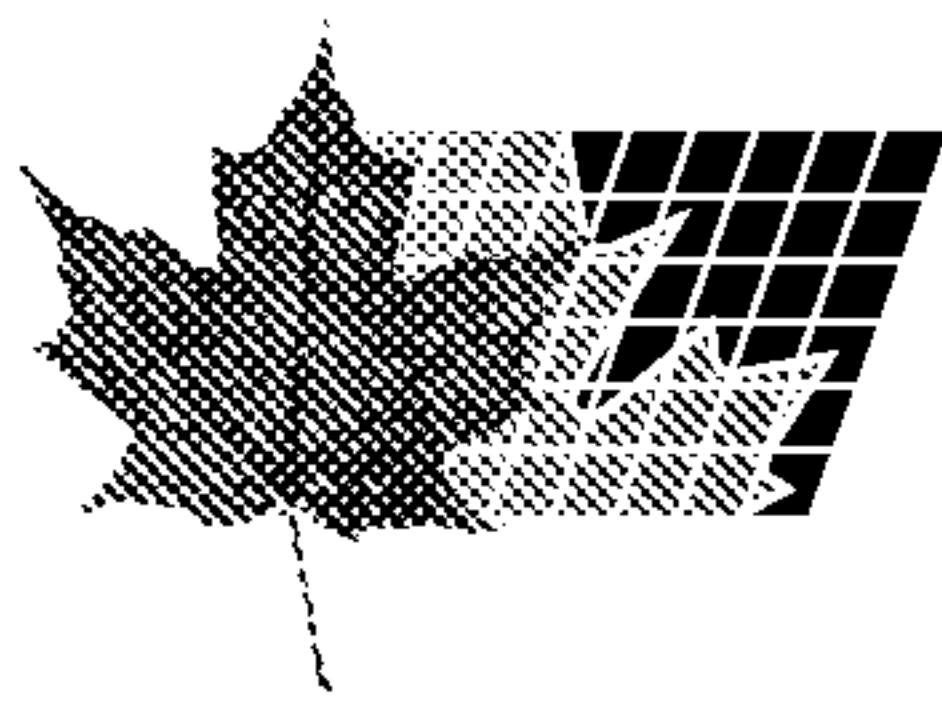




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(54) **METHODE DE MOULAGE PAR SOUFFLAGE, ET ARTICLES
AINSI MOULES**

(54) **BLOW MOLDING PROCESS AND PRODUCT**

(57) Blow molded multi-layered articles for automotive use, for example ducts, hoses, tubes, sealing devices and covers commonly include two layers of compatible material, both layers being formed of expensive, highly resistant materials. It has been found that the outer layer of a two-layered article or the middle (and possibly outer) layer of a three-layered article can be produced using a relatively inexpensive, non-resistant material without sacrificing flexibility or other desirable physical properties of the finished product. For example, the inner and outer layers of a three-layered article can be formed of a thermoplastic rubber, which exhibits the elastomeric performance of vulcanized rubbers and the processing simplicity of thermoplastic polymers, and the middle layer can be formed of a polypropylene based thermoplastic elastomer.



ABSTRACT OF THE DISCLOSURE

Blow molded multi-layered articles for automotive use, for example ducts, hoses, tubes, sealing devices and covers commonly include two layers of compatible material, both layers being formed of expensive, highly resistant materials. It has been found that the outer layer of a two-layered article or the middle (and possibly outer) layer of a three-layered article can be produced using a relatively inexpensive, non-resistant material without sacrificing flexibility or other desirable physical properties of the finished product. For example, the inner and outer layers of a three-layered article can be formed of a thermoplastic rubber, which exhibits the elastomeric performance of vulcanized rubbers and the processing simplicity of thermoplastic polymers, and the middle layer can be formed of a polypropylene based thermoplastic elastomer.

This invention relates to a process for producing a multi-layered article, and in particular to a process for producing a multi-layered automotive article and to the article thus produced.

