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**Thermoplastics pipes for the conveyance  
of fluids — Nominal outside diameters  
and nominal pressures —**

**Part 1:**  
**Metric series**  
**(Metric series)**

[ISO 161-1:1996](https://standards.iso.org/iso/161-1/1996)

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*Tubes en matières thermoplastiques pour le transport des fluides —  
Diamètres extérieurs nominaux et pressions nominales —*

*Partie 1: Série métrique*

INTERNATIONAL

**ISO**



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.

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.

International Standard ISO 161-1 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*.

This third edition cancels and replaces the second edition (ISO 161-1:1978), which has been technically revised.

ISO 161 consists of the following parts, under the general title *Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures*:

- Part 1: *Metric series*
- Part 2: *Inch-based series*

Annex A of this part of ISO 161 is for information only.

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## Introduction

In this part of ISO 161, some of the abbreviations used have been derived from the French language and others from English. It has been agreed to maintain the same abbreviations in both the French and English versions of the document.

For reference, the abbreviations are listed below with the originating language given first and the translation second:

PN:	Pression nominale (F)	Nominal pressure (E)
PMS:	Pression maximale de service (F)	Maximum allowable operating pressure (E)
MRS:	Minimum required strength (E)	Résistance minimale requise (F)
$\sigma_s$ :	Design stress (E)	Contrainte de calcul (F)

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# Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures —

## Part 1: Metric series

### 1 Scope

This part of ISO 161 specifies the nominal outside diameters for metric thermoplastics pipes for the conveyance of fluids in pressure and non-pressure applications. It also specifies nominal pressure ratings, minimum required strengths and overall service (design) coefficients for thermoplastics pipes for pressure applications.

It is applicable to smooth thermoplastics pipes of constant circular cross-section along the whole length of the pipe, whatever their method of manufacture or material of construction.

### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 161. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 161 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3:1973, *Preferred numbers — Series of preferred numbers*.

ISO 12162:1995, *Thermoplastics materials for pipes and fittings for pressure applications — Classifi-*

*cation and designation — Overall service (design) coefficient*.

### 3 Definitions

For the purposes of this part of ISO 161, the following definitions apply.

**3.1 nominal outside diameter,  $d_n$ :** A numerical designation of size which is common to all components in a thermoplastics piping system other than flanges and components designated by thread size. It is a convenient round number for reference purposes.

NOTE — For metric pipes conforming to this part of ISO 161, the nominal outside diameter, expressed in millimetres, is the minimum mean outside diameter  $d_{em,min}$  specified in the applicable pipe standard.

#### 3.2 Outside diameter, $d_e$

**3.2.1 mean outside diameter,  $d_{em}$ :** The measured length of the outer circumference of the pipe divided by  $\pi$ <sup>1)</sup>, rounded up to the nearest 0,1 mm.

**3.2.2 minimum mean outside diameter,  $d_{em,min}$ :** The minimum value of the mean outside diameter specified in the applicable pipe standard. It is equal to the nominal outside diameter  $d_n$ , expressed in millimetres.

1) The value of  $\pi$  is taken to be 3,142.

### 3.3 Pressure

**3.3.1 nominal pressure, PN:** An alphanumeric designation related to the mechanical characteristics of the components of a piping system and used for reference purposes. It is a convenient number selected from the R 10 series as defined in ISO 3.

**3.3.2 maximum allowable operating pressure,  $p_{PMS}$ :** The allowable pressure in the pipe when the overall service (design) coefficient  $C$  has been applied. It is expressed in megapascals.

**3.4 lower confidence limit,  $\sigma_{LCL}$ :** A quantity with the dimensions of stress, in megapascals, which can be considered as a property of the material under consideration and represents the 97,5 % lower confidence limit of the predicted long-term hydrostatic strength at 20 °C for 50 years with internal water pressure.

**3.5 minimum required strength, MRS:** The value of the lower confidence limit  $\sigma_{LCL}$  rounded down to the next value in the R 10 series as defined in ISO 3 when  $\sigma_{LCL}$  is less than 10 MPa or down to the next value in the R 20 series as defined in ISO 3 when  $\sigma_{LCL}$  is greater than or equal to 10 MPa. The MRS is expressed as a hoop stress in megapascals.

