taro plast

Thermoplastic copolyester elastomers

Pibiflex®

Riteflex®

Pibiflex® Riteflex®

Thermoplastic copolyester elastomers (TPC-ET)

Product description

Pibiflex® and **Riteflex**® brands are Taro Plast registered trademarks for thermoplastic copolyester elastomers (TPC-ET). These products are copolymers consisting of hard crystalline segments of polybutylene terephthalate and soft amorphous segments based on polyether chemistry. The products are high valued materials capable of performance beyond the reach of many thermoset rubbers, especially in thermal, oxidative and chemical resistance. As thermoplastics, they do not require vulcanization to obtain optimal properties. Through the combination of hard and soft segments, these materials offer many of the desirable properties of thermoset elastomers while providing ease in processability, recyclability and reuse capability of thermoplastics. Besides recycling and reuse, these materials can also, to a large extent, be made from bio-based and/or chemical recycled feedstocks.

Pibiflex® and **Riteflex**® **composition**

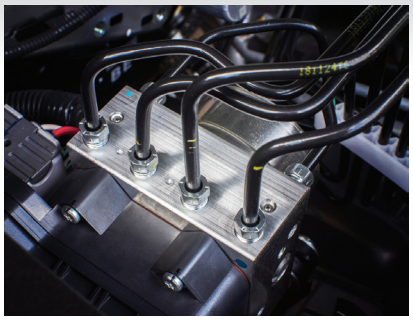
Pibiflex® and **Riteflex**® copolymers combine toughness and resilience with excellent resistance to creep, impact, tearing and flexural fatigue. Both products perform over a wide temperature range of -50°C to 150°C and have good impact at low temperatures while retaining high functionality at high temperatures. The products have excellent chemical resistance to common solvents, oils, greases, diluted acids and bases.

Pibiflex® and **Riteflex**® elastomers are available as unreinforced polymers in a wide range of Shore D hardnesses with the harder versions having enhanced heat and chemical resistance and the softer grades possessing good low temperature mechanical properties.

This wide range of properties that is available from **Pibiflex**® and **Riteflex**® elastomers is reflected in the diversity of applications for these materials such as tubes & hoses (T&H), seals, gaskets, belts, pump diaphragms, wire & cables (W&C), hooks, fasteners, films, sheets, boots & bellows as well as airducts being some of the more outstanding applications. A properly selected grade allows the replacement of a multipiece plastic or rubber component by a single plastic part in many applications.

Specialty grades of **Pibiflex**® and **Riteflex**® are also available, such as heat-stabilized, UV-stabilized and halogen-free flame-retardant grades. Colored formulations can be provided upon request based on specific applications.

Pibiflex® masterbatches to improve heat, hydrolysis stability and UV stability are available (Table 4). Conventional thermoplastics processing methods, in particular, injection molding and extrusion, can be used with **Pibiflex®** and **Riteflex®** materials. Processing temperature range depends on both the specific process and the grade selected. As with all plastic materials, end-use testing, particularly at extreme conditions, is an essential element in material and part qualification. The appropriate Material Safety Data Sheet (MSDS) should be consulted before processing **Pibiflex®** and **Riteflex®** resins.



Available grades

Taro Plast offers a complete TPC-ET portfolio ranging from soft to hard solutions.

- **Injection molding grades** offering easy processability, with a wide range of hardnesses.
- **Extrusion** and **blow molding grades** providing excellent melt strength.

Type	*Availability*
Injection molding	✓
Blow molding	✓
Extrusion	✓
Rotational molding	✓
Physical foaming	✓

Type	*Availability*
High transparency	X
UV stabilized	✓
Heat stabilized	✓
Electrically conductive	X
Thermally conductive	X
Flame retardant	✓
Low emission	✓
Food contact	✓
Medical	✓

Pibiflex® and Riteflex® characteristics

- Good chemical resistance to various chemical substances, oils, and solvents
- Good wear resistance
- Easy processing
- Good flexibility at low temperatures and good strength retention at high temperatures
- High impact strength, flexural fatigue & creep resistance over a broad temperature range
- Excellent toughness and elasticity
- Excellent surface gloss and easy miscibility with colors
- Easy to recycle and reuse.
- Bio-based and chemical recycled sustainable solutions available.