5 The production of hollow, multi-layered articles using blow molding techniques is by no means new. Examples of the production of such multi-layered articles are described in United States Patents Nos. 3,955,697, which issued to E.I. Valyi on May 11, 1976; 4,079,850, which issued to T. Suzuki
10 et al on March 21, 1978; 4,398,642, which issued to T. Okudaira et al on August 16, 1983; 4,424,834, which issued to T. Sumi et al on January 10, 1984, and 4,535,901, which issued to T. Okudaira et al on August 20, 1985. In general, the production of multi-layered articles, e.g. articles having two or three
15 layers of coextruded resins can be quite expensive. Articles commonly produced using such coextrusion methods include ducts, hoses, tubes, sealing devices and covers used in automotive vehicles. Specific articles of this type include shock absorber boots, rack and pinion boots, steering gear boots, suspension
20 strut boots, and constant velocity joint boots. Because articles of this type are exposed to a variety of temperatures and substances such as grease and oil, it is important that at least one layer of the articles be formed of a resistant resin. The usual practice is to form all layers using expensive materials.

25 The object of the present invention is to reduce the cost of such articles by forming at least one of the layers

of a less expensive material which can substantially reduce the overall cost of the article without compromising the chemical resistant properties thereof.

Accordingly, the present invention relates to a process
5 for producing multi-layered articles for automotive use comprising the steps of forming a parison including at least a chemically resistant inner layer, and a less resistant, relatively inexpensive outer layer; and blow molding the parison to yield the article.

10 When producing a two-layered article such as constant velocity joint boot, it is important that the inner layer be formed of a chemically resistant material, since it is the inner layer which is in constant contact with grease. Table
15 1 which follows provides examples of articles produced using a variety of materials, the middle or outer layer of material being less expensive than the inner layer.

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TABLE 1

SAMPLE NUMBER	INNER LAYER	MIDDLE LAYER	OUTER LAYER
5	1	SANTOPRENE 103-40	SALFLEX 145
	2	SALFLEX 145	SANTOPRENE 103-40
	3	SANTOPRENE 103-40	SALFLEX 145
10	4	HYTREL 5612	HYTREL 4275
	5	HYTREL 4275	HYTREL 5612
	6	HYTREL 4275	HYTREL 5612
15	7	HYTREL 5612	HYTREL 4275
	8	HYTREL 5612	HYTREL 5612
	9	BAYER 0148	PELPRENE P55B
20	10	PELPRENE P55B	BAYER 0148
	11	PELPRENE P55B	BASF C90A
	12	HYTREL 5612	COMPOSITION 1 HYTREL 5612
25	13	PELPRENE P55B	COMPOSITION 1 PELPRENE P55B
	14	PELPRENE P55B	COMPOSITION 2 PELPRENE P55B

Santoprene 103-40 is a Monsanto trade mark for a thermoplastic rubber, which exhibits the elastomer performance of vulcanized rubbers and the processing simplicity of thermoplastic polymers. Santoprene rubbers exhibit excellent mechanical properties over a useful operating range of -40°C to 150°C, low compression set and tension set, and excellent hot air aging at temperatures up to 150°C. Santoprene rubbers have superior abrasion resistance, high tear strength, high dynamic fatigue resistance and excellent ozone and weathering resistance. Moreover, Santoprene rubbers are inherently resistance to a wide variety of oils, solvents and chemicals, and are not readily soluble in any common solvent. Highly polar fluids such as alcohols, ketones, glycols, esters and aqueous solutions of acids, salts and bases have little effect upon the rubber.

Salflex 145 is a trade mark of Salflex Polymers for a polypropylene based thermoplastic elastomer.

