INTERNATIONAL STANDARD

ISO 7792-1

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Plastics — Thermoplastic polyester (TP) moulding and extrusion materials —

Part 1: Designation system and basis for specifications

Plastiques — Polyesters thermoplastiques (TP) pour moulage et extrusion —

Partie 1: Système de désignation et base de spécification

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 7792-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

This fourth edition cancels and replaces the third edition (ISO 7792-1:1997), which has been technically revised.

ISO 7792 consists of the following parts, under the general title *Plastics — Thermoplastic polyester (TP) moulding and extrusion materials*:

— *Part 1: Designation system and basis for specifications*

— *Part 2: Preparation of test specimens and determination of properties*

Plastics — Thermoplastic polyester (TP) moulding and extrusion materials —

Part 1: Designation system and basis for specifications

1 Scope

This part of ISO 7792 establishes a system of designation for thermoplastic polyester (TP) material, which may be used as the basis for specifications. It covers polyester homopolymers for moulding and extrusion based on poly(ethylene terephthalate) (PET), poly(butylene terephthalate) (PBT), poly(cyclohexylenedimethylene terephthalate) (PCT), poly(ethylene naphthalate) (PEN), poly(butylene naphthalates) (PBN) and other TP-types and copolyesters of various compositions for moulding and extrusion.

The types of thermoplastic polyester are differentiated from each other by a classification system based on appropriate levels of the designatory properties (viscosity number and tensile modulus of elasticity) and on information about the intended application and/or method of processing, important properties, additives, colorants, fillers and reinforcing materials.

This part of ISO 7792 is applicable to thermoplastic polyester homopolymers and copolymers. It applies to materials ready for normal use in the form of powder, granules or pellets, unmodified or modified by colorants, additives, fillers, etc.

This part of ISO 7792 does not apply to the saturated polyester/ester and polyether/ester thermoplastic elastomers covered by ISO 14910.

It is not intended to imply that materials having the same designation give necessarily the same performance. This part of ISO 7792 does not provide engineering data, performance data or data on processing conditions which may be required to specify a material for a particular application and/or method of processing. If such additional properties are required, they shall be determined in accordance with the test methods specified in part 2 of this International Standard, if suitable.

In order to specify a thermoplastic polyester material for a particular application or to ensure reproducible processing, additional requirements may be given in data block 5.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1043-1, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics*

ISO 1043-2, *Plastics — Symbols and abbreviated terms — Part 2: Fillers and reinforcing materials*

ISO 1628-5, *Plastics — Determination of viscosity of polymers in diluted solutions using capillary viscometers — Part 5: Thermoplastic polyester (TP) homopolymers and copolymers*

ISO 1874-1[1)], *Plastics — Polyamide (PA) moulding and extrusion materials — Part 1: Designation system and basis for specification*

1) Under revision as ISO 16396-1.

ISO 7792-2, *Plastics — Thermoplastic polyester (TP) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties*

ASTM D5927-09, *Standard Classification System for Thermoplastic Polyester (TPES) Injection and Extrusion Materials Based on ISO Test Methods*

3 Designation system

3.1 General

The designation system for thermoplastics is based on the following standardized pattern:

Designation						
Description block (optional)	Identity block					
		Individual-item block				
	International Standard number block	Data block 1	Data block 2	Data block 3	Data block 4	Data block 5

The designation consists of an optional description block, reading "Thermoplastics", and an identity block comprising the International Standard number and an individual-item block. For unambiguous designation, the individual-item block is subdivided into 5 data blocks comprising the following information:

— Data block 1: Identification of the plastic by its symbol PET, PBT, PCT, PEN or PBN, or TP for all such polyesters and copolyesters in general, in accordance with ISO 1043-1 (see 3.2).

— Data block 2: Position 1: Intended application or method of processing (see 3.3). Positions 2 to 8: Important properties, additives and supplementary information (see 3.3).

— Data block 3: Designatory properties (see 3.4).

— Data block 4: Fillers or reinforcing materials and their nominal content (see 3.5).

