

BOMBARDIER

Title:

Marking of Plastics, Rubbers and Thermoplastic Elastomers

Scope:

This document is applicable to all divisions of Bombardier Transportation.

Purpose / Summary:

Bombardier Transportation is committed to mark polymeric components weighing in excess of 100 grams in line with ISO 11469 and associated standards. This ensures that the polymeric components can be efficiently identified, separated and processed for recycling at end-of-life.

The purpose of this document is to define an efficient method for marking components manufactured from polymeric materials; i.e. plastics, rubbers and thermoplastic elastomers. Therefore, a concise summary of the ISO standards within this area is provided along with a broad range of supporting examples.

This document is relevant for components that are newly designed, or are in the process of being designed, as well as existing components that are undergoing a design change. In addition, those component(s) that do not currently incorporate a marking, should be modified to incorporate such a marking prior to commencement of any further manufacturing runs.

Note: This document does not replace the standards referenced herein, which should be referred to for further guidance where required.

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1 Description

Bombardier Transportation is committed to mark polymeric components weighing in excess of 100 grams in line with ISO 11469 and associated standards. This ensures that the polymeric components can be efficiently identified, separated and processed for recycling at end-of-life.

This commitment reflects the End-of-Life Vehicles (ELV) directive (2000/53/EC) and the supporting decision (2003/138/EC) for all plastic components and materials weighing in excess of 100 grams, to be marked. The ELV directive aims to prevent waste from vehicles at end-of-life and divert materials and components for reuse, recycling or energy recovery. Although the ELV directive does not currently apply to rail vehicles, through voluntarily meeting the marking requirements, the Company is able to proactively prepare for future legislation whilst also maintaining the attractiveness of rail travel in relation to other transport modes.

The purpose of this document therefore is to define an efficient method for marking components manufactured from polymeric materials; i.e. plastics, rubbers and thermoplastic elastomers. A concise summary of the ISO standards within this area is provided along with a broad range of supporting examples.

In instances where there is size, geometric, cosmetic or functional restraints, which make the inclusion of a marking difficult or impossible, refer to the DfE EBoK (accessed via Bombardier ExpressNet) for examples of markings and lessons learned. Alternatively contact the project DfE Engineer who will be able to provide advice on the most appropriate course of action.

Where reasonably practicable, it is encouraged that components weighing less than 100 grams be also marked (although this is not compulsory).

1.1 Introduction to the marking of plastics, rubbers and thermoplastic elastomers

The marking of components manufactured from plastics, rubbers and thermoplastic elastomers is one aspect of the Design for Environment (DfE) process, which aims to minimize the environmental impact of Bombardier Transportation's products, in line with customer and end-user expectations.

In order to maximize the intrinsic value of these materials, they must be easily identified and then separated at end-of-life according to their material type and chemical structure. Attempting to recycle poorly separated polymer or rubber materials at end-of-life will result in a poor quality material, which has low or zero monetary worth and properties that make it suitable for only the most undemanding of applications.

Through ensuring that materials are properly separated prior to recycling, the mechanical and aesthetic properties of the resulting recycled material can be maximized, thus dramatically increasing the value and suitability of the recycled material for future applications. This is best achieved through providing a clear marking on the surface of the plastic or rubber component in line with ISO 11469 and associated standards. To identify all of the various plastics, rubbers and thermoplastic elastomers without the aid of markings would be prohibitively cost intensive and therefore must be avoided.

1.2 Implementation

1.2.1 Determining the correct marking

Components manufactured from plastics, rubbers and thermoplastic elastomers are to be marked in accordance with the guidelines contained in ISO 11469 and the standards listed in Table 1, below:

Component	Type	ISO Reference
Base material(s)	Plastics	ISO 1043 part 1
	Rubbers	ISO 1629
	Thermoplastic elastomers	ISO 18064
Fillers and reinforcing materials		ISO 1043 part 2
Plasticizers		ISO 1043 part 3
Flame retardants		ISO 1043 part 4