Hytrel is a DuPont trade mark for a copolyester prepared by transesterification using readily available starting materials such as dimethyl terephthalate polytetramethylene ether glycol and 1,4-butanediol. The polymers are normally synthesized by conventional equilibrium melt condensation polymerization in the presence of an ester interchange catalyst. The resulting products are random block copolymers consisting of crystalline 1,4-butanediol hard segments and amorphous elastomeric polyalkylene ether terephthalate soft segments. Hytrel provides excellent resistance to non-polar materials such as oils and

hydraulic fluids even at elevated temperatures, and is resistant to most polar fluids such as acids, bases, amines and glycols at room temperature. The resistance of Hytrel to hot moist environments is also good. In general, Hytrel is resistant to the same classes of chemicals and fluids as polyurethanes, both ester and ether based. However, Hytrel has better high temperature properties than polyurethanes. Hytrel polyester elastomers do not contain an extractable plasticizer as do flexible vinyls, certain grades of nylon and many rubber compounds. Many fluids and chemicals will extract the plasticizer from these materials, causing a significant increase in stiffness and volume shrinkage. Hytrel has excellent flexibility at room temperature and low temperatures, excellent flex crack resistance, resistance to tear, abrasion and impact, and has a service temperature of -50°C to 110°C.

Bayer 0148 is a polyester-polyurethane which can be processed as a thermoplastic.

Pelprene P55B is a polyether ester block copolymer (elastomer). The polymer provides excellent properties in terms of rubbery resilience and plastic durability over a wide range of temperatures, excellent resistance to oils, fuels and chemicals at high temperatures, and excellent resistance to any weather condition. Pelprene contains no plasticizers, so that no extraction of additives by any solvent is possible. Pelprene has a thermal resistance of -70°C to 150°C.

Lomod B0100 is a General Electric trade mark for a polyester.

5 BASF C90A is a polyester-polyurethane which can be processed as a thermoplastic, and which can be used in injection molding, extrusion blow molding and thermoforming. The plastic also provides excellent resistance to most oils, gases and engine fluid. The thermal stability of such materials permits their use in extreme weather conditions. The polymer is flexible at low and high temperatures and
10 resistant to abrasion.

Composition 1 is a modified thermoplastic elastomer containing 46% Hytrel 5556 (trade mark), 44% Nordel 5892 (DuPont trade mark) and 10% Surlyn 1705. Nordel 5892 is ethylenepropylene diene (EPDM), which is a terpolymer
15 elastomer produced in several variations, the principle variant being the diene mentioned above. Dicyclopentadiene, ethylidene norbornene and 1,4-hexadiene are the types usually selected as the nonconjugated diene component. The unsaturation remaining after the initial synthesis is utilized
20 in classical sulfur type vulcanization. Nordel hydrocarbon elastomers are extremely resistant to attack by ozone, oxygen and weather. Moreover, properly prepared vulcanizates of Nordel are outstanding in resistance to deterioration by heat, steam and many chemicals. Surlyn 1705 is an ionomer based on
25 zinc salts of ethylene/(meth) acrylic acid copolymers. The zinc ions neutralize from 10 to 90% of the acid groups, and

the remaining unsaturated carboxylic acids can be either mono or dicarboxylic acids such as acrylic, methacrylic (preferred), ethacrylic, itaconic, maleic-fumaric acids, hydrogen maleate and methyl hydrogen fumarate. Surlyn provides thermal stability, excellent abrasion and impact resistance. Most ionomers are insoluble in common organic solvents at room temperature, and resist attack from most mild acids and bases. Outstanding low temperature flex and impact toughness are characteristic. The brittleness temperature for the polymers is as low as -110°C . Finally, the change in modulus versus temperature is relatively small.

Composition 2 is a modified thermoplastic elastomer containing 40% Hytrel 5556, 40% Kraton G1650 and 20% Surlyn 1705. Kraton G1650 is a Shell trade mark for a styrene-ethylene-butylene-styrene block copolymer of the A-B-A type, where A represents polystyrene end blocks and B represents a polyolefin rubber midblock. Since Kraton G rubbers have a unique olefin rubber midblock, they are heat and shear stable at processing temperatures as high as 500°F . Finished articles formed of Kraton G rubbers are highly resistant to ozone attack, oxidation and degradation from exposure to sunlight. The elastomers provide excellent resistance to water, acids and bases, and are flexible at low temperatures.