Table 2. Characteristics and typical applications of majority of **Pibiflex®** grades

	Melting point (°C)	*Hardness (Shore D)*	*Characteristics*	*Processing*	*Typical applications*
Pibiflex® 2060	165	22	Excellent low-temperature mechanical properties. Low melting point.	Injection Extrusion	Films, tubing, DC strain relief, grips, dispensers
Pibiflex® 2560	187	30	Excellent low-temperature mechanical properties.	Injection	Films, tubing, DC strain relief, grips, dispensers
Pibiflex® 3512	165	35	Good low-temperature mechanical properties. Low melting point.	Injection	Films, tubing, DC strain relief, grips, dispensers, building & construction
Pibiflex® 3560	195	36	Good low-temperature mechanical properties.	Injection	Railway pads, building& construction, dispensers, W&C outdoor jackets &insulation, springs

Table 2. Characteristics and typical applications of majority of **Pibiflex®** grades

	Melting point (°C)	*Hardness (Shore D)*	*Characteristics*	*Processing*	*Typical applications*
Pibiflex® E4010LC	155	30	Low modulus. Low melting point.	Extrusion	Medical tubes, hot-melts
Pibiflex® 4012	187	41	Medium modulus. Low melting point.	Injection	Medical tubes, hot-melts
Pibiflex® 4560	204	40	Medium modulus.	Injection	Railway pads, W&C outdoor insulation & jackets, spider couplings, springs
Pibiflex® 5510	202	50	Medium modulus.	Injection	Fuel cap tether, W&C outdoor insulation & jackets, spider couplings, railway buffers & pads
Pibiflex® 5612	208	56	Medium modulus.	Injection	Spider couplings, W&C
Pibiflex® E4482	213	44	Medium modulus. High melting point.	Extrusion	Conveyor belts, cords & ropes
Pibiflex® E5310	203	52	Medium modulus.	Extrusion	Conveyor belts, cords & ropes
Pibiflex® E5332	200	53	Medium modulus.	Extrusion	T&H
Pibiflex® E6060	217	58	Medium-high modulus. High melting point.	Extrusion	T&H, gears
Pibiflex® L6060	217	58	High flow	Injection	Cable tie, fuel cap tethers
Pibiflex® L6064	217	58	High flow	Injection	Fasteners, cable tie, fuel cap tethers
Pibiflex® 6710	216	63	High modulus	Injection	Coiled cables, T&H, conveyor belts
Pibiflex® 7212	219	70	High modulus	Injection	W&C outdoor insulation & jackets, coiled cables
Pibiflex® 3597	195	35	UV&heat stabilized	Extrusion	Breathable roofing membranes
Pibiflex® 3567S2	195	35	UV&heat stabilized, high scratch resistant	MuCell technology (Dolphin process)	Foam cover for instrument panels
Pibiflex® 4564T	207	40	Medium modulus, heat stabilized	Injection	Gaskets
Pibiflex® 4568T	208	41	Medium modulus, heat & hydrolysis stabilized, black	Injection	Automotive under the hood applications, noise encapsulation
Pibiflex® 4054IM	200	41	Medium modulus, heat stabilized, chemical resistance	Injection	CVJ boot adapter ring
Pibiflex® B4054T2	205	42	Heat stabilized, grease resistant, very high melt strength	Blow molding	Industrial CVJ boots
Pibiflex® B5050MWR	200	41	High viscosity, heat stabilized, chemical resistant to grease, high abrasion & fatigue.	Blow molding	CVJ boots
Pibiflex® 4484	213	44	Medium modulus, high melting point, heat stabilized	Injection	Car Body Plugs
Pibiflex® E4484G	213	46	High melting point	Extrusion	Mandrels
Pibiflex® E5578 FR01	200	58	V2 flame retardant grade for extrusion applications	Extrusion	W&C
Pibiflex® E6067T	215	57	Heat stabilized	Extrusion	Vacuum brake tube, T&H
Pibiflex® 56X01	201	60	Special polymer. Approximately 25% renewable content.	Injection Extrusion	Elastomer compounds, fuel tank floater

