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Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing —

Part 7: Assessment of conformity

*Systèmes de canalisations en matières plastiques pour la distribution
de combustibles gazeux — Systèmes de canalisations en polyamide
non plastifié (PA-U) avec assemblages par soudage et assemblages
mécaniques —*

Partie 7: Evaluation de la conformité

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 4, *Plastics pipes and fittings for the supply of gaseous fuels*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 155, *Plastics piping systems and ducting systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 16486 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document specifies requirements and guidance for the assessment of conformity (AoC) for a piping system and its components made from unplasticized polyamide (PA-U), and which is intended to be used for the supply of gaseous fuels.

Requirements and test methods for material and components of the piping system are specified in ISO 16486-1, ISO 16486-2, ISO 16486-3 and ISO 16486-4.

Characteristics for fitness for purpose of the system and generic fusion parameters are covered in ISO 16486-5.

Recommended practice for installation is provided in ISO 16486-6, which will not be implemented as European Standard under the Vienna Agreement.

Recommended practice for installation is also provided in CEN/TS 12007-6,^[1] prepared by Technical Committee CEN/TC 234, *Gas infrastructure*.

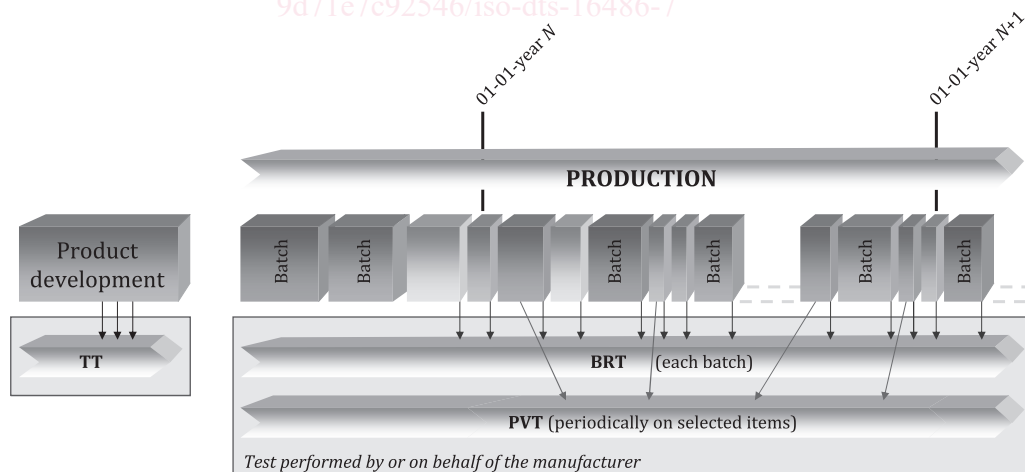
Training and assessment of fusion operators is given in ISO/TS 16486-8.

NOTE While ISO 16486-1, ISO 16486-2, ISO 16486-3, ISO 16486-5, ISO 16486-6 and ISO/TS 16486-7 (this document) and ISO/TS 16486-8 have been prepared by ISO/TC 138, SC 4, ISO 16486-4 has been prepared by ISO/TC 138, SC 7.

This document details the applicable characteristics to be assessed for type testing (TT), batch release testing (BRT), process verification testing (PVT) and audit testing (AT), as well as the frequency and sampling for testing.

The concept of testing and organization of those tests used for the AoC is shown, without or with certification, in [Figures 1](#) and [2](#).

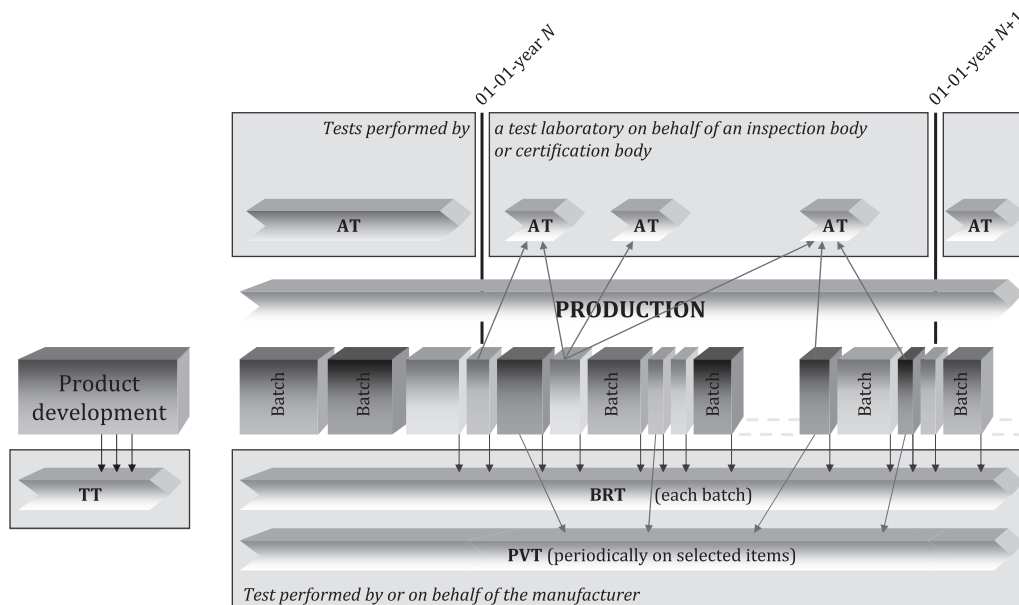
A typical scheme for the assessment of conformity of materials, compounds, pipes, fittings, valves, joints or assemblies by product manufacturers is given in [Figure 1](#).



