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**Infrastruktura za plin - Cevovodni sistemi za najvišji delovni tlak do vključno 16 bar - 6. del: Posebne funkcionalne zahteve za neplastificirani (nemehčani) poliamid (PA-U)**

Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 6: Specific functional recommendations for unplasticized polyamide (PA-U)

Gasinfrastruktur - Rohrleitungen mit einem maximal zulässigen Betriebsdruck bis einschließlich 16 bar - Teil 6: Spezifische funktionale Anforderungen für weichmacherfreies Polyamid (standards.iteh.ai)

Infrastructures gazières - Canalisations pour pression maximale de service inférieure ou égale à 16 bar - Partie 6 : Recommandations fonctionnelles spécifiques pour le polyamide non plastifié (PA-U)

**Ta slovenski standard je istoveten z: CEN/TS 12007-6:2021**

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**ICS:**

83.140.40	Gumene cevi	Hoses
91.140.40	Sistemi za oskrbo s plinom	Gas supply systems

**SIST-TS CEN/TS 12007-6:2021** en,fr,de

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TECHNICAL SPECIFICATION  
SPÉCIFICATION TECHNIQUE  
TECHNISCHE SPEZIFIKATION

**CEN/TS 12007-6**

March 2021

ICS 23.040.20

English Version

**Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 6: Specific functional recommendations for unplasticized polyamide (PA-U)**

Infrastructures gazières - Canalisations pour pression maximale de service inférieure ou égale à 16 bar - Partie 6 : Recommandations fonctionnelles spécifiques pour le polyamide non plastifié (PA-U)

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This Technical Specification (CEN/TS) was approved by CEN on 25 January 2021 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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## European foreword

This document (CEN/TS 12007-6:2021) has been prepared by Technical Committee CEN/TC 234 “Gas infrastructure”, the secretariat of which is held by DIN.

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

The basis of this document has been provided by an Ad Hoc group of interested parties consisting variously of pipe manufacturers, material suppliers and gas network engineers. The aim is to support the introduction of Polyamide pipe, PA-U, into Europe for use in natural gas pipe networks operating at working pressures up to and including 16 bar. The Secretariat of the Ad Hoc group was held by NEN.

This document is part of the following series of standards, of which the parts 1 to 4 and this document are in the responsibility of CEN/TC 234 Working Group 2, Secretariat held by BSI and of which part 5 is in the responsibility of CEN/TC 234 Working Group 10, Secretariat held by NSAI:

- *Part 1: General functional requirements*
- *Part 2: Specific functional requirements for polyethylene (MOP up to and including 10 bar)*
- *Part 3: Specific functional requirements for steel*
- *Part 4: Specific functional requirements for renovation*

This document has been written in the style and form of the above functional EN standards, but at this time has the status only of a CEN TS. This document will be amended under the authority of CEN/TC 234 as soon as more supporting evidence of the safe use of PA-U becomes available.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

**CEN/TS 12007-6:2021 (E)****1 Scope**

This document describes the specific functional requirements for polyamide (PA) pipelines in addition to the general functional requirements of EN 12007-1 for:

- a) a maximum operating pressure (MOP) up to and including 16 bar;
- b) an operating temperature between  $-20\text{ °C}$  and  $+40\text{ °C}$ .

This document covers one type of pipe:

- PA pipes single layer solid wall.

This document specifies common basic principles for gas infrastructure.

NOTE 1 Users of this document are aware that more detailed national standards and/or code of practice can exist in the CEN member countries.

This document is intended to be applied in association with these national standards and/or codes of practice setting out the above-mentioned basic principles.

NOTE 2 In the event of conflicts in terms of more restrictive requirements in national legislation/regulation with the requirements of this document, the national legislation/regulation takes precedence as illustrated in CEN/TR 13737 (all parts).

CEN/TR 13737 (all parts) give:

- clarification of all legislations/regulations applicable in a member state;
- if appropriate, more restrictive national requirements;
- a national contact point for the latest information.

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**2 Normative references**

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN ISO 16486-1:2020, *Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing — Part 1: General (ISO 16486-1)*

EN ISO 16486-2:2020, *Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing — Part 2: Pipes (ISO 16486-2)*

EN ISO 16486-3, *Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing — Part 3: Fittings (ISO 16486-3)*

EN ISO 16486-4, *Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing — Part 4: Valves<sup>1</sup>*

EN ISO 16486-5, *Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing — Part 5: Fitness for purpose of the system (ISO/DIS 16486-5)<sup>2</sup>*

<sup>1</sup> Under preparation. Stage at the time of publication: prEN ISO 16486-4.