Table 1: ISO standards

In many instances, plastics, rubbers and thermoplastic elastomers may contain additives such as fillers, plasticizers and flame retardants. Therefore, the correct marking may consist of abbreviated terms for the base material(s) plus symbols for the additives described above. As indicated in Table 1, the base material is to be marked according to abbreviated terms given in ISO 1043 part 1 (if it is a plastic), ISO 1629 (if it is a rubber) and ISO 18064 (if it is a thermoplastic elastomer). Parts 2, 3 and 4 of ISO 1043 provide symbols for fillers, plasticizers and flame retardants for polymeric materials. These three parts of the ISO 1043 plastic marking standard also apply to rubbers and thermoplastic elastomers.

In order to efficiently determine the correct marking it is recommended that the step-by-step approach shown in Figure 1 be followed in conjunction with the steps included in Table 2.

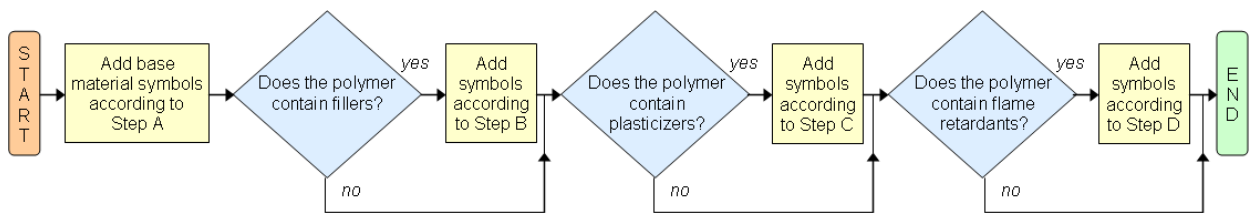


Figure 1: Steps to marking plastics, rubbers and thermoplastic elastomers

The marking for a polymer that contains fillers, plasticizers and flame retardants will look something like the following:

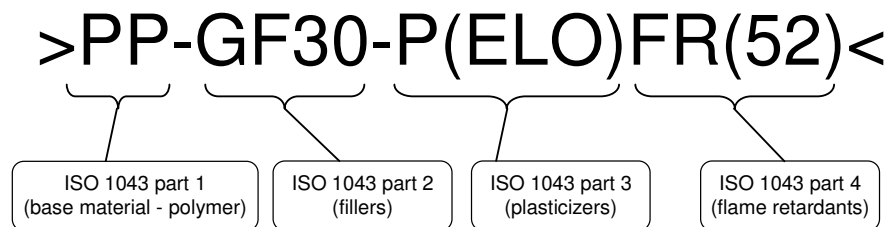


Figure 2: Example marking

In all instances, the letters and numbers representing the plastics, rubbers and thermoplastic elastomers are to be placed in-between “>” and “<” as indicated above.

Table 2, below, provides a concise and thorough explanation of how to correctly mark components. Definitions of polymer terms are given in Section 2. Refer to Section 1.3 or the referenced ISO standard for symbols of the most commonly used plastics, rubbers, thermoplastic elastomers and additives.