Table 3. **Riteflex®** Characteristics and typical applications

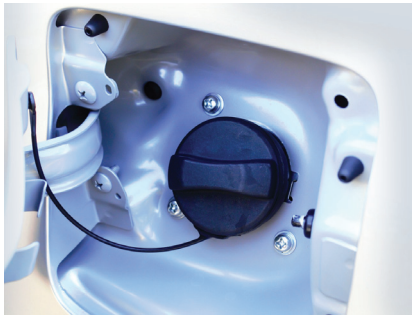
	Melting point (°C)	*Hardness (Shore D)*	*Characteristics*	*Processing*	*Typical applications*
Riteflex® 425	155	24	Low modulus, low melting point, outstanding temp. impact, tear resistance	Injection	Films, soft touch grips
Riteflex® 430	170	30	Low modulus, low melting point, low temperature impact strength	Extrusion	Films, tubing, W&C, soft touch grips
Riteflex® 440F	195	36	Medium modulus	Injection	Fasteners, cable tie, Fuel cap tethers, gaskets
Riteflex® 440	195	37	Medium modulus	Injection Extrusion	Films, wires&cable jackets, T&H, sprinkler seals, profiles and grommets
Riteflex® 640A	170	40	Medium modulus, low melting point	Extrusion	Fasteners, cable tie, Fuel cap tethers, gaskets
Riteflex® XFR 440	195	40	Medium modulus, halogen free flame-retardant (V0 UL94)	Extrusion	General applications requiring flame retardancy
Riteflex® 447	212	46	Medium modulus, high melting point	Injection Extrusion	Tubes, hot-melts
Riteflex® 655A	200	55	Medium modulus	Injection Extrusion	Grommets, bumper pads and body plugs, gears, belting, profiles, W&C jackets
Riteflex® XFR 655	200	55	High modulus, halogen free flame-retardant (V0 UL94)	Extrusion	General applications requiring flame retardancy
Riteflex® 663	212	63	Medium modulus	Injection Extrusion	Grommets, body plugs, A/C louver, connectors, seals, bushings and profiles
Riteflex® 672	215	72	High modulus	Injection Extrusion	Gears, sprockets, electrical connectors, profiles, seals and bushings
Riteflex® 677	218	75	High modulus	Injection Extrusion	Connectors, gears and sprockets, electrical connector and bushings

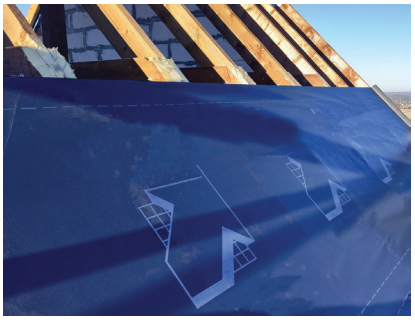
Table 4. **Riteflex®** masterbatches

	Melting point (°C)	*Characteristics*
Pibiflex® 100CB	170	Carbon black masterbatch
Pibiflex® 102HS	170	Heat stabilizer masterbatch
Pibiflex® 102UV	170	UV stabilizer masterbatch

Summary of properties

- Hardness from 20 up to 75 Shore D
- Flexural Modulus from 20 up to 700 MPa
- Tensile Strength from 14 up to 45 MPa
- Elongation at break from 300 up to 900 %
- Vicat (1 kg/120 °C) from 80 up to over 200 °C
- HDT (0.45 MPa) from 46 up to over 120 °C





Mechanical properties

Pibiflex® and **Riteflex®** feature excellent mechanical properties, such as tensile and tear strength, toughness and resilience, high creep and flexural fatigue resistance.

Temperature resistance

Pibiflex® and **Riteflex®** have an excellent temperature behavior showing good flexibility at low temperatures and good retention of characteristics at high temperatures.

Chemical resistance

Pibiflex® and **Riteflex®** offer outstanding chemical resistance to fuels, oils, greases, and they are particularly suitable for applications in the automotive sector where continuous contact with oils and grease at high temperature is required.

	Hardness (Shore D)		
	35-40	45-55	>60
Oils, greases, hydrocarbons			
Mineral oil, grease, non-aromatic hydrocarbons	●	●	●
Benzene, toluene, aromatic hydrocarbons, chemicals, solvents	●	●	●
Water, alcohols, glycols			
At ambient temperature 23 °C	●	●	●
> 50 °C without specific stabilizers	●	●	●
> 50 °C with specific stabilizers	●	●	●
Acids and bases			
Diluted	●	●	●
Concentrated	●	●	●

● Little or no effect ● Moderate effect ● Severe effect

Recycling

Pibiflex® and **Riteflex®** are fully recyclable materials. Production scraps can be reprocessed after grinding. Recovered material can be mixed with virgin material. Taro Plast recommends no more than a 20% mix to not affect final quality.

