
**Plastics — Polyamide (PA) moulding and
extrusion materials —**

Part 1:
**Designation system and basis for
specification**

*Plastiques — Matériaux polyamides (PA) pour moulage et extrusion —
Partie 1: Système de désignation et base de spécification*

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Contents

Page

| | |
|---|-----------|
| Foreword | iv |
| 1 Scope | 1 |
| 2 Normative references | 1 |
| 3 Designation system | 2 |
| 3.1 General | 2 |
| 3.2 Data block 1 | 2 |
| 3.3 Data block 2 | 5 |
| 3.4 Data block 3 | 5 |
| 3.5 Data block 4 | 8 |
| 3.6 Data block 5 | 9 |
| 4 Examples of designations | 9 |
| 4.1 Designation only | 9 |
| 4.2 Designation transformed into a specification | 11 |
| Annex A (normative) Definition and designation of polyamides | 13 |
| Bibliography | 15 |

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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 1874-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

This third edition cancels and replaces the second edition (ISO 1874-1:1992), which has been technically revised.

ISO 1874 consists of the following parts, under the general title *Plastics — Polyamide (PA) moulding and extrusion materials*:

- *Part 1: Designation system and basis for specifications*
- *Part 2: Preparation of test specimens and determination of properties*

Plastics — Polyamide (PA) moulding and extrusion materials —

Part 1: Designation system and basis for specification

1 Scope

This part of ISO 1874 establishes a system of designation for polyamide (PA) thermoplastic materials, which may be used as the basis for specifications.

It covers polyamide homopolymers for moulding and extrusion based on PA 6, PA 66, PA 69, PA 610, PA 612, PA 11, PA 12, PA MXD6, PA 46, PA 1212, PA 4T, PA 6T and PA 9T and copolyamides of various compositions for moulding and extrusion.

The types of polyamide plastic are differentiated from each other by a classification system based on appropriate levels of the designatory properties

- a) viscosity number,
- b) tensile modulus of elasticity and
- c) presence of nucleating agent,

and on information about chemical structure, intended application, method of processing, important properties, additives, colour, fillers and reinforcing materials.

The designation system is applicable to all polyamide homopolymers and copolymers. It applies to materials ready for normal use, unmodified and modified by colorants, additives, fillers, reinforcing materials, polymer modifiers, etc.

This part of ISO 1874 does not apply to monomer casting-type polyamides of PA 6 and PA 12.

It is not intended to imply that materials having the same designation give necessarily the same performance. This part of ISO 1874 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 ISO 1874-2, if suitable.

In order to specify a thermoplastic material for a particular application or reproducible processing, additional requirements may be given in data block 5 (see 3.1 and 3.6).

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 307, *Plastics — Polyamides — Determination of viscosity number*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 1874-2, *Plastics — Polyamide (PA) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties*

3 Designation system

3.1 General

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

| Designation | | | | | | |
|------------------------------|-------------------------------------|-----------------------|--------------|--------------|--------------|--------------|
| Description block (optional) | Identity block | | | | | |
| | International Standard number block | Individual-item 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 five data blocks comprising the following information:

- Data block 1: Identification of the plastic by its abbreviated term (PA), and information about the chemical structure and composition (see 3.2).
- Data block 2: Position 1: Intended application and/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: For the purpose of specifications, a fifth data block containing additional information may be added (see 3.6). The kind of information and the code-letters used are not the subject of this part of ISO 1874.

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 (,,).

3.2 Data block 1

In this data block, after the hyphen, the polyamide (PA) is identified by using the symbols listed in Tables 1 and 2.

Polyamides containing a plasticizer may be designated by adding the letter P after the symbol, separated from it by a hyphen (e.g. PA 610-P).

Polyamides containing an impact modifier may be designated by adding the letters HI after the symbol, separated from it by a hyphen (e.g. PA 6-HI).