ID	Description	Example	Table Ref.	ISO Ref.
Step A – Base material (plastic)				
A1	<p><u>Single-constituent plastics</u></p> <p>For components made from a single polymer (i.e. homopolymer or copolymer) the marking would be the abbreviated term for the polymer enclosed by > and <. The most common homopolymers and copolymers are listed in Table 3.</p> <p>As seen in the third example, a stroke “/” may be used to designate a copolymer when its omission would be confusing.</p> <p><i>Note: once you have your symbol, check whether any of the below items apply; for example do you need to add any further symbols for special characteristics? (See ID A3).</i></p>	<p><u>Example:</u> Polycarbonate (a homopolymer)</p> <p>>PC<</p> <p><u>Example:</u> Acrylonitrile-butadiene-styrene polymer (a copolymer)</p> <p>>ABS<</p> <p><u>Example:</u> Copolymer of PA6 and PA12</p> <p>>PA6/12<</p>	Table 3	ISO 11469; ISO 1043 part 1
A2	<p><u>Multiple-constituent plastics (polymer blends)</u></p> <p>If a mixture (blend or alloy) of polymers is used, the abbreviated terms for the different polymers would be separated by a “+”, with the main component in first place. This would then be followed by the other components in the order of their decreasing mass fractions.</p>	<p><u>Example:</u> A blend of polycarbonate and poly(butylene terephthalate), in which the polycarbonate is the main polymer</p> <p>>PC+PBT<</p> <p><i>Note: there should be no space before or after the “+” sign.</i></p>	Table 3	ISO 11469; ISO 1043 part 1
A3	<p><u>Special characteristics in polymers</u></p> <p>Up to four letters can be added to the abbreviated term for the base polymer in order to differentiate between different modifications of the polymer. The supplementary symbol(s) would be placed after the abbreviated term of the base polymer, separated by a hyphen “-”, with no spacing before or after the hyphen.</p>	<p><u>Example:</u> High Density Polyethylene</p> <p>>PE-HD<</p> <p><i>Note: No symbol should be placed in front of the abbreviated term for the base polymer. Hence >PE-HD< is preferred to >HDPE<.</i></p>	Table 4	ISO 1043, part 1

ID	Description	Example	Table Ref.	ISO Ref.
A4	<p><u>Two or more components, which are difficult to separate (such as laminates)</u></p> <p>Products that comprise of two or more components, some of which are not readily visible, should preferably be marked so that the primary visible material is identified first, followed by the identification of the other material(s), with the individual materials separated by a comma. Underlining is used to identify the main component by mass.</p> <p><i>Note: Parts that consist of glued or welded components made of different plastics, rubbers and thermoplastic elastomers are to be marked on each component according to the material used.</i></p>	<p><u>Example:</u> A product made of three components, where the visible one is a thin coating of poly(vinyl chloride) over polyurethane containing an insert of acrylonitrile-butadiene-styrene, which is the major component by mass</p> <p>>PVC,PUR,<u>ABS</u><</p>	N/A	ISO 11469
Step A – Base material (rubber)				
A5	<p><u>Single-constituent rubbers</u></p> <p>For components made from a single rubber, the marking should be the abbreviated term for the rubber (see Table 5), enclosed by > and <.</p>	<p><u>Example:</u> Butadiene rubber</p> <p>>BR<</p>	Table 5	ISO 11469; ISO 1629
Step A – Base material (thermoplastic elastomer)				
A6	<p><u>Single-constituent thermoplastic elastomers</u></p> <p>The prefix “TP” is to be followed by a letter representing the appropriate category of the thermoplastic elastomer (see Table 6). This is to be followed by a hyphen, followed by the symbols describing the specific member of the category (see Table 6).</p>	<p><u>Example:</u> A urethane thermoplastic elastomer, of type aromatic hard segment, polyester soft segment</p> <p>>TPU-ARES<</p>	Table 6	ISO 18064
A7	<p><u>Thermoplastic elastomer blends of polymers and rubbers</u></p> <p>Some types of thermoplastic elastomers are a blend of a thermoplastic material and a conventional rubber.</p> <p>For these, the group name of the thermoplastic elastomer (see Table 6) should first be followed by a hyphen “-“. This should then be followed by parentheses (curved brackets), which accommodate the standard abbreviation for the rubber type (see Table 5), a “+” sign and the standard abbreviation for the thermoplastic type (see Table 3).</p>	<p><u>Example:</u> Blend of ethylene-propylene-diene terpolymer with polypropylene, with no or little crosslinking of the EPDM phase, the amount of EPDM present being greater than that of PP</p> <p>TPO-(EPDM+PP)</p>	Table 6	ISO 18064