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Figure 1 — Typical scheme for the AoC by a manufacturer, without certification

A typical scheme for the assessment of conformity of compounds, pipes, fittings, valves, joints or assemblies by manufacturers, including certification, is given in [Figure 2](#).



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Figure 2 — Typical scheme for the AoC by a manufacturer, including certification

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Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing —

Part 7: Assessment of conformity

1 Scope

This document gives guidance and requirements for the assessment of conformity of compounds, products, joints and assemblies in accordance with the applicable part(s) of the ISO 16486 series which are intended to be included in the manufacturer's quality plan as part of the quality management system and for the establishment of certification procedures.

NOTE 1 A basic test matrix in [Annex B](#) provides an overview of the testing scheme.

It is recommended that the manufacturer have a management system such as ISO 9001^[4] or equivalent.

NOTE 2 If certification is involved, certification bodies and inspection bodies operating according to ISO/IEC 17065 and ISO/IEC 17020 are considered to be competent.

In conjunction with the other parts of the ISO 16486 series (see [Clause 2](#)), this document is applicable to unplasticized polyamide (PA-U) piping systems intended to be buried and used for the supply of gaseous fuels. It is applicable to PA-U pipes, fittings and valves, as well as to their joints and to joints with components of other materials intended to be used under the following conditions:

- a) a maximum operating pressure (MOP) up to and including 18 bar¹⁾ (the MOP is limited to 16 bar for CEN member countries, where ISO 16486-6 is replaced by CEN/TS 12007-6^[1]);
- b) an operating temperature of 20 °C as the reference temperature.

NOTE 3 For operating temperatures different to 20 °C, derating coefficients can be used (see ISO 16486-6). CEN member countries use CEN/TS 12007-6^[1] and ISO/TS 16486-7 (this document) as a basis, but they can also request additional requirements. For non-CEN member countries, information for dealing with special cases for PA-U can be found in ISO/TS 16486-7 (this document) and PPI TR-3.^[2]

For mechanical fittings conforming to ISO 17885, guidance for assessment of conformity is not given in this document. When requested, a quality plan based on the tests mentioned can be set up in agreement between user and manufacturer.

The ISO 16486 series covers a range of maximum operating pressures and gives requirements concerning colours.

NOTE 4 It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking into account their particular requirements and any relevant national regulations and installation practices or codes.

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.

1) 1 bar = 0,1 MPa = 10⁵ Pa; 1 MPa = 1 N/mm².

ISO 12162, *Thermoplastics materials for pipes and fittings for pressure applications — Classification, designation and design coefficient*

ISO 13477, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Small-scale steady-state test (S4 test)*

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 16486-2:2020, *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 16486-3:2020, *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 16486-4:2022, *Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing — Part 4: Valves*

ISO 16486-5:2021, *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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16486-1, ISO 16486-2, ISO 16486-3, ISO 16486-4 and ISO 16486-5 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 certification body
third-party conformity assessment body operating certification schemes

Note 1 to entry: A certification body can be non-governmental or governmental (with or without regulatory authority).

3.2 laboratory

body that performs one or more of the following activities:

- testing;
- calibration;
- sampling, associated with subsequent testing or calibration

Note 1 to entry: Within the context of this document, the materials and products can be subjected to type testing, batch release testing, process verification testing and audit testing, as applicable.

3.3 quality management system

part of a management system with regard to quality

Note 1 to entry: Requirements for quality management systems are given in ISO 9001.

[SOURCE: ISO 9000:2015, 3.5.4, modified — Note 1 to entry added.]