The results of physical tests on the samples listed in Table 1 are found in Table 2, which follows:

TABLE 2

TEST	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SAMPLE NO.														
TENSILE (MPa) @ break 2"/min	12.1	16.5	11.8	40.9	36.7	33.1	34.2	36.3	44.5	32.1	31.4	26.7	32.6	20.0
ELONGATION (%) @ break	575	588	513	725	750	675	738	525	475	512	513	700	738	550 delam- inates
PULL STRENGTH (one layer from another) @ yield (MPa) 2"/min	the layers could not be separated, showing excellent adhesion of one layer to another													
THICKNESS in	12	19	12	43	57	17	22	2	54	33	38	24	35	12
OF LAYERS mid	88	81	61	57	43	42	26	3	46	19	15	41	28	61
out (%)			27			41	52	95		48	47	35	37	27

NOTE: In the above table, "in", "mid" and "out" mean inner, middle and outer, respectively.

It will be appreciated that the material used in the inner layers of the coextruded products must be resistant to a variety of automotive fluids - more so than the middle and outer layers. The inner layers are directly exposed to the fluids on a continuous basis, and must resist attack even under extreme temperature and flex conditions. Table 3 provides a list of a few examples of oil aged coextruded products, and a comparison for non-oil aged and single layer samples. The single layer samples are formed of the same material as the inner or outer layer. The test is oil aging in ASTM #3 oil at 125°C for 168 hours. The samples are tensile bars cut from fabricated components.

TABLE 3

SINGLE LAYER		TENSILE		COEXTRUDED 3-LAYERS	
NON-OIL AGED	OIL AGED	NON-OIL AGED		OIL AGED	
HYTREL 5612		HYTREL 5612/HYTREL 4275/HYTREL 5612			
30.0MPa	24.0MPa	34.2MPa		23.7MPa	
HYTREL 4275		HYTREL 4275/HYTREL 5612/HYTREL 4275			
28.0MPa	23.0MPa	33.1MPa		22.9MPa	
HYTREL 5612		HYTREL 5612/COMP.1 / HYTREL 5612			
30.0MPa	24.0MPa	26.7MPa		24.1MPa	

It will be noted that the oil aging tensile results for the coextruded samples are approximately equal to those obtained for single layer samples, where the single layer is the inner layer material of a three layer sample. Thus it is seen that the coextrusion process does not have any deleterious

effect on the property of the most important layer, namely the inner layer of the product.

On the basis of physical and chemical test date, including stress/strain tests, it has been found that the coextrusion process does not adversely affect the excellent properties exhibited by thermoplastic elastomers or polyesters when used alone. The main advantage of the process described herein, especially for shock absorber, rack and pinion, steering gear, suspension strut and constant velocity joint boots or covers, is reduced cost. At present, the production of such parts utilizing polyester or thermoplastic elastomers is quite expensive. Using the coextrusion process of the present invention, a less expensive middle or outer layer can be employed in combination with chemical, abrasion and flex resistant materials in the inner or outer and inner layers. The result is a substantial reduction in the cost of the products.

Table 4 below lists examples of combinations of elastomers and the characteristics which yield the advantages described herein.

TABLE 4

<u>SAMPLE NO.</u>	<u>LAYER</u>	<u>MATERIAL</u>	<u>CHARACTERISTICS</u>
1	INNER	Santoprene 103-40	good grease and fluid resistance, excellent high temperature flex
	OUTER	Salflex 145	less expensive and lower grease and fluid resistance than inner layer