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

| Symbol | Name and chemical structure |
|--|--|
| PA 4T | Polyamide 4T: homopolymer based on tetramethylenediamine and terephthalic acid |
| PA 6 | Polyamide 6: homopolymer based on ϵ -caprolactam |
| PA 66 | Polyamide 66: homopolymer based on hexamethylenediamine and adipic acid |
| PA 69 | Polyamide 69: homopolymer based on hexamethylenediamine and azelaic acid |
| PA 610 | Polyamide 610: homopolymer based on hexamethylenediamine and sebacic acid |
| PA 612 | Polyamide 612: homopolymer based on hexamethylenediamine and dodecanedioic acid ^a |
| PA 6T | Polyamide 6T: homopolymer based on hexamethylenediamine and terephthalic acid |
| PA 9T | Polyamide 9T: homopolymer based on nonamethylenediamine and terephthalic acid |
| PA 11 | Polyamide 11: homopolymer based on 11-aminoundecanoic acid |
| PA 12 | Polyamide 12: homopolymer based on ω -aminododecanoic acid or on laurilactam |
| PA MXD6 | Polyamide MXD6: homopolymer based on <i>m</i> -xylylenediamine and adipic acid |
| PA 46 | Polyamide 46: homopolymer based on tetramethylenediamine and adipic acid |
| PA 1212 | Polyamide 1212: homopolymer based on dodecanediamine and dodecanedioic acid ^a |
| ^a 1,10-Decanedicarboxylic acid. | |

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

| Symbol | Chemical structure |
|---|--|
| PA 66/610 | Polyamide copolymers based on hexamethylenediamine, adipic acid and sebacic acid |
| PA 6/12 | Polyamide copolymers based on ϵ -caprolactam and lauro lactam |
| PA 6/66/PACM 6 | Polyamide ternary copolymers based on ϵ -caprolactam, hexamethylenediamine, adipic acid, bis(<i>p</i> -aminocyclohexyl)methane and adipic acid |
| PA 12/IPDI | Polyamide copolymers based on lauro lactam, isophoronediamine and isophthalic acid |
| PA 46/6 | Polyamide copolymers based on tetramethylenediamine, adipic acid and ϵ -caprolactam |
| PA 4T/6T | Polyamide copolymers based on tetramethylenediamine, terephthalic acid and hexamethylenediamine |
| PA 6T/MPMDT ^a | Polyamide copolymers based on hexamethylenediamine, terephthalic acid and methylpentamethylenediamine |
| PA 6T/66 ^a | Polyamide copolymers based on hexamethylenediamine, terephthalic acid and adipic acid |
| PA 6T/6I ^a | Polyamide copolymers based on hexamethylenediamine, terephthalic acid and isophthalic acid |
| PA 6T/6I/66 ^a | Polyamide copolymers based on hexamethylenediamine, terephthalic acid, isophthalic acid and adipic acid |
| PA 66/6I | Polyamide copolymers based on hexamethylenediamine, adipic acid and isophthalic acid |
| PA NDT/INDT | Polyamide copolymers based on 1,6-diamino-2,2,4-trimethylenehexane, 1,6-diamino-2,4,4-trimethylenehexane and terephthalic acid |
| PA 12/IPDI | Polyamide copolymers based on lauro lactam, isophoronediamine and isophthalic acid |
| The following three symbols include an indication of the mass content ratio (see Annex A). | |
| PA 66/6 (90/10) | Polyamide copolymers based on 90 % (by mass) of hexamethylenediamine and adipic acid and 10 % (by mass) of ϵ -caprolactam |
| PA 6/66 (80/20) | Polyamide copolymers based on 80 % (by mass) of ϵ -caprolactam and 20 % (by mass) of hexamethylenediamine and adipic acid |
| PA 66/6 (20/80) | Polyamide copolymers based on 20 % (by mass) of hexamethylenediamine and adipic acid and 80 % (by mass) of ϵ -caprolactam |
| ^a Polyamides designated PA 6T/XX/YY may also be called polyphthalamides (PPAs) provided the residues of terephthalic acid or isophthalic acid or the combination of the two make up at least 55 mole percent of the dicarboxylic acid portion of the repeating structural units of the polymer chain (ASTM D5336). | |

