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International Standard



1874/1

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**Plastics — Polyamide (PA) homopolymers for moulding  
and extrusion —  
Part 1: Designation**

*Plastiques — Homopolymères polyamides (PA) pour moulage et extrusion — Partie 1: Désignation*

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 1874/1 was prepared by Technical Committee ISO/TC 61, *Plastics*.

ISO 1874/1 and ISO 1874/2 cancel and replace ISO Recommendation R 1874-1971, of which they constitute a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

# Plastics — Polyamide (PA) homopolymers for moulding and extrusion — Part 1: Designation

## 1 Scope and field of application

**1.1** 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 and PA MXD6.

**1.2** The types of polyamide plastics 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 information about chemical structure, intended application, method of processing, important properties, additives, colour, fillers and reinforcing materials.

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

This International Standard does not apply to casting type polyamides of PA 6 and PA 12.

**1.4** 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 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.

**1.5** In order to specify a thermoplastic material for a particular application or reproducible processing, additional requirements may be coded in Data Block 5 (see clause 4).

## 2 References

ISO 307, *Plastics — Polyamides — Determination of viscosity.*

ISO 527, *Plastics — Determination of tensile properties.*

ISO 1043, *Plastics — Symbols and codes*

— *Part 1: Symbols for basic polymers and their modifications, and for plasticizers.*<sup>1)</sup>

— *Part 2: Codes for designations of polymers by a data-block system.*<sup>1)</sup>

ISO 1874/2, *Plastics — Polyamide (PA) homopolymers for moulding and extrusion — Part 2: Preparation of test specimens and determination of properties.*<sup>2)</sup>

ISO 3451/4, *Plastics — Determination of ash — Part 4: Polyamides.*<sup>3)</sup>

## 3 Definition

**polyamide materials:** Thermoplastic materials that contain carboxylic amide groups, —CONH—, at regular distances in the linear polymer chain.

Polyamides may be built up from a single starting material (aminocarboxylic acids or their lactams); they are designated by a figure corresponding to the number of carbon atoms in the starting material (see table 1).

1) At present at the stage of draft. (Partial revision of ISO 1043-1978.)

2) At present at the stage of draft. (Partial revision of ISO/R 1874-1971.)

3) At present at the stage of draft.

**Table 1 — Designation of polyamides of general formula —  $[\text{NH} - (\text{CH}_2)_x - \text{CO}]_n -$**

Symbol	Value of $x$	Number of C atoms in the starting material
PA 6	5	6
PA 11	10	11
PA 12	11	12

However, the polyamides may also be built up from one starting material with amino groups plus one starting material with carboxylic acid groups. These polyamides based on diamines and dicarboxylic acids, are designated by a two-digit or three-digit number, respectively, the first digit corresponding to the number of C atoms in the diamine [MXD is used for meta-xylylene diamine (see table 3)] and the second (with some materials the second and third) to the number of C atoms in the dicarboxylic acid (see table 2).

**Table 2 — Designation of polyamides of general formula —  $[\text{NH} - (\text{CH}_2)_6 - \text{NH} - \text{CO} - (\text{CH}_2)_y - \text{CO}]_{\frac{n}{2}} -$**

Symbol	Value of $y$
PA 66	4
PA 610	8
PA 612	10

#### 4 Designation system

The designation system of thermoplastics is based on the following standardized pattern<sup>1)</sup>:

Designation						
Description Block (optional)	Identity Block					
	International Standard Number Block	Individual Item Block				Data Block 5
		Data Block 1	Data Block 2	Data Block 3	Data Block 4	

It consists of an optional Description Block, reading Thermoplastics, and an Identity Block comprising the International Standard number and an Individual Item Block. For unambiguous coding the Individual Item Block is subdivided into four data blocks comprising the following information:

- No. 1: Identification of the plastic by its symbol PA, according to ISO 1043/1, and coded information about chemical structure and composition (see 4.1).
- No. 2: Position 1: Intended application or method of processing (see 4.2).  
Positions 2 to 4: Important properties, additives and supplementary information (see 4.2).
- No. 3: Designatory properties (see 4.3).
- No. 4: Fillers or reinforcing materials and their nominal content (see 4.4).

For the purpose of specifications, a fifth data block may be added containing additional information. The kind of information and its codes are not the subject of this part of ISO 1874.

The first character of the Individual Item Block shall be a hyphen. The four data blocks shall be separated from each other by a comma.

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

1) See ISO 1043/2.

#### 4.1 Data Block 1

In this data block, after a hyphen, PA plastics are identified by the symbols and codes listed in table 3.

Plastics containing plasticizer can be designated by the letter P after the symbol, separated by a hyphen (for example PA 610-P).

#### 4.2 Data Block 2

In this data block, information about intended application or method of processing is given in Position 1 and information about important properties, additives and colour in Positions 2 to 4. The codes are specified in table 4.

If information is presented in Positions 2 to 4 and no specific information is given in Position 1, the letter X shall be inserted in Position 1.

#### 4.3 Data Block 3

In this data block, the viscosity number is coded by two figures (see 4.3.1) and the modulus of elasticity by three figures (see 4.3.2). The two codes are separated from each other by a hyphen.

Rapid setting (nucleated) material may be coded by the letter N in the very last position of Data Block 3.

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

NOTE — Not all combinations of the designatory properties may be provided by currently available materials.