	3	INNER	Santoprene 103-40	good grease and fluid resistance, excellent high temperature flex
		MIDDLE	Salflex 145	less expensive, and lower grease and fluid resistance than inner layer
5		OUTER	Santoprene 103-40	good grease and fluid resistance, excellent high temperature flex
	4	INNER	Hytrel 5612	excellent grease, fluid and abrasion resistance, excellent high/low temperature flex
10		OUTER	Hytrel 4275	excellent grease, fluid and abrasion resistance, excellent high/low temperature flex, and slightly less expensive than inner layer
	5	INNER	Hytrel 4275	see above
15		OUTER	Hytrel 5612	see above
	6	INNER	Hytrel 4275	see above, slightly less expensive than Hytrel 5612
		MIDDLE	Hytrel 5612	see above
20		OUTER	Hytrel 4275	see above
	7	INNER	Hytrel 5612	see above
		MIDDLE	Hytrel 4275	see above
		OUTER	Hytrel 5612	see above
25	8	INNER	Hytrel 5612	see above
		MIDDLE	Lomod B0100	slightly less expensive than inner layer, with good chemical and fluid resistance, and good temperature flex
		OUTER	Hytrel 5612	see above

	9	INNER	Bayer 0148	less expensive than Hytrel 5612, with excellent chemical and fluid resistance, excellent strength (tensile, tear strength)
5		OUTER	Pelprene P55B	excellent chemical, fluid and abrasion resistance, excellent high and low temperature flex, and long flex life
	10	INNER	Pelprene P55B	see above
10		MIDDLE	Bayer 0148	see above
		OUTER	Pelprene P55B	see above
	11	INNER	Pelprene P55B	see above
15		MIDDLE	BASF C90A	less expensive than inner layer, excellent resistance to chemicals and fluids, and excellent strength (tensile, tear strength)
		OUTER	Pelprene P55B	see above
20	12	INNER	Hytrel 5612	excellent grease, fluid and abrasion resistance, excellent high and low temperature flex
		MIDDLE	Composition 1	substantially less expensive than inner layer, with good flex life under hot and cold temperature conditions
25		OUTER	Hytrel 5612	see above

13	INNER	Pelprene P55B	see above
	MIDDLE	Composition 1	see above
	OUTER	Pelprene P55B	see above
14	INNER	Pelprene P55B	see above
	MIDDLE	Composition 2	substantially less expensive than inner layer, with good flex life under hot and cold temperature conditions

10 It has been found that the middle or outer layer of
the product can be a softer material, which increases the flex
life of the boot or cover under extreme temperature conditions.
For example, in Sample #1, Salflex 145 is less expensive than
Santoprene, and has good high and low temperature flex results.

15 The Santoprene 103-40 is a softer material for use in the outer
layer to improve the flex life of the product under extreme
temperature conditions. In the case of Sample #5, both of the
Hytrels have excellent chemical, fluid and abrasion resistance,
and excellent high and low temperature flex, but the Hytrel

20 5612 used in the outer layer is softer than Hytrel 4275 to improve
the flex life under extreme temperatures. For Samples 6 to
12, all of the layers have excellent properties, the softer
material being used in the middle layer to ensure a long flex
life of the product even under extreme temperature conditions.

25 Although, while most of the examples of 3-layer

coextruded articles listed hereinbefore include inner and outer layers of the same material, it will be appreciated that the outer layer of material could be changed to a less expensive, yet still abrasion and fluid resisted material. In many cases, the outer layer is not exposed to the same grease and automotive fluids as the inner layer. Thus, while the outer layer must be durable, in many cases it is possible to use a polyester or thermoplastic elastomer which is less expensive than the outer layer material. Samples 1 and 4 of Table 1 are examples of inner and outer layer materials, where the outer layer is less expensive and has a lower resistance than the inner layer. Other examples are Hytrel 5612 as the inner layer, and Salflex 4275 as the outer layer, Pelprene P55B as the inner layer, and Lomod B0100 as the outer layer, and Pelprene P55B as the inner layer, BASF C90A as the middle layer and Lomod B0100 as the outer layer.

Table 5 which follows provides a list of the fluids most commonly contacted by the coextruded products. The table also provides an indication of the changes in physical properties of the compound contacted by the fluids.