ID	Description	Example	Table Ref.	ISO Ref.
	<p><i>Note: The thermoplastic and the rubber type should be listed in decreasing order of abundance in the thermoplastic elastomer.</i></p>			
Step B – Fillers and reinforcing materials				
B1	<p><u>Compositions containing a single filler or reinforcing material</u></p> <p>Compositions containing a single filler or reinforcing material should be marked with the abbreviated term for the polymer, followed by a hyphen “-”, then the abbreviated term or symbol for the additive (see Table 7), with its percent by mass, arranged as shown in the example.</p> <p>Note: The symbol for a filler comprises of two parts:</p> <ol style="list-style-type: none"> 1) The symbol for the filler / reinforcing material. 2) The symbol for the form or structure of the filler / reinforcing material. <p>Example: GF is the symbol for glass in the form of fibre.</p>	<p><u>Example:</u> Polypropylene containing 30% by mass of mineral powder</p> <p>>PP-MD30<</p>	Table 7	ISO 11469; ISO 1043 part 2
B2	<p><u>Compositions containing two or more fillers or reinforcing materials</u></p> <p>For compositions containing a mixture of fillers or reinforcing materials, the marking to show the presence of these additives should be between parentheses (curved brackets).</p>	<p><u>Example:</u> Polypropylene containing a mixture of 25% by mass of fibreglass and 15% by mass of mineral powder</p> <p>>PP-(GF25+MD15)<</p> <p><i>Note: there should be no space before or after the “+” sign.</i></p>	Table 7	ISO 11469; ISO 1043 part 2
B3	<p><u>Compositions containing metallic fillers</u></p> <p>The further information required for metals should be indicated by the chemical symbol in parenthesis (curved brackets). Refer to ISO 1043 part 2 for more details.</p> <p>For example, MD(Al) is the symbol for aluminium powder.</p>	<p><u>Example:</u> Polypropylene containing 30% by mass of aluminium powder.</p> <p>>PP-MD(Al)30<</p> <p><i>Note: only capital letters are to be used except for chemical symbols.</i></p>	N/A	ISO 1043 part 2

ID	Description	Example	Table Ref.	ISO Ref.
Step C - Plasticizers				
C1	<p><u>Compositions containing plasticizers</u></p> <p>Compositions containing plasticizers are to be marked with the abbreviated term for the polymer followed by a hyphen, then the symbol "P" followed by the abbreviated term of the plasticizer in parentheses (curved brackets), as given in Table 8.</p>	<p><u>Example:</u> PVC containing Epoxidized Linseed Oil as plasticizer</p> <p>>PVC-P(ELO)<</p>	Table 8	ISO 1043 part 3
Step D – Flame Retardants				
D1	<p><u>Compositions containing flame retardants</u></p> <p>Compositions containing flame retardants are to be marked with the abbreviated term for the polymer followed by a hyphen, then the symbol "FR" followed by the code number of the flame retardant in parentheses (curved brackets), as given in Table 9.</p> <p><i>Note: All plastics containing flame retardants that have been intentionally added or that exceed 1% by weight must include the flame retardant code.</i></p>	<p><u>Example 1:</u> Polypropylene with red phosphorus as a flame retardant</p> <p>>PP-FR(52)<</p> <p><u>Example 2:</u> Polyamide 66 containing a mixture of 15% by mass of mineral powder and 25% by mass of glass fibre and, additionally, red phosphorus (52) as a flame retardant</p> <p>>PA66-(GF25+MD15)FR(52)<</p>	Table 9	ISO 1043 part 4

Table 2: Marking of plastics, rubbers and thermoplastic elastomers

1.2.2 Physical method of marking

ISO 11469 states that markings are to be made by one of the following methods:

- During moulding by having the appropriate symbol included in the mould design.
- By embossing, by melt imprinting or by other legible and indelible marking of the polymer.

Bombardier's preferred method of marking polymers is to integrate a relief into the mould, so that the component has a clear, consistent and indelible marking on the surface of the part. In instances where this is not possible, such as for extruded components and where adding such a relief into the tool would be impossible, an alternative method of marking is to be employed. Refer to the DfE EBoK for examples of markings and lessons learned. Alternatively contact the project DfE Engineer for guidance if required.