**3.6 overall service (design) coefficient,  $C$ :** An overall coefficient with a value greater than 1, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confidence limit.

The minimum values of  $C$  for specified materials are given in ISO 12162.

**3.7 design stress,  $\sigma_s$ :** The allowable stress for a given application. It is derived by dividing the MRS by the overall service (design) coefficient  $C$  and rounding to the nearest lower value in the R 20 series as defined in ISO 3, i.e.

$$\sigma_s = \frac{MRS}{C}$$

It is expressed in megapascals.

**3.8 standard dimension ratio, SDR:** The ratio of the nominal outside diameter of a pipe to its nominal wall thickness.

The SDR can be calculated from either of the following equations:

$$SDR = \frac{2 \times MRS}{C \times p_{PMS}} + 1$$

or

$$SDR = \frac{2 \times \sigma_s}{p_{PMS}} + 1$$

where

MRS is the minimum required strength, in megapascals;

$p_{PMS}$  is the maximum allowable operating pressure, in megapascals;

$C$  is the overall service (design) coefficient;

$\sigma_s$  is the design stress, in megapascals.

For a given SDR, and using the values of MRS and  $C$  specified in the applicable product standard, the maximum allowable operating pressure  $p_{PMS}$  can be calculated from either of the following equations:

$$p_{PMS} = \frac{2 \times MRS}{C \times (SDR - 1)}$$

or

$$p_{PMS} = \frac{2 \times \sigma_s}{(SDR - 1)}$$

**3.9 hydrostatic stress,  $\sigma$ :** The stress induced in the wall of a pipe when the pipe is filled with a fluid under pressure. The hydrostatic stress, expressed in megapascals, is related to the pressure, the wall thickness and the outside diameter of the pipe by the following equation:

$$\sigma = \frac{p(d_e - e)}{2e}$$

where

$p$  is the hydrostatic pressure, in megapascals;

$d_e$  is the outside diameter of the pipe, in millimetres;

$e$  is the wall thickness of the pipe, in millimetres.

## 4 Nominal outside diameter, $d_n$

The nominal outside diameter  $d_n$  shall be selected from the values given in table 1.

**Table 1 — Permitted values of nominal outside diameter,  $d_n$**

2,5	10	40	125	250	500	1 000
3	12	50	140	280	560	1 200
4	16	63	160	315	630	1 400
5	20	75	180	355	710	1 600
6	25	90	200	400	800	1 800
8	32	110	225	450	900	2 000

### 5 Nominal pressure rating, PN

The nominal pressure rating PN shall be selected from the values given in table 2.

**Table 2 — Permitted values of nominal pressure rating, PN (together with the corresponding values of the maximum allowable operating pressure  $p_{PMS}$ )**

PN	$p_{PMS}$	
	bar	MPa
1	1	0,1
2,5	2,5	0,25
3,2	3,2	0,32
4	4	0,4
5	5	0,5
6	6	0,6
6,3	6,3	0,63
8	8	0,8
10	10	1
12,5	12,5	1,25
16	16	1,6
20	20	2

NOTE — If higher nominal pressures are required, they shall be selected from the R 5 or R 10 series given in ISO 3.

### 6 Minimum required strength, MRS

The minimum required strength MRS shall be selected from the values given in table 3.

**Table 3 — Permitted values of minimum required strength, MRS**

Values in megapascals

1	6,3	20
1,25	8	22,4
1,6	10	25
2	11,2	28
2,5	12,5	31,5
3,15	14	35,5
4	16	40
5	18	

NOTE — The steps between the values from 1 to 10 are based on the R 10 series given in ISO 3 (25 % increments), whilst the steps between the values greater than 10 are based on the R 20 series (12 % increments).

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## **Annex A**

(informative)

### **Bibliography**

- [1] ISO 161-2:1996, *Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures — Part 2: Inch-based series.*
- [2] ISO 497:1973, *Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers.*
- [3] ISO 4065:1996, *Thermoplastics pipes — Universal wall thickness table.*

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