TABLE 5				
FLUID	HYTREL		PELPRENE	SANTOPRENE
<u>PHYSICAL PROPERTIES</u>	<u>5612 & 4275</u>		<u>P55B</u>	<u>103-40</u>
Standard	5612	4275		
Tensile (MPa)	32.0	30.0	30.0	19.0
Elongation (%)	700	600	700	560

ASTM OIL #1			
168hr @ 120°C		70 hr	
% Tensile loss	0	13	11
% Elong. loss	+9	+14	20
% Vol. increase	2	10	N/A

ASTM OIL #3			
168 hr @ 120°C		70 hr	
% Tensile loss	+2	19	28
% Elong. loss	+9	5	41
% Vol. increase	13	29	N/A

AUTOMATIC TRANSMISSION			
168hr @ 120°C			
%Tensile loss	+10	N/A	N/A
% Elong. loss	+9		
% Vol. increase	6		

MOTOR OIL	HARMONY #41*	TOYOTA 20W-40*	
	168hr @ 100°C	72hr @ 80°C	N/A
% Tensile loss	+1	+2	
% Elong. loss	2	+20	
% Vol. increase	3	5	

HYDRAULIC FLUID:			
PYDRAUL 312*			
168hr @ 120°C			
% Tensile loss	10	N/A	6
% Elong. loss	9		11
% Vol. increase	31		N/A

SKYDROL 500B4*			
168 hr @ 120°C			
% Tensile loss	90	N/A	5
% Elong. loss	90		7
% Vol. increase	32		N/A

HYDRAULIC BRAKE FLUID		NISSAN *	SAE J1703f
		72hr @ 80°C	166hr @ 80°C
% Tensile loss	N/A	8	+.4
% Elong. loss		+21	2
% Vol. increase		13	N/A

GREASE			
168hr @ 120°C			
% Tensile loss	N/A	TOYOTA MP 2	QUAKER STATE*
		0	9
% Elong. loss		+32	13
% Vol. increase		21	N/A

ASTM REFERENCE
FUEL C

5	168hr @ 23°C		
	% Tensile loss	7	N/A
	% Elong. loss	6	6
	% Vol. increase	24	2
			N/A

* - denotes trade mark

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A process for producing a multi-layered article for automotive use comprising the steps of forming a parison including at least a chemically resistant inner layer selected from the group consisting of a copolyester, a polyether ester block copolymer, a thermoplastic rubber and a polyester-polyurethane; and a less chemically resistant outer layer selected from the group consisting of a polypropylene based thermoplastic elastomer, a copolyester and a polyether ester block copolymer; and blow molding the parison to yield the article.
2. A process according to claim 1, including a middle layer between said inner and outer layers selected from the group consisting of a polypropylene based thermoplastic elastomer, a copolyester, a polyester, a polyester-polyurethane; a modified thermoplastic elastomer containing a copolyester, ethylene propylene diene and an ionomer based on zinc salts of ethylene/acrylic acid copolymers, and a modified thermoplastic elastomer containing a copolyester, a styrene-ethylene-butylene-styrene block copolymer and an ionomer based on zinc salts of ethylene/acrylic acid copolymers.
3. A process according to claim 1, wherein said parison includes an inner layer of thermoplastic rubber, and an outer layer of a polypropylene based thermoplastic elastomer.
4. A process according to claim 1, wherein said parison includes an inner layer of a polypropylene based thermoplastic elastomer and an outer layer of a thermoplastic rubber.