— Data block 5: Information required for specification purposes. The use of data block 5 converts the designation to a specification. Only information listed in data block 5 becomes part of the specification requirements (see 3.6).

The first character of the individual Item Block shall be a hyphen.

The five data blocks shall be separated from each other by a comma.

If a data block is not used, this shall be indicated by doubling the separation sign, i.e. by two commas (,,).

Terminal commas may be omitted.

3.2 Data block 1

In this data block, after the hyphen, thermoplastic polyesters are identified using the symbols and designations listed in Tables 1 and 2.

Table 1 — Symbols indicating the chemical structure of polyester materials in data block 1

Symbol	Name and chemical identification
PET (TP 2T)	Poly(ethylene terephthalate): polyester based on ethylene glycol and terephthalic acid (or its ester).
PTT (TP 3T)	Poly(trimethylene terephthalate): polyester based on 1,3-propanediol and terephthalic acid (or its ester).
PBT (TP 4T)	Poly(butylene terephthalate): polyester based on 1,4-butanediol and terephthalic acid (or its ester).
PCT (TP CHT)	Poly(cyclohexylenedimethylene terephthalate): polyester based on cyclohexanedimethanol and terephthalic acid (or its ester).
PEN (TP 2N)	Poly(ethylene naphthalate): polyester based on ethylene glycol and 2,6-naphthalenedicarboxylic acid (or its ester).
PBN (TP 4N)	Poly(butylene naphthalate): polyester based on 1,4-butanediol and 2,6-naphthalenedicarboxylic acid (or its ester).
TP 26	Poly(ethylene adipate): polyester based on ethylene glycol and adipic acid.
TP 4I	Poly(butylene isophthalate): polyester based on 1,4-butanediol and isophthalic acid.
TP CH10	Polyester based on cyclohexanedimethanol and sebacic acid.

Table 2 — Symbols indicating the chemical structure of copolyester materials in data block 1 (examples)

Symbol [a]	Chemical identification
TP 6I/6T	Copolyester based on hexanediol, isophthalic acid and terephthalic acid.
TP BAI/BAT	Copolyester based on bisphenol A, isophthalic acid and terephthalic acid.
TP 2T/CHT	Copolyester based on ethylene glycol, cyclohexanedimethanol and terephthalic acid (or its derivates).
TP 2T/2I	Copolyester based on ethylene glycol, terephthalic acid and isophthalic acid (or its ester).
TP 2/6/NG// T/I/6	Copolyester based on ethylene glycol, 1,6-hexanediol, neopentyl glycol, terephthalic acid, isophthalic acid and adipic acids.
The following two designations include an indication of the mass content ratio:	
TP 2T/26 (90/10)	Copolyester based on 90 % (*m*/*m*) ethylene glycol and terephthalic acid and 10 % (*m*/*m*) ethylene glycol and adipic acid.
TP NGT/6I (75/25)	Copolyester based on 75 % (*m*/*m*) neopentyl glycol and terephthalic acid, and 25 % (*m*/*m*) 1,6-hexanediol and isophthalic acid.
[a] See Annex A (*Designation of thermoplastic polyesters*).	

Blends of thermoplastic polyesters with other polymers are identified using the symbols for the basic polymers separated by a plus sign, for example:

PBT + ASA for a blend of poly(butylene terephthalate) and acrylonitrile/styrene/acrylate.

3.3 Data block 2

In this data block, information about intended application and/or method of processing is given in position 1 and information about important properties, additives and colour in positions 2 to 8. The code-letters used are specified in Table 3.

If information is presented in positions 2 to 8 and no specific information is given in position 1, the letter X shall be inserted in position 1.