EN 12327, *Gas infrastructure — Pressure testing, commissioning and decommissioning procedures - Functional requirements*

ISO 12176-1, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 1: Butt fusion*<sup>3</sup>

ISO 12176-2, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 2: Electrofusion*<sup>4</sup>

ISO 17885, *Plastic piping systems — Mechanical fittings for pressure piping systems — Specifications*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <http://www.electropedia.org/>

#### 3.1

##### **nominal outside diameter**

$d_n$

specified outside diameter

#### 3.2

##### **nominal wall thickness**

$e_n$

numerical designation of the wall thickness of a component, which is a convenient round number, approximately equal to the manufacturing dimension in millimetres

#### 3.3

##### **standard dimension ratio**

**SDR**

number approximately equal to the quotient of the nominal outside diameter and the nominal wall thickness

#### 3.4

##### **maximum operating pressure**

**MOP**

maximum pressure at which a system can be operated continuously under normal operating conditions

Note 1 to entry: Normal operating conditions are: no fault in any device or stream.

<sup>2</sup> Under preparation. Stage at the time of publication: prEN ISO 16486-5.

<sup>3</sup> This standard is also applicable for PA-U without any changes.

<sup>4</sup> This standard is also applicable for PA-U without any changes

**CEN/TS 12007-6:2021 (E)****3.5****maximum incidental pressure*****MIP***

maximum pressure which a system can experience during a short time limited by the safety devices

**3.6****butt fusion joint**

method of jointing PA-U pipes and fittings where the two pipe ends are heated and brought together to be fused without the use of a separate fitting or filler material

**3.7****electrofusion joint**

method of jointing PA-U pipes, using fittings which have an integrated electric heating element

**3.8****squeeze-off**

act of squeezing a pipe to prevent the flow of gas

**3.9****minimum required strength*****MRS***

value of the lower confidence limit rounded down to the next lower value of the R10 series when the lower confidence limit is below 10 MPa, or to the next lower value of the R20 series when the lower confidence limit is 10 MPa or greater

Note 1 to entry: R10 and R20 series are the Renard number series conforming to ISO 3 and ISO 497.

**3.10****lower confidence limit*****LCL***

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quantity, expressed in MPa, which can be considered as a material property, representing the 97,5 % lower confidence limit of the predicted long term hydrostatic strength for water at 20 °C for 50 years

**3.11****critical rapid crack propagation pressure*****P<sub>RCP</sub>***

pressure level at which a rapid crack propagation (RCP) can occur in a PA-U pipeline, defined at a reference temperature

Note 1 to entry: Reference temperature is 0 °C.

**4 Symbols and abbreviations**

PA-U unplasticized polyamide



## 5 Design

### 5.1 General

The PA-U products are covered by CEN/TC 155, *Plastics piping systems and ducting systems*. Purchasing products to CEN standards can be part of a quality programme to ensure the safety and integrity of gas systems over their design life in service.

The selection of materials, SDR series, dimensions and assembling techniques shall be the responsibility of the pipeline operator.

### 5.2 Materials and components

PA-U materials and components used shall comply with EN ISO 16486-1, EN ISO 16486-2, EN ISO 16486-3, EN ISO 16486-4<sup>1</sup> and EN ISO 16486-5<sup>2</sup>.

Other components not covered by future EN ISO 16486-1, EN ISO 16486-2, EN ISO 16486-3, EN ISO 16486-4<sup>1</sup> and EN ISO 16486-5<sup>2</sup> shall conform to the relevant European Standards and International Standards or, in their absence, to national or other established standards and shall be fit for their purpose.

### 5.3 Maximum operating pressure

#### 5.3.1 General

The *MOP* should be selected on the basis of the gas infrastructure operating requirements provided that the *MOP* does not exceed 16 bar and the conditions in 5.3.2 and 5.3.3 are satisfied.

#### 5.3.2 Verification of the overall service (design) coefficient

The overall service (design) coefficient *C* shall be calculated using the formula as given below and in Figure 1 shall be greater than or equal to 2. This coefficient *C* takes into consideration service conditions as well as the properties and components of a pipeline.

$$C \geq \frac{20 \times MRS}{MOP \times (SDR - 1) \times D_F} \quad (1)$$

All pressures measured in bar.

Derating factor ( $D_F$ ) is a coefficient used in the calculation of *MOP* which takes into account the influence of operating temperature.

NOTE Derating factors are listed in Annex A of ISO 16486-6:2012 will be moved to Annex A of EN ISO 16486-5<sup>2</sup> during the ongoing revision.