5. A process according to claim 2, wherein said parison includes an inner layer of a thermoplastic rubber, a middle layer of a polypropylene based thermoplastic elastomer and an outer layer of a thermoplastic rubber.
6. A process according to claim 1, wherein said parison includes an inner layer of a copolyester, and an outer layer of a less chemically resistant copolyester.
7. A process according to claim 2, wherein said parison includes inner, middle and outer layers, each formed of a copolyester, the middle layer being less chemically resistant than the inner and outer layers.
8. A process according to claim 2, wherein said parison includes inner and outer layers formed of a copolyester, and a middle layer formed of a less resistant polyester.
9. A process according to claim 1, wherein said parison includes an inner layer of a polyester-polyurethane and an outer layer of a polyether ester block copolymer.
10. A process according to claim 2, wherein said parison includes outer and inner layers of polyether ester block copolymer and a middle layer of polyester-polyurethane.
11. A process according to claim 2, wherein said parison includes outer and inner layers of a copolyester, and a middle layer of a modified thermoplastic elastomer containing a copolyester, ethylene propylene diene and an ionomer based on zinc salts or ethylene/acrylic acid copolymers.
12. A process according to claim 2, wherein said parison includes outer and inner layers of a polyether ester block copolymer, and a middle layer of a

modified thermoplastic elastomer containing a copolyester, ethylene propylene diene and an ionomer based on zinc salts of ethylene/acrylic acid copolymers.

13. A process according to claim 2, wherein said parison includes inner and outer layers of a polyether ester block copolymer, and a middle layer of a modified thermoplastic elastomer containing a copolyester, a styrene-ethylene-butylene-styrene block copolymer and an ionomer based on zinc salts of ethylene/acrylic acid copolymers.

14. A multi-layered article for automotive use comprising at least a chemically resistant inner layer selected from a group consisting of a copolyester, a polyether ester block copolymer, thermoplastic rubber and a polyester-polyurethane; and an outer layer selected from the group consisting of a polypropylene based thermoplastic elastomer, a copolyester and a polyether ester block copolymer.

15. An article according to claim 14, including a middle layer selected from the group consisting of a polypropylene based thermoplastic elastomer, a copolyester, a polyester, a polyester-polyurethane, a modified thermoplastic elastomer containing a copolyester, ethylene propylene diene and an ionomer based on zinc salts of ethylene/acrylic acid copolymers, and a modified thermoplastic elastomer containing a copolyester, a styrene-ethylene-butylene-styrene block copolymer and an ionomer based on zinc salts of ethylene/acrylic acid copolymers.

16. A multi-layered article for automotive use comprising an inner layer of thermoplastic rubber, and an outer layer of a polypropylene based thermoplastic elastomer.

17. A multi-layered article for automotive use comprising an inner layer of a polypropylene based thermoplastic elastomer and an outer layer of a thermoplastic rubber.

18. A multi-layered article for automotive use comprising an inner layer of a thermoplastic rubber, a middle layer of a polypropylene based thermoplastic elastomer and an outer layer of a thermoplastic rubber.

19. A multi-layered article for automotive use comprising an inner layer of a copolyester, and an outer layer of a less resistant, relatively inexpensive copolyester.

20. A multi-layered article for automotive use comprising inner, middle and outer layers, each formed of a copolyester, the middle layer being less resistant and expensive than the inner and outer layers.

21. A multi-layered article for automotive use comprising inner and outer layers formed of a copolyester, and a middle layer formed of a less resistant polyester.

22. A multi-layered article for automotive use comprising an inner layer of a polyester-polyurethane and an outer layer of a polyether ester block copolymer.

23. A multi-layered article for automotive use comprising outer and inner layers of polyether ester block co-polymer and a middle layer of polyester-polyurethane.

24. A multi-layered article for automotive use comprising outer and inner layers of a copolyester, and a middle layer of a modified thermoplastic elastomer containing a co-polyester, ethylene propylene diene and an ionomer based on zinc salts of ethylene/acrylic acid copolymers.

25. A multi-layered article for automotive use comprising outer and inner layers of a polyether ester block copolymer, and a middle layer of a modified thermoplastic elastomer containing a copolyester, ethylene propylene diene and an ionomer based on zinc salts of ethylene/acrylic acid copolymers.

26. A multi-layered article for automotive use comprising inner and outer layers of a polyether ester block copolymer, and a middle layer of a modified thermoplastic elastomer containing a copolyester, a styrene-ethylene-butylene-styrene block copolymer and an ionomer based on zinc salts of ethylene/acrylic acid copolymers.