Table 3 — Code-letters used in data block 2

Code-letter	Position 1	Code-letter	Positions 2 to 8
A	Adhesive	**A**	Processing stabilized
B	Blow moulding	**B**	Antiblocking
C	Calendering	**C**	Coloured
D	Disc manufacture	**D**	Powder
E	Extrusion	**E**	Expandable
F	Extrusion of films	**F**	Special burning characteristics
G	General use	**G**	Granules
H	Coating	**H**	Heat-ageing stabilized
K	Cable and wire coating	**L**	Light or weather stabilized
L	Monofilament extrusion	**M**	Nucleated
M	Injection moulding	**N**	Natural (no colour added)
R	Rotational moulding	**P**	Impact modified
S	Sintering	**R**	Mould release agent
X	No indication	**S**	Lubricated
		T	Transparent
		W	Stabilized against hydrolysis
		Z	Antistatic

3.4 Data block 3

3.4.1 General

In this data block, viscosity number is represented by a 2-figure code-number (see 3.4.2) and tensile modulus of elasticity by a 3-figure code-number (see 3.4.3). The 2 code-numbers are separated from each other by a hyphen.

If a property value falls on or near a range limit, the manufacturer shall state which range will designate the material. If subsequent individual test values lie on, or on either side of, the range limit because of manufacturing tolerances, the designation is not affected.

NOTE Not all the combinations of the values of the designatory properties are provided by currently available polymers.

3.4.2 Viscosity number

The viscosity number shall be determined in accordance with ISO 1628-5, using 50/50 phenol/1,2-dichlorobenzene for PET and *m*-cresol for PBT.

The possible values of viscosity number are divided into 8 ranges, each represented by a 2-figure code-number as specified in Table 4.

Table 4 — Code-numbers used for viscosity number in data block 3

Code-number	Range of viscosity number ml/g
03	≤ 40
05	> 40 but ≤ 60
07	> 60 but ≤ 80
09	> 80 but ≤ 100
11	> 100 but ≤ 120
13	> 120 but ≤ 140
15	> 140 but ≤ 160
17	> 160 but ≤ 180

NOTE 1 Viscosity numbers determined in other solvents can be converted into viscosity numbers determined in phenol/1,2-dichlorobenzene using the following equations.

For phenol/1,1,2,2-tetrachloroethane (50/50): $x = 0{,}93y + 1{,}87$

For phenol/1,1,2,2-tetrachloroethane (60/40): $x = 1{,}20y - 13{,}34$

For *o*-chlorophenol: $x = 1{,}22y - 10{,}24$

For dichloroacetic acid: $x = 1{,}20y - 18{,}07$

where

x is the viscosity number in phenol/1,2-dichlorobenzene (50/50);

y is the viscosity number in the alternative solvent.

NOTE 2 Viscosity numbers determined in other solvents can be converted into viscosity numbers determined in *m*-cresol using the following equations.

For phenol/1,1,2,2-tetrachloroethane (50/50): $x = 0{,}70y + 5{,}59$

For phenol/1,1,2,2-tetrachloroethane (60/40): $x = 0{,}57y + 29{,}22$

For *o*-chlorophenol: $x = 0{,}85y + 3{,}14$

For dichloroacetic acid: $x = 0{,}70y + 7{,}34$

For phenol/1,2-dichlorobenzene: $x = 0{,}75y + 0{,}96$

where

x is the viscosity number in *m*-cresol;

y is the viscosity number in the alternative solvent.

For PCT, the viscosity number shall be determined using phenol/1,1,2,2-tetrachloroethane (60/40) as the solvent.

For amorphous PEN, the viscosity number shall be determined using phenol/1,1,2,2-tetrachloroethane (60/40) as the solvent, and for crystalline PEN phenol/2,4,6-trichlorophenol (60/40) is the specified solvent.

For PBN, the viscosity number shall be determined using phenol/1,1,2,2-tetrachloroethane (60/40) as the solvent.

For other TP homopolymers and copolymers, the use of *m*-cresol is preferred.

3.4.3 Tensile modulus of elasticity

The tensile modulus of elasticity shall be determined in accordance with ISO 7792-2.

The possible values of tensile modulus of elasticity are divided into 23 ranges, each represented by a 3-figure code-number as specified in Table 5.

