bonding, it is important that the correct processing temperatures are used. The recommended melt temperature for A3 series is 190°C – 220°C and the surface temperature of the engineering plastic should be approximately 30 – 40°C.

All the above information about chemical and physical properties consists of values measured in tests on injection moulded test specimens. We provide written and illustrated advice in good faith. This should only be regarded as being advisory, and does not absolve the customer from doing their own tests and trials, to determine the suitability of the material for the intended applications. We retain the right to make changes without prior notice.

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