INTERNATIONAL STANDARD

ISO 22621-6

First edition
2010-04-15

Plastics piping systems for the supply of gaseous fuels for maximum operating pressures up to and including 2 MPa (20 bar) — Polyamide (PA) —

Part 6:
Code of practice for design, handling and installation

Systèmes de canalisations en matières plastiques pour la distribution de combustibles gazeux pour des pressions maximales de service inférieures ou égales à 2 MPa (20 bar) — Polyamide (PA) —

Partie 6: Code de pratique pour la conception, la manutention et l'installation

Reference number
ISO 22621-6:2010(E)

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Published in Switzerland

Contents

Page

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 22621-6 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*.

ISO 22621 consists of the following parts, under the general title *Plastics piping systems for the supply of gaseous fuels for maximum operating pressures up to and including 2 MPa (20 bar) — Polyamide (PA)*:

— *Part 1: General*

— *Part 2: Pipes*

— *Part 3: Fittings*

— *Part 5: Fitness for purpose of the system*

— *Part 6: Code of practice for design, handling and installation*

Introduction

This part of ISO 22621 addresses the common basic principles for gas supply systems. More detailed national standards or codes of practice might exist in the ISO member countries. This part of ISO 22621 is intended to be applied in association with those national standards or codes of practice related to the above-mentioned basic principles.

Plastics piping systems for the supply of gaseous fuels for maximum operating pressures up to and including 2 MPa (20 bar) — Polyamide (PA) —

Part 6: Code of practice for design, handling and installation

1 Scope

This part of ISO 22621 specifies a code of practice dealing with polyamide (PA) piping systems, intended to be buried outside buildings and used for the supply of gaseous fuels.

It is applicable to mains and service lines, the components of which are prepared for jointing by scraping and/or machining, and gives instructions for the design, storage, handling, transportation, laying conditions and fusion quality control of PA pipes and fittings up to and including 250 mm outside diameter, as well as subsequent joint testing, backfilling, pipe system testing, commissioning and decommissioning.

The jointing methods covered by this part of ISO 22621 are butt fusion jointing and electrofusion jointing.

No special precautions are necessary for areas exposed to the influence of mining and earthquakes other than those precautions mentioned in this part of ISO 22621.

It is the responsibility of users of this part of ISO 22621 to take existing and new national regulations into account.

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

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

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

ISO 12176-3, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 3: Operator's badge*

EN 12327, *Gas supply systems — Pressure testing, commissioning and decommissioning procedures — Functional requirements*

ISO 22621-1, *Plastics piping systems for the supply of gaseous fuels for maximum operating pressures up to and including 2 MPa (20 bar) — Polyamide (PA) — Part 1: General*

ISO 22621-2, *Plastics piping systems for the supply of gaseous fuels for maximum operating pressures up to and including 2 MPa (20 bar) — Polyamide (PA) — Part 2: Pipes*

ISO 22621-3, *Plastics piping systems for the supply of gaseous fuels for maximum operating pressures up to and including 2 MPa (20 bar) — Polyamide (PA) — Part 3: Fittings*

ISO 22621-5, *Plastics piping systems for the supply of gaseous fuels for maximum operating pressures up to and including 2 MPa (20 bar) — Polyamide (PA) — Part 5: Fitness for purpose of the system*

3 Terms and definitions

For the purposes of this document, the terms, definitions, symbols and abbreviated terms given in ISO 22621-1 and ISO 22621-5 and the following apply.

3.1
butt fusion machine pressure
pressure indicated on the manometer or on a pressure display on a butt fusion machine, giving an indication of the interface force applied to the pipe or fitting ends

3.2
clearance
shortest distance between the outer limits of two objects

3.3
drag resistance
frictional resistance due to the weight of the length of pipe fixed in the movable clamp at the point at which movement of the movable clamp is initiated (peak drag), or the friction occurring during movement (dynamic drag)

3.4
electrofusion control box
unit implementing the output fusion parameters of voltage or current and time or energy to execute the fusion cycle, as specified by the electrofusion fitting manufacturer

3.5
frictional losses in the butt fusion machine
force necessary to overcome friction in the whole mechanism of a butt fusion machine

3.6
interface force
force between the fusion surfaces of the pipe(s) and/or fitting(s) during the fusion cycle, as specified in the fusion diagram

3.7
operator
person authorized to build PA systems from pipes or fittings, based on a written procedure agreed on by the pipeline operator

3.8
overall service (design) coefficient
C
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

3.9
pipeline operator
private or public organization authorized to design, construct or operate and maintain a gas supply system

3.10
soil cover
vertical distance between the top of a buried pipe and the normal surface after finishing work

4 Symbols and abbreviated terms

d_e outside diameter of pipe at any point

MOP maximum operating pressure

MRS minimum required strength

RCP rapid crack propagation

SDR standard dimension ratio

5 Design

5.1 General

A written laying procedure, authorized by the pipeline operator, shall be made available prior to the construction of a pipeline. The laying procedure shall include specification of the jointing procedure, the pipe and fitting materials to be used, the trenching and backfilling requirements, the pressure testing and commissioning requirements, and the data to be collected for the traceability system.