Processing

Pibiflex® and **Riteflex**® thermoplastic elastomers main processing technologies are injection molding and extrusion. Processing conditions are typically determined by melting point and viscosity of the grade being processed.

Pibiflex® and **Riteflex**® resins should be dried before processing. Reducing moisture level to less than 0.05% can be done with desiccant dryers or dehumidifying hoppers.

For processing materials with crystalline melting points and relatively low melt viscosities, the screw L/D ratio should be in the range of 20:1 or greater with at least 3 or 4 flights of metering zone. The feed zone should account for about half the screw length, with the remaining half equally divided between transition and metering zones. A compression ratio, i.e., the ratio of flight depth in the feed zone to that in the metering zone, should be preferably below 3.2.

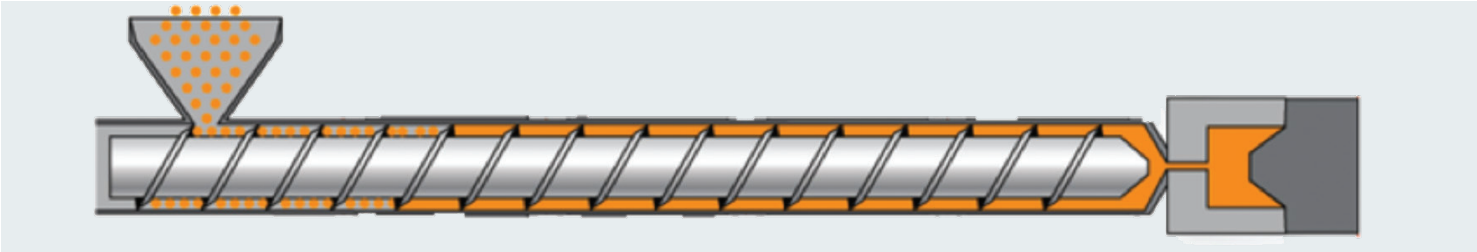


Table 1. Indicative temperature profiles for **Pibiflex**® and **Riteflex**® grades.

Melting temperature range of the product (°C)	*Hopper temp.°C*	*Feed temp.°C*	*Rear temp.°C*	*Middle temp.°C*	*Front temp.°C*	*Nozzle temp.°C*	*Mold temp.°C*	*Melt temp.°C*
150-170	20-50	150-170	160-180	170-180	170-190	170-190	20-30	175-190
180-190	20-50	160-180	180-200	180-210	190-210	210-220	20-55	200-220
195-210	20-50	180-200	200-210	210-220	210-220	210-225	20-55	210-230
>210	20-50	200-210	210-220	220-230	220-230	225-240	20-55	220-240

Applications

- **Automotive:** CVJ boots, airbag components, air ducts, soft skins for dashboard, conveyor belts, hoses, steering wheel covers, interior trims, shock absorber bellows, radiator grilles, bellows, body plugs, cable ties, pneumatic tubing, fuel cap tether, gaskets, wire and cable jacketing, antenna gasket, power adapter plug
- **Electrical appliances:** Wire and cable jacketing, buttons and grips of electric power tools equipment, connectors, capacitor cover
- **Industrial:** Railway pads, train buffer spring, high pressure gaskets, seals, silent gears, springs, cable ties, conveyor belts, jaw couplings, conveyor chains, ball joints, pump diaphragms, mandrels
- **Consumer:** Hose and sprinkler seals, belts, nonslip mats, bedsprings, frisbees, flipper blades, ski boot shells, snowboard cover laminates, furniture textiles, roof sheeting, bike saddles

Adhesion-2K molding

Pibiflex® and **Riteflex**® feature very good adhesion properties to many polymeric materials including ABS, PBT, PC, PC/PBT, PC/ABS, EVA, TPU, SEBS (special grades) and to many paints, adhesives and metals.

Approvals

Various **Pibiflex**® and **Riteflex**® TPC-ET grades have been approved for automotive applications by the most important automotive manufacturers and Tier 1s.

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