Table 5 — Code-numbers used for tensile modulus of elasticity in data block 3

Code-number	Range of tensile modulus of elasticity MPa
001	< 150
002	> 150 but ≤ 250
003	> 250 but ≤ 350
004	> 350 but ≤ 450
005	> 450 but ≤ 600
007	> 600 but ≤ 800
010	> 800 but ≤ 1 500
020	> 1 500 but ≤ 2 500
030	> 2 500 but ≤ 3 500
040	> 3 500 but ≤ 4 500
050	> 4 500 but ≤ 5 500
060	> 5 500 but ≤ 6 500
070	> 6 500 but ≤ 7 500
080	> 7 500 but ≤ 8 500
090	> 8 500 but ≤ 9 500
100	> 9 500 but ≤ 10 500
110	> 10 500 but ≤ 11 500
120	> 11 500 but ≤ 13 500
140	> 13 500 but ≤ 15 500
160	> 15 500 but ≤ 17 500
190	> 17 500 but ≤ 20 500
220	> 20 500 but ≤ 23 500
250	> 23 500

3.5 Data block 4

In this data block, the type of filler and/or reinforcing material is represented by a single code-letter in position 1 and its physical form by a second code-letter in position 2, the code-letters being as specified in Table 6. Subsequently (without a space), the mass content may be given by a 2-figure number in positions 3 and 4.

Mixtures of materials and/or forms may be indicated by combining the relevant codes using the sign "+" and placing the whole between parentheses. For example, a mixture of 25 % glass fibres (GF) and 10 % mineral powder (MD) would be indicated by (GF25+MD10).

Table 6 — Code-letters for fillers and reinforcing materials in data block 4

Code-letter	Material	Code-letter	Form
B	Boron	**B**	Beads, spheres, balls
C	Carbon [a]	**D**	Powder
G	Glass	**F**	Fibre
K	Calcium carbonate	**G**	Ground
M	Mineral [a], metal [b]	**H**	Whiskers
S	Synthetic, organic [a]	**X**	Not specified
T	Talc	**Z**	Others
X	Not specified		
Z	Others [a]		

[a] These materials may be further defined after position 4 of the data block by their chemical symbol, for example, or additional symbols defined in ISO 1043-2 or by additional symbols agreed between the interested parties.

[b] Metal fillers shall be identified by their chemical symbol after the mass content.

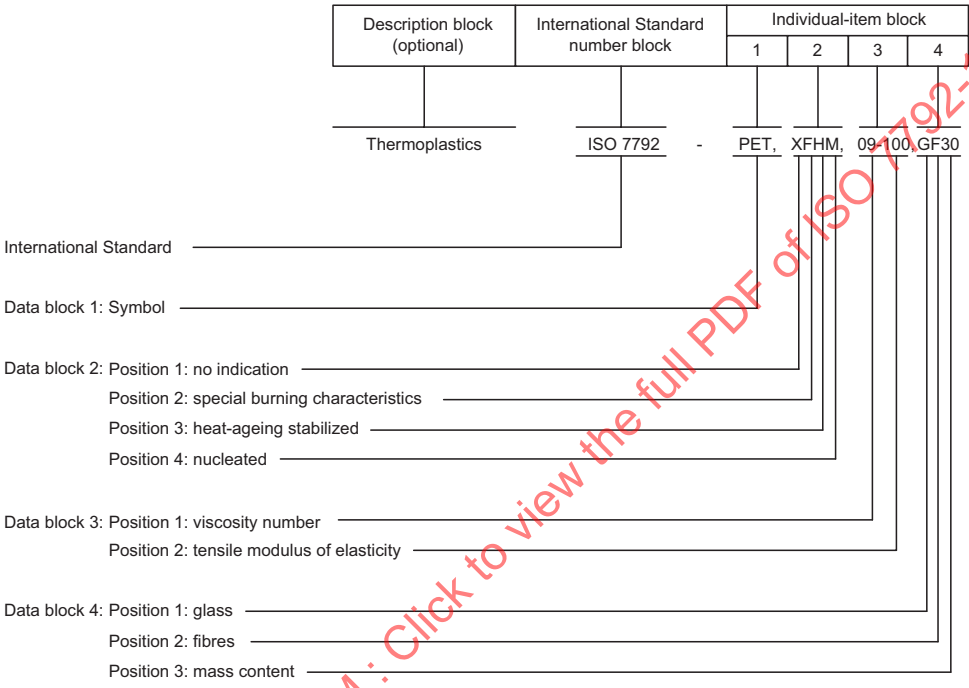
3.6 Data block 5

Indication of additional requirements in this optional data block is a way of transforming the designation of a material into a specification for a particular application. This may be done, for example, by reference to a suitable national standard or to a standard-like, generally established specification.