#### 5.3.3 Verification of the RCP criterion

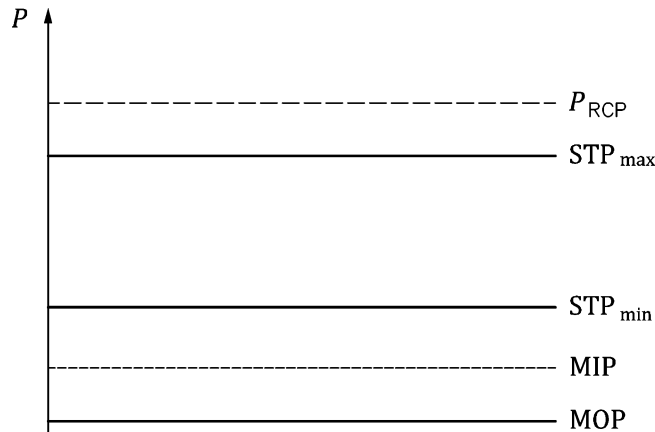
The ratio of critical *RCP* pressure to *MOP* shall be greater than or equal to 1,5 (according to EN ISO 16486-2)

The *RCP* criterion is the critical pressure, is dependent on pipe size and material, and shall be determined in accordance with EN ISO 16486-2.

The critical *RCP* pressure is based on a temperature of 0 °C.

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Where pipe temperature decreases below 0 °C the  $P_{RCP}/MOP$  ratio should be recalculated in accordance with EN ISO 16486-5<sup>2</sup> using a value of  $RCP$  pressure determined from the minimum expected operating temperature of the pipe. The value of  $MOP$  should be reduced so as to maintain the  $P_{RCP}/MOP$  ratio at a value greater than or equal to 1,5. See Figure 1.



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**Key**

$P$  pressure levels

$P_{RCP}$  critical rapid crack propagation pressure

$STP_{max}$  maximum strength test pressure

$STP_{min}$  minimum strength test pressure

$MIP$  maximum incidental pressure

$MOP$  maximum operating pressure

**Figure 1 — Pressure conditions in a PA-U-system**

System design:

$$MOP \leq \frac{20 \times MRS}{C \times (SDR - 1) \times D_F}$$

$$MOP \leq \frac{P_{RCP}}{1,5} \quad (2)$$

Pressure testing:

$$1,5 \times MOP \leq STP \leq \frac{20MRS}{SDR - 1} \quad (3)$$

$$MIP < STP \leq 0,9P_{RCP} \quad (4)$$

NOTE For RCP conditions see EN ISO 16486-2 and EN ISO 16486-5<sup>2</sup>.

## 5.4 Assembly techniques

Joining procedures can vary depending upon the PA-U material and sizes used.

The acceptable joining methods that shall be used are:

- fusion joints; or
- mechanical joints.

Joints made between new and existing PA-U gas pipework shall be compatible with the materials being joined.

Components made from PA-U 11 shall be heat fusion jointed only to components made from PA-U 11.

Components made from PA-U 12 shall be heat fusion jointed only to components made from PA-U 12.

Components made from PA-U are not fusion compatible with components made from other polymers.

NOTE Test methods for assuring fusibility are given in EN ISO 16486-3 and EN ISO 16486-5<sup>2</sup>.

The fusion joining techniques for the construction of PA-U pipelines shall be butt fusion and electrofusion.

Written joining procedures, authorized by the pipeline operator, shall be available prior to the construction of a pipeline.

## 5.5 Material properties for flow stopping by squeeze-off

When squeeze-off techniques are considered, the suitability of pipe for squeeze-off shall be established in accordance with EN ISO 16486-2:2020, Annex A, as the described methodology is applicable for PA-U.

NOTE In publication [8] the squeeze-off behaviour of PA-U 12 pipes is shown.

## 6 Construction

### 6.1 Storage, handling and transportation

Care shall be taken during the transport, handling and storage of pipes, fittings and other components to ensure at all stages that their specified properties and conditions, which can be affected by environmental factors, are preserved and that physical damage and distortions are avoided.

Pipes and fittings shall be inspected and those pipes with surface defects deeper than 10 % of the nominal wall thickness shall not be used. For pipe areas which are foreseen for jointing the surface shall be free of damages which would potentially effect the life time of the system.

PA-U pipes and fittings stored outside are subjected to UV degradation when exposed to direct daylight. PA-U materials are stabilized to give protection for a UV radiation level of 3,5 GJ/m<sup>2</sup>. National bodies should give recommendations for allowed storage times in their countries. The average radiation level for one year in European countries are given in Figure 2.