3.3 Data block 2

In this data block, information about the intended application or method of processing is given in position 1 and information about important properties, additives and colorants 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 | Positions 2 to 8 |
|-------------|---|---------------------------------|
| A | | Processing stabilized |
| B | Blow moulding | Antiblocking |
| C1 | | Coloured but transparent |
| C2 | | Coloured and non-transparent |
| D | | Powder; dry blend |
| E | Extrusion of pipes, profiles and sheets | Expandable |
| F | Extrusion of film and thin sheeting | Special burning characteristics |
| G | General use | Pellets; granules |
| H | Coating | Heat-ageing stabilized |
| K | Cable and wire coating | |
| L | Monofilament extrusion | Light and/or weather stabilized |
| M | Injection moulding | |
| N | | Natural (not coloured) |
| R | Rotational moulding | Moulding release agent |
| S | Powder coating or sintering | Lubricated |
| T | Tape manufacture | Improved transparency |
| W | | Stabilized against hydrolysis |
| X | No indication | |
| Z | | Antistatic |

3.4 Data block 3

3.4.1 General

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

Nucleated polyamides are designated by adding a hyphen followed by the letter N at the very last position in data block 3.

If no specific information is given in one of the positions, the letter X shall be inserted.

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 either side of, the range limit because of manufacturing tolerances, the designation is not affected.

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

3.4.2 Viscosity number

The viscosity number shall be determined in accordance with ISO 307, using the solvent specified in Table 4. The average value of the viscosity number is represented by a two-figure code-number as specified in Table 4.

For copolyamides, 96% (by mass) sulfuric acid should preferably be used as solvent, but some copolyamides dissolve better in *m*-cresol or phenol/1,1,2,2-tetrachloroethane (60%/40%). Information concerning the most suitable solvent can be obtained from the suppliers of copolyamides and homopolyamides which are not covered in the last column of Table 4.

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

| Code-number | Range of viscosity number ml/g | | | Applicable to |
|-------------|---|------------------------------|---|--|
| | Solvent: 96 % (by mass) sulfuric acid | Solvent: <i>m</i> -cresol | Solvent: phenol/1,1,2,2- tetrachloroethane (60%/40%) | |
| 09 | ≤ 90 | | | PA 6, PA 66, PA 69, PA 610, PA 612, PA MXD6 and copolyamides |
| 10 | > 90 but ≤ 110 | | | |
| 12 | > 110 but ≤ 130 | | | |
| 14 | > 130 but ≤ 160 | | | |
| 18 | > 160 but ≤ 200 | | | |
| 22 | > 200 but ≤ 240 | | | |
| 27 | > 240 but ≤ 290 | | | |
| 32 | > 290 but ≤ 340 | | | |
| 34 | > 340 | | | |
| 11 | | ≤ 110 | | PA 1212, PA 11, PA 12 and copolyamides |
| 12 | | > 110 but ≤ 130 | | |
| 14 | | > 130 but ≤ 150 | | |
| 16 | | > 150 but ≤ 170 | | |
| 18 | | > 170 but ≤ 200 | | |
| 22 | | > 200 but ≤ 240 | | |
| 24 | | > 240 | | |
| 12 | | | ≤ 120 | PA 6T/66, PA 6I/66, PA 6I/6T, PA 6T/6I/66, PA 6T/6I, PA 6I/6T/66 and copolyamides |
| 13 | | | > 120 but ≤ 140 | |
| 15 | | | > 140 but ≤ 160 | |
| 17 | | | > 160 but ≤ 180 | |
| 19 | | | > 180 but ≤ 200 | |
| 20 | | | > 200 | |

NOTE Viscosity numbers determined with 90 % (by mass) formic acid as solvent can be converted into viscosity numbers determined in 96 % (by mass) sulfuric acid using the following equations (see ISO 307:2007, Clause 13 and Annex E):

$$\text{For PA 6: } \ln y = 0,416\ 1 + 0,927\ 6 \ln x$$

$$\text{For PA 66: } \ln y = 0,454\ 1 + 0,926\ 1 \ln x$$

$$\text{For PA 69: } \ln y = 0,463\ 4 + 0,909\ 5 \ln x$$

$$\text{For PA 610: } \ln y = 0,982\ 3 + 0,793\ 2 \ln x$$

where

x is the viscosity number in 90 % (by mass) formic acid;

y is the viscosity number in 96 % (by mass) sulfuric acid.

For the viscosity number of PA 612, which may be determined in accordance with ISO 307 in either *m*-cresol or 96 % (by mass) sulfuric acid, the following conversion formula applies:

$$\ln y = 0,285\ 7 + 0,985\ 9 \ln x$$

where

x is the viscosity number in 96 % (by mass) sulfuric acid;

y is the viscosity number in *m*-cresol.