4 Examples of designations

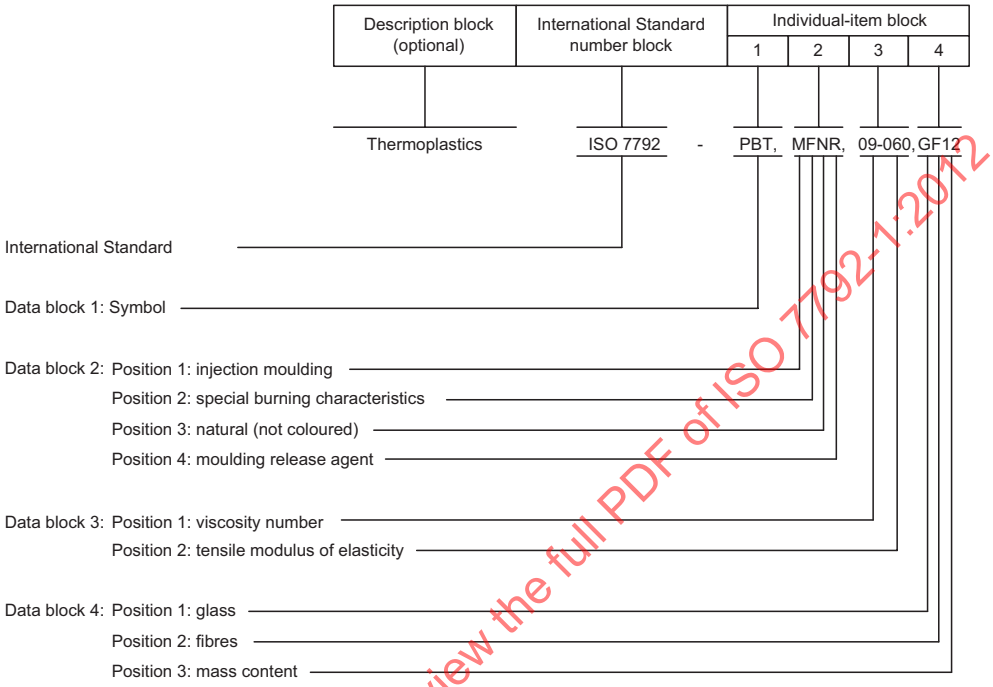
4.1 Designation only

4.1.1 A poly(ethylene terephthalate) thermoplastic material (PET), with special burning characteristics (F), stabilized against heat ageing (H), with a nucleating agent (M), having a viscosity number of 85 ml/g (09) and a tensile modulus of elasticity of 10 300 MPa (100), and reinforced by a nominal glass fibre content of 30 % (m/m) (GF30), would be designated:



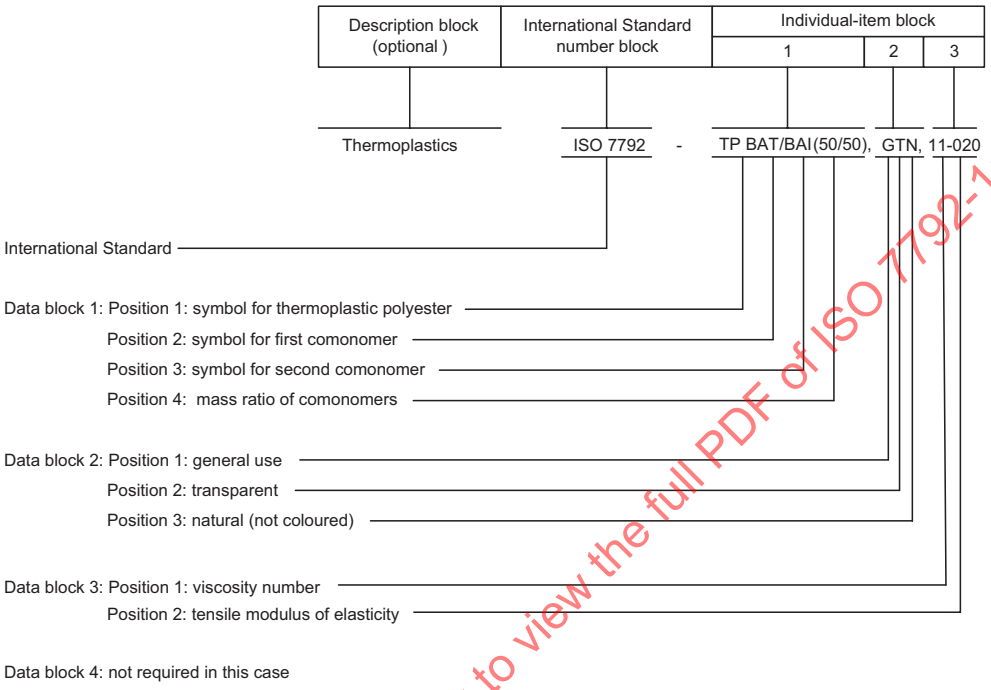
Designation: **ISO 7792-PET,XFHM,09-100,GF30**

4.1.2 A poly(butylene terephthalate) thermoplastic material (PBT) for injection moulding (M), with special burning characteristics (F), natural (no colour added) (N), provided with a mould release agent (R), having a viscosity number of 96 ml/g (09) and a tensile modulus of elasticity of 5 900 MPa (060), and reinforced with 12 % (m/m) of glass fibres (GF12), would be designated:



Designation: **ISO 7792-PBT,MFNR,09-060,GF12** or in shortened form: **ISO 7792-PBT,,,GF12**

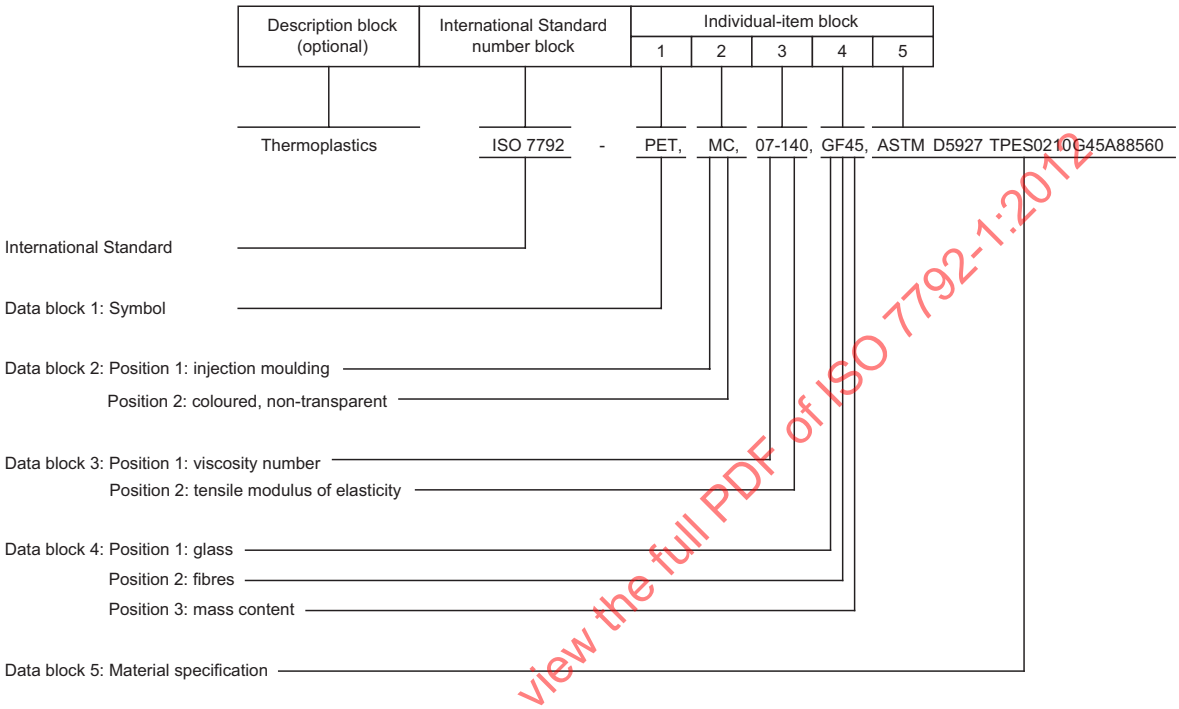
4.1.3 A thermoplastic copolyester (TP) based on 50 % (m/m) bisphenol A (BA) and terephthalic acid (T) and 50 % (m/m) bisphenol A (BA) and isophthalic acid (I), for general use (G), transparent (T), natural (no colour added) (N) and having a viscosity number of 115 ml/g (11) and a tensile modulus of elasticity of 1 900 MPa (020), would be designated:



Designation: **ISO 7792-TP BAT/BAI(50/50),GTN,11-020** or in shortened form: **ISO 7792-TP BAT/BAI**

4.2 Designation transformed into a specification

A poly(ethylene terephthalate) thermoplastic material (PET) for injection moulding (M), coloured (C), having a viscosity number of 75 (07) and a tensile modulus of elasticity of 13 800 MPa (140), reinforced with 45 % (*m*/*m*) of glass fibres (GF45) and meeting the requirements of the specification ASTM D5927 TPES0210G45A88560, would be specified:



Specification: ISO 7792-PET,MC,07-140,GF45,ASTM D5927 TPES0210G45A88560

Annex A
(normative)

Designation of thermoplastic polyesters

Thermoplastic polyester materials contain ester groups, -CO-O-, at regular intervals in the linear polymer chain.

Straight-chain polyesters are built up from one starting material with two hydroxyl (-OH) groups, also called diols, plus one starting material with two carboxylic acid (-COOH) groups, also called dicarboxylic acids, or esters of such acids, by a polycondensation process. A hydroxycarboxylic acid or its lactone may also be used to build up polyesters. If a tricarboxylic acid and/or a triol is used, branched polymer chains will result.

The following six homopolyester thermoplastics are well known:

PET Poly(ethylene terephthalate)

PTT Poly(trimethylene terephthalate)

PBT Poly(butylene terephthalate)

PCT Poly(cyclohexylenedimethylene terephthalate)

PEN Poly(ethylene naphthalate)

PBN Poly(butylene naphthalate)

These designations remain unchanged, but for other polyesters and copolyesters a designation system similar to that for polyamides and copolyamides (see ISO 1874-1) is used to avoid creating new abbreviations for each member of this large family.

TP is the symbol for thermoplastic polyester, in accordance with ISO 1043-1.

Aliphatic polyesters based on linear diols and linear dicarboxylic acids or esters of such acids are designated by two or more code-numbers. The first code-number (which may have one or two digits) corresponds to the number of C-atoms in the linear diol (see Table A.1) and the second code-number (which may also have one or two digits) corresponds to the number of C-atoms in the linear dicarboxylic acid (see Table A.2).

Nonlinear aliphatic, cycloaliphatic and aromatic compounds used as monomer units in the polyester chain are designated by code-letters (see Tables A.1, A.2 and A.3).

Copolyesters are designated by an oblique stroke (/) between the code-numbers representing the components of the copolyester (cf. A.6, in ISO 1043-1:2011). Copolyesters with the same code-numbers or code-letters can have quite different properties, depending on the ratio of the starting materials. Therefore, the ratio, in mass percent, may optionally be indicated in parentheses at the end of the designation (see Table 2).

Copolyesters containing more than three monomers can also be represented by a simplified designation — TP $DO_1/DO_2/DO_3//DA_1/DA_2/DA_3$ — where DO_1, DO_2 and DO_3 are three different diols and DA_1, DA_2 and DA_3 are three different dicarboxylic acids. Two oblique strokes (//) are used between the diols and dicarboxylic acids.

Due to the great variety of polyesters and copolyesters, only a few examples are given here.