**Table 3 — Symbol and codes for chemical structure of the polyamide materials in Data Block 1**

Symbol	Name and chemical structure
PA 6	Polyamide 6; homopolymer based on $\epsilon$ -caprolactam
PA 66	Polyamide 66; homopolycondensate based on hexamethylenediamine and adipic acid
PA 69	Polyamide 69; homopolycondensate based on hexamethylenediamine and azelaic acid
PA 610	Polyamide 610; homopolycondensate based on hexamethylenediamine and sebacic acid
PA 612	Polyamide 612; homopolycondensate based on hexamethylenediamine and dodecanedioic acid <sup>1)</sup>
PA 11	Polyamide 11; homopolymer based on 11-aminoundecanoic acid
PA 12	Polyamide 12; homopolymer based on $\omega$ -aminododecanoic acid (laurolactam)
PA MXD6	Polyamide MXD6; homopolycondensate based on <i>m</i> -xylylenediamine and adipic acid

1) 1,10-Decanedicarboxylic acid.

Table 4 — Codes used in Data Block 2

Code	Position 1	Code	Positions 2 to 4
B	Blow moulding	A	Processing stabilized
E	Extrusion of pipes, profiles and sheet	B	Antiblocking
F	Extrusion of film and thin sheeting	C	Coloured <sup>1)</sup>
G	General use	D	Powder; dry blend
H	Coating	E	Expandable
K	Cable and wire coating	F	Special burning characteristics
L	Monofilament extrusion	G	Pellets; granules
M	Injection moulding	H	Heat-ageing stabilized
R	Rotational moulding	L	Light and/or weather stabilized
S	Powder coating or sintering	N	Natural (not coloured)
T	Tape manufacture	P	Impact modified
X	No indication	R	Moulding release agent
		S	Lubricated
		T	Improved transparency
		W	Stabilized against hydrolysis
		Z	Antistatic

- 1) C1 = coloured transparent;  
C2 = coloured non-transparent.

#### 4.3.1 Viscosity number

The viscosity number shall be determined according to ISO 307, using the solvents specified in table 5. The average value of the viscosity number is coded by two figures as specified in table 5.

Table 5 — Cell codes and cell ranges for viscosity number in Data Block 3

Code	Range of viscosity number ml/g		Applicable to
	Solvent: sulfuric acid 96 % (m/m)	Solvent: m-cresol	
09	< 90		PA 6
10	> 90 to 110		PA 66
12	> 110 to 130		PA 69
14	> 130 to 160		PA 610
18	> 160 to 200		PA 612
22	> 200 to 240		PA MXD6
27	> 240 to 290		
32	> 290 to 340		
34	> 340		
11		< 110	PA 11
12		> 110 to 130	PA 12
14		> 130 to 150	
16		> 150 to 170	
18		> 170 to 200	
22		> 200 to 240	
24		> 240	

NOTE — Viscosity numbers determined with 90 % (m/m) formic acid as a solvent can be converted into viscosity numbers determined in 96 % (m/m) sulfuric acid by the following equations:

for PA 6 :  $\ln y = 0,416 1 + 0,927 6 \ln x$

for PA 66 :  $\ln y = 0,454 1 + 0,926 1 \ln x$

for PA 69 :  $\ln y = 0,463 4 + 0,909 5 \ln x$

for PA 610 :  $\ln y = 0,982 3 + 0,793 2 \ln x$

where

$x$  is the viscosity number in 90 % (m/m) formic acid;

$y$  is the viscosity number in 96 % (m/m) sulfuric acid.

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

$$\ln y = 0,2857 + 0,9859 \ln x$$

where

*x* is the viscosity number in 96 % (*m/m*) sulfuric acid;

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

The above conversion formulae have been calculated from the results of an interlaboratory investigation carried out in 1982 (see ISO 307, clause 13). The accuracy of the conversions depends on both the level 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 % (*m/m*) sulfuric acid, converted from different values of the nominal viscosity number in the other solvents, are given in table 6.

Table 6 – Confidence intervals

Nominal viscosity number <sup>1)</sup>	95 % confidence intervals of converted nominal viscosity numbers in 96 % ( <i>m/m</i> ) 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

1) Solvents: 90 % (*m/m*) formic acid for PA 6, PA 66, PA 69, PA 610;  
*m*-cresol for PA 612.

#### 4.3.2 Tensile modulus of elasticity

The tensile modulus of elasticity shall be determined in the dry state according to ISO 527 with the test conditions specified in ISO 1874/2. The range of the tensile modulus of elasticity is coded by three figures as specified in table 7.

Table 7 – Cell codes and cell ranges for tensile modulus of elasticity in Data Block 3

Tensile modulus of elasticity	
Code	Range N/mm <sup>2</sup>
001	< 150
002	> 150 to 250
003	> 250 to 350
004	> 350 to 450
005	> 450 to 600
007	> 600 to 800
010	> 800 to 1 500
020	> 1 500 to 2 500
030	> 2 500 to 3 500
040	> 3 500 to 4 500
050	> 4 500 to 5 500
060	> 5 500 to 6 500
070	> 6 500 to 7 500
080	> 7 500 to 8 500
090	> 8 500 to 9 500
100	> 9 500 to 10 500
110	> 10 500 to 11 500
120	> 11 500 to 13 000
140	> 13 000 to 15 000
160	> 15 000 to 17 000
190	> 17 000 to 20 000
220	> 20 000 to 23 000
250	> 23 000