The above conversion formulae were calculated from the results of an interlaboratory investigation carried out in 1982. The accuracy of the conversions depends on both the size of the viscosity number and the type of PA, the latter resulting from the fact that different numbers of the different PA types were included in the investigation. The 95 % confidence intervals for the values of the nominal viscosity number in 96 % (by mass) sulfuric acid, converted from different values of the nominal viscosity number in the other solvent, are given in Table 5.

Table 5 — Confidence intervals

| Nominal viscosity number ^a | 95 % confidence intervals for converted nominal viscosity numbers in 96% (by mass) sulfuric acid | | | | |
|---------------------------------------|--|-------|-------|--------|--------|
| | PA 6 | PA 66 | PA 69 | PA 610 | PA 612 |
| 100 | ±0,8 | ±1,6 | ±2,0 | ±4,7 | ±4,4 |
| 140 | ±0,8 | ±1,4 | ±1,9 | ±4,1 | ±4,9 |
| 180 | ±0,7 | ±1,2 | ±2,9 | ±5,8 | ±10,2 |
| 220 | ±0,7 | ±1,3 | ±4,7 | ±9,0 | ±17,6 |
| 260 | ±0,8 | ±1,7 | ±6,9 | ±12,9 | ±26,0 |
| 300 | ±1,0 | ±2,4 | ±9,3 | ±17,2 | ±35,3 |
| 340 | ±1,3 | ±3,3 | ±11,9 | ±21,8 | ±45,3 |

^a Solvents: 90 % (by mass) formic acid for PA 6, PA 66, PA 69 and PA 610; *m*-cresol for PA 612.

3.4.3 Tensile modulus of elasticity

The tensile modulus of elasticity shall be determined in the dry state in accordance with ISO 527-2 under the test conditions specified in ISO 1874-2. The average value of the tensile modulus of elasticity is represented by a three-figure code-number as specified in Table 6.

Table 6 — 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 ≤ 13 000 |
| 140 | > 13 000 but ≤ 15 000 |
| 160 | > 15 000 but ≤ 17 000 |
| 190 | > 17 000 but ≤ 20 000 |
| 220 | > 20 000 but ≤ 23 000 |
| 250 | > 23 000 |

3.5 Data block 4

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

Mixtures of materials or forms may be indicated in parentheses by combining the relevant codes using the sign “+”. For example, a mixture of 25 % (by mass) of glass fibre (GF) and 10 % (by mass) of mineral powder (MD) would be indicated by (GF25+MD10).

Table 7 — Code-letters used for fillers and reinforcing materials in data block 4

| Code-letter | Material (position 1) | Form (position 2) |
|-------------|---|--|
| B | Boron | Balls; beads; spheres Powder; dry blend Fibre Granules; ground Whiskers Not specified Others |
| C | Carbon ^a | |
| D | | |
| F | | |
| G | Glass | |
| H | | |
| K | Chalk (CaCO ₃) | |
| M | Mineral ^a ; metal ^b | |
| S | Organic; synthetic ^a | |
| T | Talcum | |
| X | Not specified | |
| Z | Others ^a | |

^a These materials may be defined after position 4 of the data block, e.g. by chemical symbol or additional codes to be agreed upon.

^b Metal fillers shall be identified by the chemical symbol (in capital letters) after the mass content. For example, steel whiskers may be designated "MH05FE".