1.2.3 Appearance and position of the marking

The appearance and position of the marking is to be in-keeping with the following guidelines:

- The recommendations in ISO 11469 and referenced standards, regarding marking method and structure, are to be followed. These have been summarised in Sections 1.2.1 and 1.2.2.
- It is recommended that the height of the text be between 2.5 and 25 mm. On smaller parts where the inclusion of this size text is not possible, it is permissible to use smaller text sizes. However, all instances of this should be recorded and communicated to the project DfE Engineer.
- The font Helvetica is to be used.
- Capital letters must be used for symbols and abbreviated terms; the only exception to this being for chemical symbols for metallic fillers (example: Al for aluminium).
- The marking should be indelible and remain legible during the entire life of the component.
- The appearance and function of the component or product must not be impaired by the marking.
- The marking code, location, size, and physical process of marking should be specified on the associated technical drawing for the component.

1.3 Abbreviated terms and symbols

This section includes condensed versions of the tables provided in ISO 1043 (plastics), ISO 1629 (rubbers) and ISO 18064 (thermoplastic elastomers). The most commonly used abbreviated terms and symbols are therefore presented. For a complete list of symbols, refer to the aforementioned standards.

1.3.1 Symbols for commonly used plastics

Table 3 presents a compilation of the most commonly used plastics and their respective symbols, in accordance with ISO 1043 part 1. For a complete list, or to determine how to build a new symbol, refer to ISO 1043 part 1.

Symbol	Description
ABS	acrylonitrile-butadiene-styrene
EP	epoxide; epoxy resin or plastic
E/P	ethylene-propylene plastic
MF	melamine-formaldehyde resin
PA6	polyamide 6
PA12	polyamide 12
PA66	polyamide 66
PAEK	polyaryletherketone
PBT	poly(butylene terephthalate)
PC	polycarbonate
PE	polyethylene
PE-UHMW	polyethylene, ultra high molecular weight
PEEK	polyetheretherketone
PET	poly(ethylene terephthalate)
PF	phenol-formaldehyde resin
PI	polyimide
PMMA	poly(methyl methacrylate)
POM	polyacetal, polyoxymethylene
PP	polypropylene
PPE	poly(phenylene ether)
PS	polystyrene
PS-HI	polystyrene, high impact
PSU	polysulfone
PTFE	polytetrafluoroethylene
PUR	polyurethane
PVC	poly(vinyl chloride)
SAN	styrene-acrylonitrile plastic
SB	styrene-butadiene plastic
SI	silicone plastic
UP	unsaturated polyester resin

Table 3: Abbreviated terms for homopolymeric, copolymeric and natural polymeric materials

Note: The symbols for the monomer components of a copolymer generally appear from left to right in the order of decreasing mass ratio. A stroke “/” may be used to designate a copolymer when its omission would be confusing.

1.3.2 Symbols for special characteristics

The abbreviated terms for the basic polymers may be supplemented by up to four symbols to differentiate between modifications of the polymer. Table 4 presents a compilation of the symbols used to indicate special characteristics of the polymer, in accordance with ISO 1043 part 1. For a complete list refer to ISO 1043 part 1.

Note: The supplementary symbol(s) are to be placed after the abbreviated term of the basic polymer, separated by a hyphen, with no spacing before or after the hyphen. No symbol should be placed in front of the abbreviated term for the basic polymer. As an example, High Density Polyethylene should be marked as >PE-HD< rather than >HDPE<.

Symbol	Description
C	chlorinated
D	density
F	flexible or fluid or fluorinated
H	high or homo
I	impact
L	linear or low
M	medium or molecular
N	normal or novolak
P	plasticized or thermoplastic
S	sulfonated or syndiotactic or thermosetting
U	ultra or unplasticized or unsaturated
V	very
W	weight
X	crosslinked or crosslinkable

Table 4: Symbols for special characteristics

1.3.3 Symbols for commonly used rubbers

Table 5 presents a compilation of symbols for commonly used rubbers, in accordance with ISO 1629. For a full list, refer to ISO 1629.