3.4**quality plan**

document setting out the specific quality practices, responsibilities, resources and sequence of activities relevant to a particular product or range of products

3.5**type testing****TT**

test performed to prove that the material, component, product, joint or assembly is capable of conforming to the requirement(s) given in the relevant standard

3.6**batch release test****BRT**

test performed on a batch of material, components, products, joints or assemblies which has to be satisfactorily completed before the batch can be released

Note 1 to entry: A batch release test can be performed by the manufacturer or outsourced on behalf of the manufacturer.

3.7**process verification test****PVT**

test performed on material, component, product, joint or assembly at specific intervals to confirm that the process continues to be capable of producing components, products which conform to the requirements given in the relevant standard

Note 1 to entry: Process verification tests can be performed by the manufacturer or outsourced on behalf of the manufacturer.

Note 2 to entry: Process verification tests are regularly performed to demonstrate that the product remains compliant with the type test results.

Note 3 to entry: ISO/AWI 8149:²⁾ presents the stress rupture curves for PA-U and PPI TR-4^[9] lists the long-term hydrostatic strength at different temperatures for a number of different PA-U piping materials.

3.8**audit test****AT**

test performed on behalf of a certification body

Note 1 to entry: Audit tests are generally required to confirm that the compound, components, product, joint or assembly continues to conform to the requirements given in the relevant standard and to provide information to assess the effectiveness of the quality management system.

3.9**indirect test****IT**

batch release test performed which differs from that specified test for that particular characteristic, having previously verified its correlation with the specified test

Note 1 to entry: Indirect tests can be performed by the manufacturer or outsourced on behalf of the manufacturer.

3.10**witness test****WT**

type test or audit test which is performed in the presence of a representative of the certification body

2) Under preparation. Stage and the time of publication: ISO/AWI 8149:2023.

**3.11
material**

generic term for compounds grouped by families, expressed by generic names

Note 1 to entry: Examples of generic names are PA-U 11, PA-U 12.

**3.12
compound**

homogenous mixture of substances used for the manufacture of the product as defined in the referring product standard

Note 1 to entry: [Annex A](#) gives testing requirements for changes made to the compound.

**3.13
material batch
batch of material**

quantity of a given homogeneous compound manufactured under uniform conditions defined and identified by the compound manufacturer

**3.14
product**

item as defined in the scope of this document, e.g. pipe, fitting, valve

**3.15
product batch
batch of products**

clearly identified collection of products, manufactured consecutively or continuously under the same conditions, using the same compound conforming to the same specification

Note 1 to entry: The production batch is defined and identified by the product manufacturer.

**3.16
lot**

clearly identifiable sub-division of a batch for inspection purposes

**3.17
sample**

one or more units or products drawn from the same production batch or a lot, selected at random without regard to their quality

**3.18
group**

collection of similar components or products from which samples are selected for testing purposes

**3.19
component**

item manufactured out of a specific compound, supplied as part of a product or as a spare part for that product

Note 1 to entry: Depending on the context, components can potentially be considered as products and be individually approved (e.g. o-ring, gasket) or they are tested as an integral part of a finished product (e.g. in a valve).

**3.20
joint**

connection between two or more products

**3.21
assembly**

set of components that forms a product or a test piece

3.22**product type**

generic description of a product

EXAMPLE A pipe or fitting or valve or their main parts, of the same design, from a particular compound.

3.23**body type**

<valve> generic description of a valve body

Note 1 to entry: A valve body is of a particular design which can have different end connections.

3.24**cavity**

space within a mould to be filled to form the moulded product

EXAMPLE That part of an injection mould which gives the form to the injection-moulded product.

4 Abbreviated terms

To avoid misunderstanding, the abbreviated terms listed in this Clause are defined as being equivalent in each language. For the same reason, the terms are given in the languages, English, French, Russian and German; see [Table 1](#).

Table 1 — Abbreviated terms in English, French, Russian and German

Term	EN	FR	RU	DE
AT	audit test	essai d'audit	Инспекционные испытания	Überwachungsprüfung
BRT	batch release test	essai de libération de campagne de fabrication	Приемо-сдаточные испытания	Freigabepfung einer Charge
PVT	process verification test	essai de vérification du procédé de fabrication	Периодические испытания	Prozessüberprüfung
TT	type test	essai de type	Типовые испытания	Typprüfung

5 General

Materials, products and fitness for purpose shall conform to the requirements given in ISO 16486-1, ISO 16486-2, ISO 16486-3, ISO 16486-4 and ISO 16486-5.