3.6 Data block 5

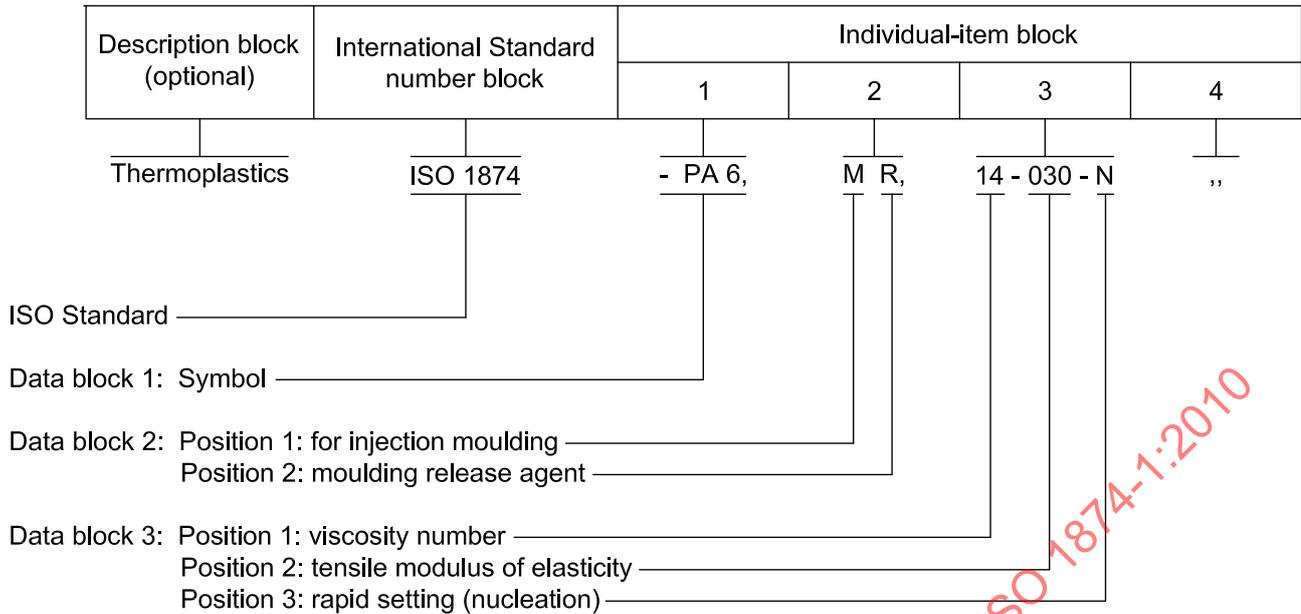
Indication of additional requirements in optional data block 5 is a way of transforming the designation of a material into a specification for a particular application. This may be done for example by reference to a suitable national standard or to a standard-like, generally established specification (see 4.2).

4 Examples of designations

4.1 Designation only

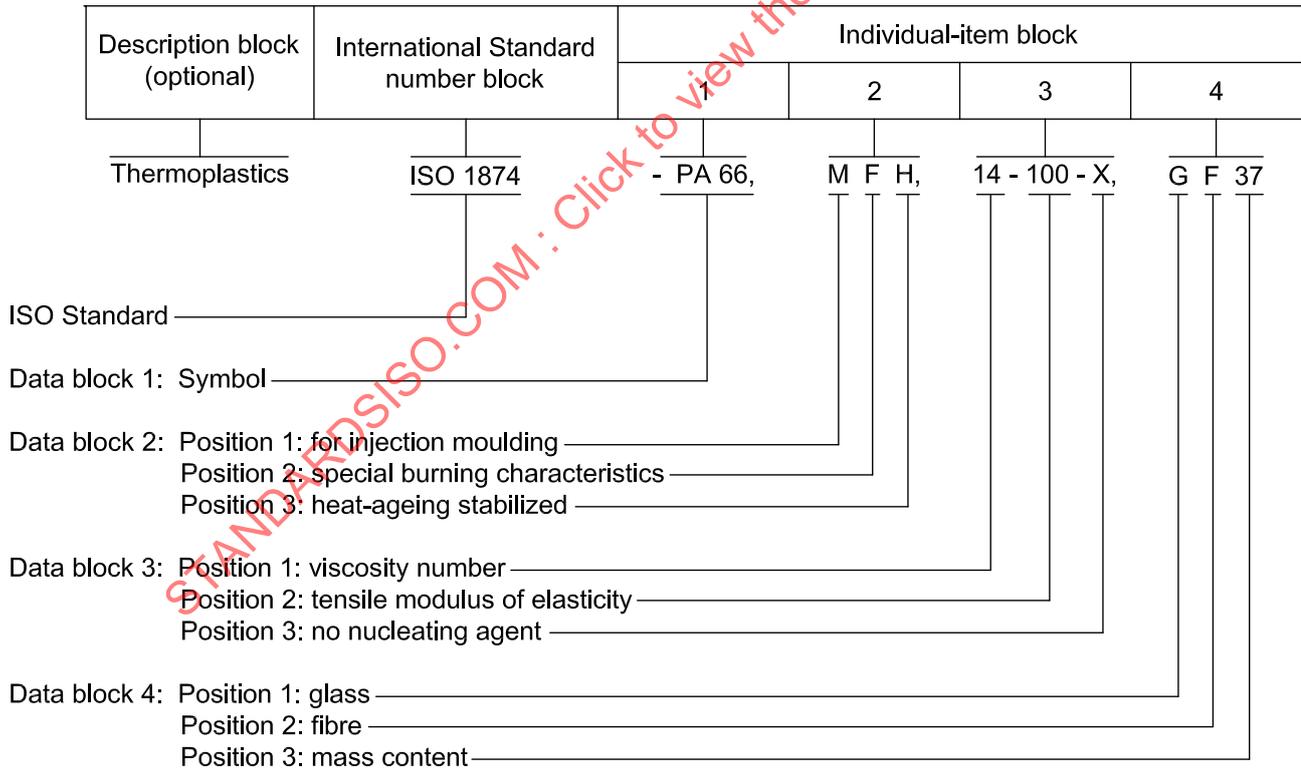
4.1.1 A polyamide material (PA 6) for injection moulding (M), with moulding release agent (R), having a viscosity of 150 m²/g (14) and a tensile modulus of elasticity of 2 700 MPa (030), and with a nucleating additive (N), would be designated:

ISO 1874-1:2010(E)



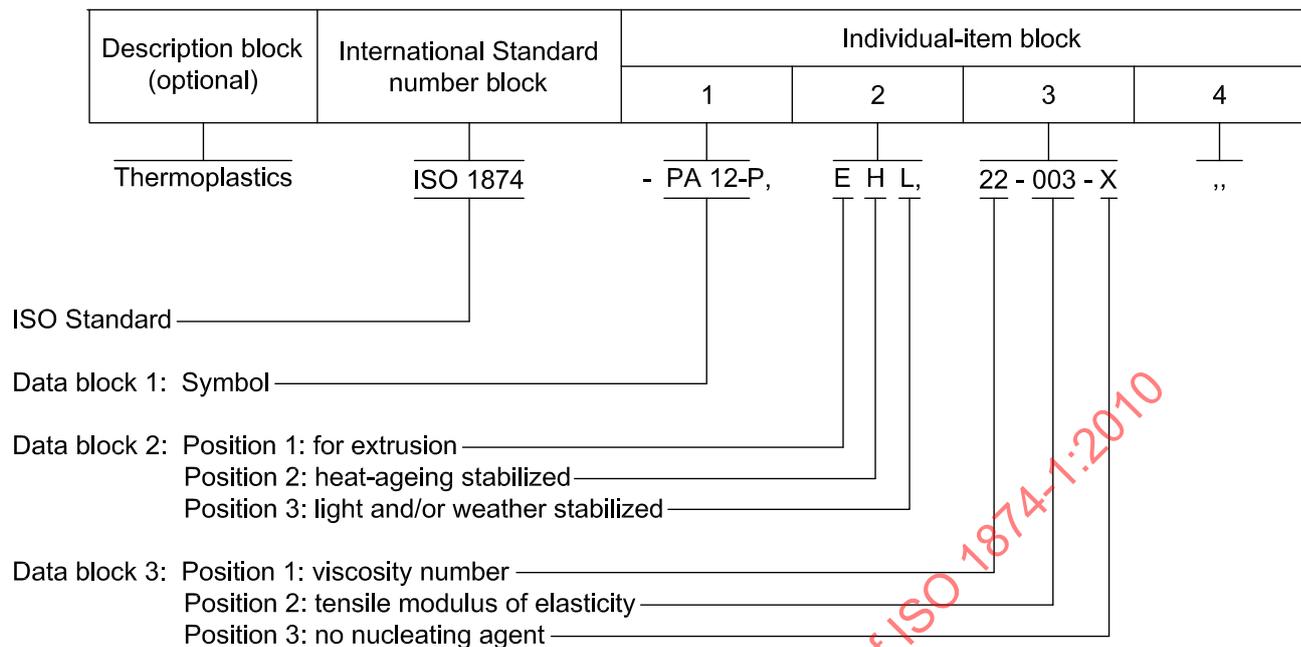
Designation: ISO 1874-PA 6,MR,14-030-N,

4.1.2 A polyamide material (PA 66) for injection moulding (M), with special burning characteristics (F) and a heat-ageing stabilizer (H), having a viscosity number of 140 ml/g (14) and a tensile modulus of elasticity of 10 200 MPa (100), and reinforced with 37 % of glass fibre (GF), would be designated:



Designation: ISO 1874-PA 66,MFH,14-100-X,GF37

4.1.3 A polyamide material containing plasticizer (PA 12-P), for extrusion (E), with a heat-ageing stabilizer (H) and a light and weather stabilizer (L), and having a viscosity number of 210 ml/g (22) and a tensile modulus of elasticity of 280 MPa (003), would be designated:

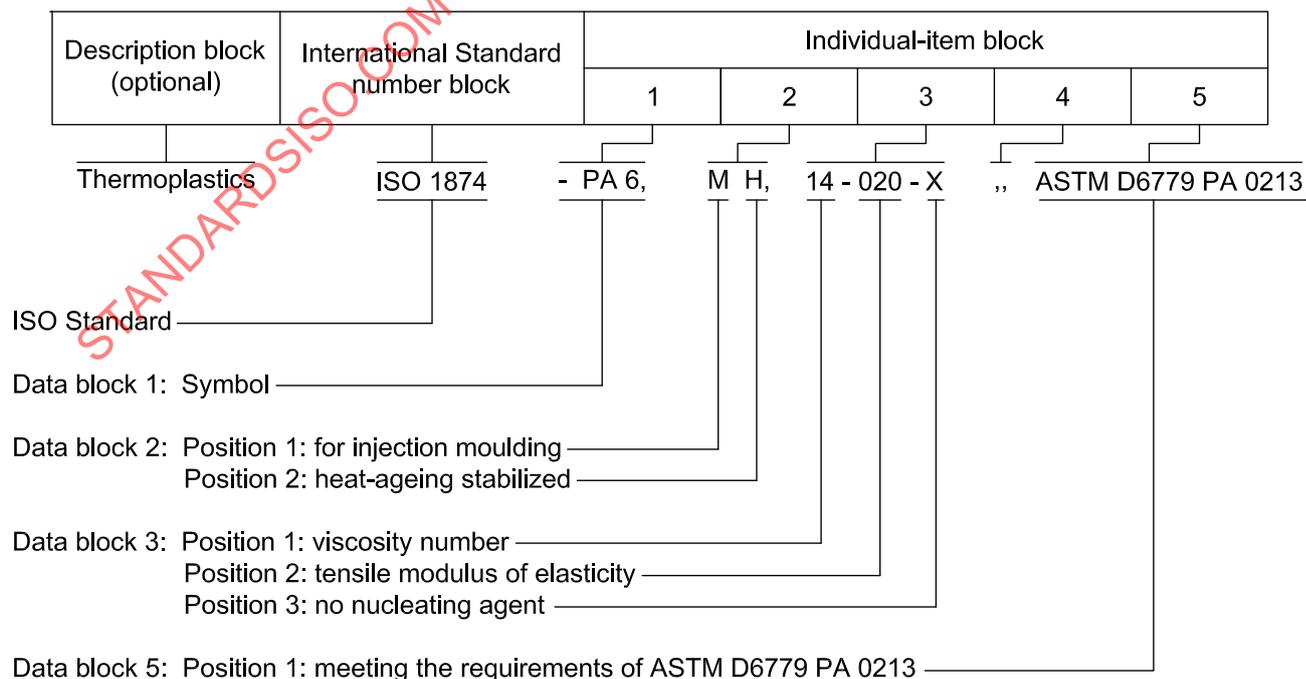


Designation: ISO 1874-PA 12-P,EHL,22-003-X,,

4.2 Designation transformed into a specification

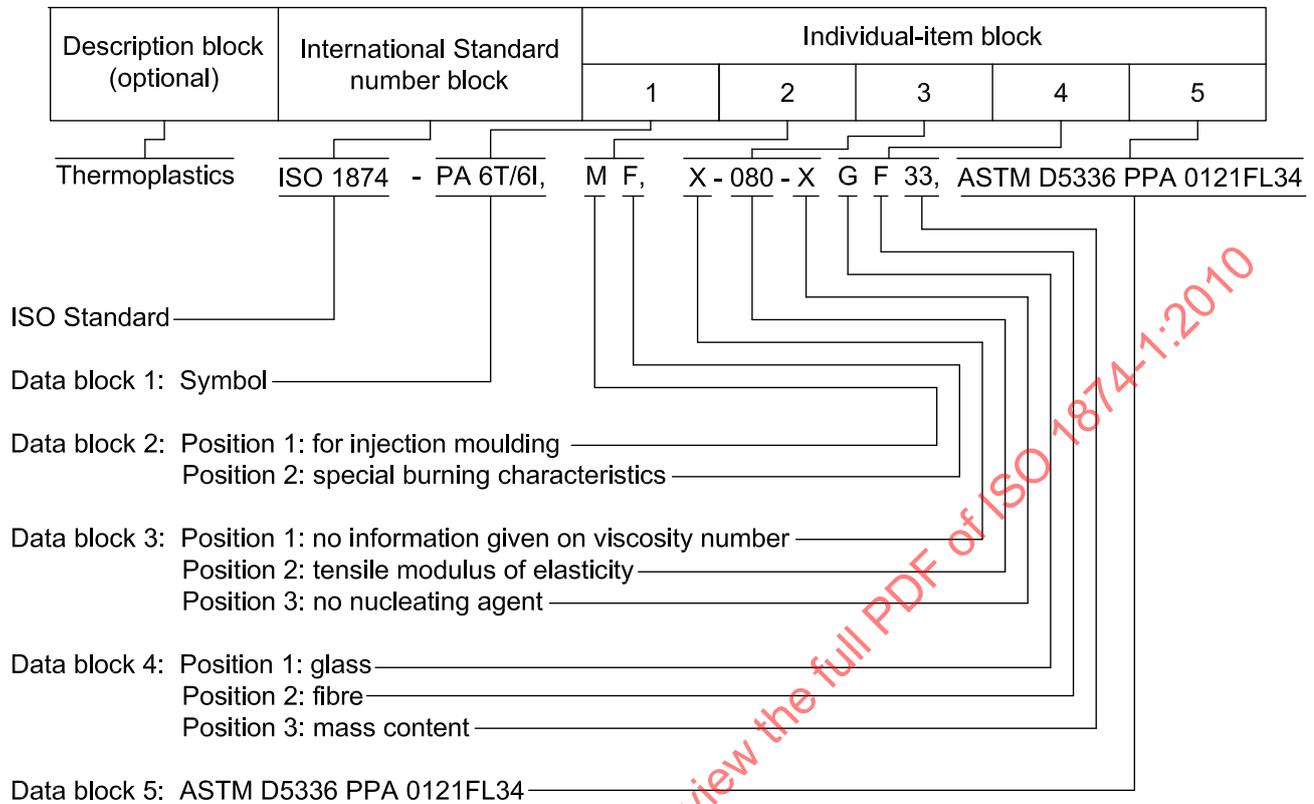
4.2.1 This subclause provides examples of how to use the designation system to convert a designation into a specification. When used to provide a designation, the system only employs information from data blocks 1 to 4. When converting the designation into a specification, the system also includes information from data block 5.

4.2.2 A polyamide material (PA 6) for injection moulding (M), containing a heat-ageing stabilizer (H), having a viscosity of 150 ml/g (14) and a tensile modulus of elasticity of 2 200 MPa (020), and meeting the requirements of ASTM D6779, would have the specification:



Specification: ISO 1874-PA 6,MH,14-020-X,,ASTM D6779 PA 0213

4.2.3 A polyamide material (PA 6T/6I) for injection moulding (M), with special burning characteristics (F), having a tensile modulus of elasticity of 8 000 MPa (080), reinforced with 33 % of glass fibre (GF), and meeting the requirements of ASTM D5336 PPA 0121FL34, would have the specification:



Specification: ISO 1874-PA 6T/6I,MF,X-080-X,GF33,ASTM D5336 PPA 0121FL34

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