Symbol	Description
ACM	Copolymer of ethyl acrylate and monomer for vulcanization (Acrylic rubber)
ANM	Copolymer of ethyl acrylate and acrylonitrile
EPDM	Ethylene, propylene rubber
ECO	Copolymer of ethylene oxide and chloromethyloxirane
BR	Butadiene rubber
CR	Chloroprene rubber
IIR	Isobutene-isoprene rubber
IR	Isoprene rubber, synthetic
NR	Natural rubber
SBR	Styrene-butadiene rubber
FMQ	Silicone rubber with methyl and fluorine groups
MQ	Silicone rubber with methyl group
AU	Polyester urethane
EU	Polyether urethane

Table 5: Symbols for commonly used rubbers

1.3.4 Symbols for commonly used thermoplastic elastomers

Table 6 presents a compilation of symbols for commonly used thermoplastic elastomers, in accordance with ISO 18064. For more detail refer to ISO 18064.

Category	Description	
Polyamide thermoplastic elastomer (TPA)	Polyamide thermoplastic elastomer, comprising a block copolymer of alternating hard and soft segments with amide chemical linkages in the hard blocks and ether and/or ester linkages in the soft blocks.	
	Sub-Category	Description
	TPA-EE	Soft segment with both ether and ester linkages
	TPA-ES	Polyester soft segment
	TPA-ET	Polyether soft segment
Copolyester thermoplastic elastomer (TPC)	Copolyester thermoplastic elastomer, consisting of a block copolymer of alternating hard segments and soft segments, the chemical linkages in the main chain being ester and/or ether.	
	Sub-Category	Description
	TPC-EE	Soft segment with ester and ether linkages
	TPC-ES	Polyester soft segment
	TPC-ET	Polyether soft segment
Olefinic thermoplastic elastomer (TPO)	Olefinic thermoplastic elastomer, consisting of a blend of a polyolefin and a conventional rubber, the rubber phase in the blend having little or no crosslinking.	
	Sub-Category	Description
	TPO-(EPDM+PP)	Blend of ethylene-propylene-diene terpolymer with polypropylene, with no or little crosslinking of the EPDM phase, the amount of EPDM present being greater than that of PP.
Styrenic thermoplastic elastomer (TPS)	Styrenic thermoplastic elastomer, consisting of at least a triblock copolymer of styrene and a specific diene, where the two end blocks (hard blocks) are polystyrene and the internal block (soft block or blocks) is a polydiene or hydrogenated polydiene.	
	Sub-Category	Description
	TPS-SBS	Block copolymer of styrene and butadiene
	TPS-SEBS	Polystyrene-poly(ethylene-butylene)-polystyrene
	TPS-SEPS	Polystyrene-poly(ethylene-propylene)-polystyrene
	TPS-SIS	Block copolymer of styrene and isoprene
Urethane thermoplastic elastomer (TPU)	Urethane thermoplastic elastomer, consisting of a block copolymer of alternating hard and soft segments with urethane chemical linkages in the hard blocks and ether, ester or carbonate linkages or mixtures of them in the soft blocks.	
	Sub-Category	Description
	TPU-ARES	Aromatic hard segment, polyester soft segment
	TPU-ARET	Aromatic hard segment, polyether soft segment
	TPU-AREE	Aromatic hard segment, soft segment with ester and ether linkages
	TPU-ARCE	Aromatic hard segment, polycarbonate soft segment
	TPU-ARCL	Aromatic hard segment, polycaprolactone soft segment
	TPU-ALES	Aliphatic hard segment, polyester soft segment
	TPU-ALET	Aliphatic hard segment, polyether soft segment
Dynamically vulcanized thermoplastic elastomer (TPV)	Thermoplastic rubber vulcanizate consisting of a blend of a thermoplastic material and a conventional rubber in which the rubber has been crosslinked by the process of dynamic vulcanization during the blending and mixing step.	
	Sub-Category	Description
	TPV-(EPDM+PP)	Combination of EPDM and polypropylene in which the EPDM phase is highly crosslinked and finely dispersed in a continuous polypropylene phase