Materials and products shall be produced by the manufacturer under a quality management system which includes a quality plan.

6 Testing and inspection**6.1 Grouping****6.1.1 General**

For the purpose of this document, the groups specified in [6.1.2](#) to [6.1.4](#) apply.

6.1.2 Size groups

Three size groups are defined for pipes and fittings, as given in [Table 2](#).

For testing purposes, one individual nominal diameter, d_n , shall be selected from each group.

Table 2 — Size groups

Size group	Nominal diameter d_n mm
1	$16 \leq d_n \leq 63$
2	$63 < d_n \leq 225$
3	$225 < d_n \leq 630$

6.1.3 Fitting groups

Three groups of fittings each having a similar design are defined, as given in [Table 3](#).

For testing purposes, one individual fitting shall be selected from each group.

Table 3 — Fitting groups

Fitting groups	
(A)	Electrofusion socket fitting
(B)	Electrofusion saddle fitting
(C)	Spigot end fitting

6.1.4 Fitting types

Fitting groups are divided into fitting types.

Fitting group (A) includes the following fitting types: electrofusion couplers, electrofusion 45° elbows, electrofusion 90° elbows, electrofusion tees, electrofusion reducers, electrofusion end caps, etc.

Fitting group (B) includes the following fitting types: electrofusion tapping saddles, electrofusion branch saddles, etc.

Fitting group (C) includes the following fitting types: 45° elbows, 90° elbows, tees, reducers, end caps, etc.

6.2 Type testing

Type testing is intended to demonstrate the ability of the product to fulfil the intended use and characteristics detailed in the referring product standard.

Type testing shall be performed as described in [Tables 4, 5, 6](#) and [7](#) whenever there is:

- a) a new system (N);
- b) a change in design (D);
- c) a change in material (M);
- d) an extension of the product range (E).

It can be necessary to revalidate type testing in the case of process verification test deviation (see [6.4](#)).

When a change of production site occurs, the manufacturer shall determine which type tests need to be revalidated.

Unless any of the conditions described in points a) to d) occurs, the type test results remain valid.

A type test may be performed by the manufacturer or outsourced on behalf of the manufacturer.

NOTE It is recommended that the location of the test be made available if certification is involved.

Type tests shall demonstrate that the products conform to all requirements for the characteristics given in [Tables 4](#) to [7](#), as applicable.

In case of a change in compound as defined in [Clause A.2](#), relevant type testing requirements as defined in [Clause A.3](#), and in [Tables 4](#) to [7](#) as applicable, shall apply.

For the purposes of a change:

- a) dimensions and geometry (see column D1 of [Tables 6](#) and [7](#)), are defined as: change of visual and functional optimizations, change of overall dimensions, change of a non-PA part;
- b) jointing system joint affected part (see column D2 of [Tables 6](#) and [7](#)), is defined as: change of the dimensions of the fusion zone (e.g. wire pitch, wire depth), the electrical characteristics (e.g. wire, resistance), the fusion parameters (e.g. time, voltage).

For the extension of the production range, the relevant characteristics given in [Table 6](#) and [Table 7](#), column E, as applicable, shall be retested. If certification is involved, retesting shall be agreed between the certification body and the manufacturer.

Table 4 — Characteristics of compounds that require type testing (TT) by the compound manufacturer

Characteristic	Reference	Sampling procedure
Compound density	ISO 16486-1:2020, 5.2.5	Once/compound
Viscosity number	ISO 16486-1:2020, 5.2.5	Once/compound
Water content	ISO 16486-1:2020, 5.2.5	Once/compound
Carbon black content ^a	ISO 16486-1:2020, 5.2.5	Once/compound
Carbon black dispersion ^a	ISO 16486-1:2020, 5.2.5	Once/compound
Pigment dispersion ^b	ISO 16486-1:2020, 5.2.5	Once/compound
Chemical resistance (or resistance to gas condensate)	ISO 16486-1:2020, 5.2.5	Once/compound
Resistance to weathering	ISO 16486-1:2020, 5.2.5	Once/compound ^c
Resistance to rapid crack propagation (Critical pressure, p_c) ($e \geq 5$ mm) (Full-scale test)	ISO 16486-1:2020, 5.2.5	Once/compound ^d according to ISO 13478 (withdrawn) ^e
Resistance to rapid crack propagation (critical pressure, $p_{c,S4}$) (S4 test)	ISO 16486-1:2020, 5.2.5	Once/compound ^{f,g} according to ISO 13477
Resistance to slow crack growth (d_n : 110 mm SDR 11)	ISO 16486-1:2020, 5.2.5	Once/compound