Category	Description	
	TPV-(NBR+PP)	Combination of acrylonitrile-butadiene rubber and polypropylene in which the NBR phase is highly crosslinked and finely dispersed in a continuous polypropylene phase
	TPV-(NR+PP)	Combination of natural rubber and polypropylene in which the NR phase is highly crosslinked and finely dispersed in a continuous polypropylene phase
	TPV-(ENR+PP)	Combination of epoxidized natural rubber and polypropylene in which the ENR phase is highly crosslinked and finely dispersed in a continuous polypropylene phase
	TPV-(IIR+PP)	Combination of butyl rubber and polypropylene in which the IIR phase is highly crosslinked and finely dispersed in a continuous polypropylene phase
Miscellaneous material (TPZ)	Unclassified thermoplastic elastomer comprising any composition or structure other than those grouped in TPA, TPC, TPO, TPS, TPU and TPV.	
	Sub-Category	Description
	TPZ-(NBR+PVC)	Blend of acrylonitrile-butadiene rubber and poly(vinyl chloride) <i>Note: Many NBR+PVC blends are thermoset vulcanized rubbers, and with these the prefix TPZ should not be used.</i>

Table 6: Symbols for commonly used thermoplastic elastomers

1.3.5 Symbols for commonly used fillers and reinforcing materials

Table 7 presents a compilation of symbols for commonly used fillers and reinforcing materials, as well as symbols for the form or structure that these materials may take. When determining the symbol for a filler or reinforcing material, combine one symbol from position 1 with one symbol from position 2. For example, carbon fibre would have the symbol CF.

For a complete list, refer to ISO 1043 part 2.

Symbol Pos 1	Description	Symbol Pos 2	Description
C	carbon	B	beads, spheres, balls
G	glass	D	powder
K	calcium carbonate	F	fibre
L	cellulose	L	layer
M	mineral, metal	M	mat
P	mica	P	paper
Q	silica	W	woven fabric
R	aramid	X	not specified
T	talcum	Y	yarn
W	wood	Z	others
X	not specified		
Z	others		

Table 7: Symbols for commonly used fillers and reinforcing materials

1.3.6 Symbols for commonly used plasticizers

Table 8 presents a compilation of symbols for commonly used plasticizers, in accordance with ISO 1043 part 3. For a full list, refer to ISO 1043 part 3.

Symbol	Description
BBP	Benzyl butyl phthalate
DBP	Dibutyl phthalate
DEP	Diethyl phthalate
DIDP	Diisodecyl phthalate
DINA	Diisononyl adipate
DINP	Diisononyl phthalate
DMP	Dimethyl phthalate
DOA	Diocetyl adipate
DOP	Diocetyl phthalate
ELO	Epoxidized lineseed oil
ESO	Epoxidized soya bean oil

Table 8: Symbols for commonly used plasticizers

1.3.7 Symbols for commonly used flame retardants

Table 9 presents a compilation of symbols for commonly used flame retardants, in accordance with ISO 1043 part 4. For a full list of fire retardants, refer to ISO 1043 part 4.

Type	Code	Description
Halogenated compounds	10	aliphatic/alicyclic chlorinated compounds
	11	aliphatic/alicyclic chlorinated compounds in combination with antimony compounds
	12	aromatic chlorinated compounds
	13	aromatic chlorinated compounds in combination with antimony compounds
	14	aliphatic/alicyclic brominated compounds
	15	aliphatic/alicyclic brominated compounds in combination with antimony compounds
	16	aromatic brominated compounds (excluding brominated diphenyl ether and biphenyls)
	17	aromatic brominated compounds (excluding brominated diphenyl ether and biphenyls) in combination with antimony compounds
	18	polybrominated diphenyl ether
	19	polybrominated diphenyl ether in combination with antimony compounds
	20	polybrominated biphenyls
	21	polybrominated biphenyls in combination with antimony compounds
	22	aliphatic/alicyclic chlorinated and brominated compounds
25	aliphatic fluorinated compounds	
Nitrogen compounds	30	nitrogen compounds (confined to melamine, melamine cyanurate, urea)
Organic phosphorus compounds	40	halogen-free organic phosphorus compounds
	41	chlorinated organic phosphorus compounds
	42	brominated organic phosphorus compounds
Inorganic phosphorus compounds	50	ammonium orthophosphates
	51	ammonium polyphosphates
	52	red phosphorus
Metal oxides, metal hydroxides, metal salts	60	aluminium hydroxide
	61	magnesium hydroxide
	62	antimony(III) oxide
	63	alkali-metal antimonite
	64	magnesium/calcium carbonate hydrate
Boron and zinc compounds	70	inorganic boron compounds
	71	organic boron compounds
	72	zinc borate
	73	organic zinc compounds
	74	not allocated
Silica compounds	75	inorganic silica compounds
	76	organic silica compounds
Others	80	Graphite

Table 9: Symbols of commonly used flame retardants

2 Definitions and Abbreviations

<u>Term</u>	<u>Definition</u>
Copolymer	A polymer formed from two or more different types of monomers.
ELV	End-of-Life Vehicles
Filler	Additives that lower the consumption of more expensive base material or enhance the properties of the manufactured component in some way (examples: strength, performance).
Flame retardant	A substance that markedly retards the propagation of a flame.
Homopolymer	A polymer formed from a single type of monomer.
Monomer	A molecule that can be chemically bonded to other monomers to form a chain of molecules (known as a polymer chain). It is thus the repeat unit of a polymer chain.
Plasticizer	A substance used to make a plastic more flexible or pliable. In some cases they are also added to improve the processing of the component.
Polymer	A substance produced through the chemical bonding of many identical or compatible molecules known as monomers. The term polymer is often used in place of plastic, rubber or elastomer.
Reinforcing materials	Materials that are used to improve the strength of the manufactured component.
Rubber	Pliable and elastic material that is either processed from naturally occurring sap (most commonly from a rubber tree) or various synthetic elastic materials whose properties resemble that of natural rubber.
Thermoplastic elastomer	Consisting of a polymer or blend of polymers that has properties at its service temperature similar to those of vulcanised rubber but can be processed and reprocessed at elevated temperature like a thermoplastic.

All other definitions and abbreviations are defined in the [Bombardier Transportation lexicon](#).

3 Reference documents

Doc ID-number	Title
- ISO 11469	Plastics - Generic identification and marking of plastic products, 2nd Ed., 2000-05-15.
- ISO 1043-1	Plastics - Symbols and abbreviated terms – Part 1: Basic polymers and their special characteristics, 3rd Ed., 2001-12-15.
- ISO 1043-2	Plastics - Symbols and abbreviated terms – Part 2: Fillers and reinforcing materials, 2nd Ed., 2000-07-15.
- ISO 1043-3	Plastics - Symbols and abbreviated terms - Part 3: Plasticizers, 2nd Ed., 1996-04-15.
- ISO 1043-4	Plastics - Symbols and abbreviated terms – Part 4: Flame retardants, 1 st Ed., 1998-02-15.
- ISO 1629	Rubber and Latex – Nomenclature, 3rd Ed., 1995-11-15.
- ISO 18064	Thermoplastic elastomers – Nomenclature and abbreviated terms, 2005-02-03.
- 2000/53/EC	End-of-Life Vehicles (ELV) directive.
- 2003/138/EC	Commission Decision of 27 February 2003 - establishing component and material coding standards for vehicles pursuant to Directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles.

The current status of each business process document is documented on the coversheet of the available document in the respective database (e.g. in the eBTM).

4 Approval Information

Prepared:	Ben Rose	2010-03-29
	Author	Signature
		Date (yyyy-mm-dd)
Released :	Sara Paulsson / Manager CoC DfE	2010-03-30
	process owner	Signature
		Date (yyyy-mm-dd)

5 Revision Log

Revision	Date of Release	Description of changes
0	2002-10-03	First release
1	2010-03-17	Updated to reflect latest document template and ISO standards. Enhancements include: - Document type changed from a Directive to a Standard. - Title changed from 'marking of polymers' to reflect increased scope of document in line with ISO standards. - Details of how to mark thermoplastic elastomers added in line with ISO 18064.