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

There are two SDR series in common use for gas supply systems: SDR 17 and SDR 11. Other SDR series can also be used, such as SDR 26 for renovation.

The training and the level of skill of the operator shall be in accordance with the requirements of the jointing procedures.

General guidelines for supervision and quality control are given in Clause 8.

5.2 Materials, components and jointing equipment

The PA materials and components used shall conform to ISO 22621-1, ISO 22621-2 and ISO 22621-3, as relevant.

Other components not covered by the above-mentioned parts of ISO 22621 shall conform to the relevant national standards.

If pipes and fittings are to be stored outside, requirements on maximum storage time shall be given in the laying procedure. PA materials shall be stabilized to give protection against a UV radiation level of 3,5 GJ/m^2. It is desirable that national bodies give recommendations for allowed storage times in their countries.

The fusion equipment used for the construction of the pipeline shall comply with the requirements of ISO 12176-1 or ISO 12176-2. If the operation of the fusion equipment requires an operator's badge, the badge shall conform to ISO 12176-3.

5.3 Maximum operating pressure

The maximum operating pressure (MOP) of the system shall be selected by the pipeline operator on the basis of the gas supply system operating requirements and the materials used. The MOP of a PA system depends on the type of resin used (the MRS), the pipe SDR series and the service conditions, and is limited by the overall service (design) coefficient, C, and the RCP criteria.

The overall service (design) coefficient, C, for thermoplastics materials is specified in ISO 12162. This coefficient is used to calculate the MOP of the pipeline. C shall be greater than or equal to 2 for PA pipeline systems for natural gas.

$$\text{MOP} = \frac{20 \times \text{MRS}}{C \times (\text{SDR} - 1) \times D_{\text{F}}} \tag{1}$$

NOTE The derating factor, D_{F}, is a coefficient used in the calculation of the MOP which takes into account the influence of the operating temperature. Derating factors for various operating temperatures are given in Annex A.

The ratio of the critical RCP pressure to the MOP shall be $\geqslant$ 1,5 at the minimum operating temperature. The critical RCP pressure is dependent on temperature, pipe size and type of PA material used. It is defined in this subclause in accordance with ISO 22621-1, based on the full-scale test method in accordance with ISO 22621-1:2007, Annex C, which specifies a test temperature of 0 °C.

Where the pipe temperature decreases below 0 °C, the p_{c}/MOP ratio shall be recalculated using a p_{c} (critical pressure) value determined from the minimum expected operating temperature of the pipe. If necessary, the value of the MOP shall be reduced so as to maintain the p_{c}/MOP ratio at a value $\geqslant$ 1,5.

5.4 Assembly techniques

Jointing procedures may vary depending on the pipe size used.

Fusion is the preferred jointing method. Preference shall be given to butt fusion and electrofusion.

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

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

Components made from polyamide are not fusion compatible with components made from other polymers.

A written jointing procedure, authorized by the pipeline operator, shall be available prior to the construction of a pipeline. The jointing procedure shall include specification of the jointing method, the fusion parameters, the fusion equipment, the jointing conditions, the level of skill of the operator, and the quality control methods to be used.

5.5 Squeeze-off properties

When squeeze-off techniques are considered, the suitability of the pipe for squeeze-off shall be established in accordance with the manufacturer's recommendations.

6 Installation

6.1 Jointing procedure

The jointing operation shall be performed in accordance with the pipeline operator's written procedure and shall take into account the procedures outlined in ISO 22621-5:2010, Annex A, for butt fusion jointing and ISO 22621-5:2010, Annex B, for electrofusion jointing.

Polyamide pipes, fittings and accessories may be jointed by heated-tool fusion jointing or electrofusion jointing. The jointing and quality control methods used for the construction of the gas supply system shall be appropriate to the design of the network and take into account the requirements of ISO 22621-5.

6.2 Training

The operator shall be competent in the appropriate laying and jointing methods. He or she shall possess the necessary skill and knowledge to produce joints of consistently high quality.

Operators shall receive formal training under the supervision of a qualified instructor. The gas company may require a certificate indicating that the operator has reached an adequate standard in accordance with national or local regulations.

6.3 Heated-tool fusion jointing

6.3.1 General

Heated-tool fusion joints shall be made under defined conditions of pressure, time and temperature, using a written procedure (see 6.1). Mating surfaces should be heated to their fusion temperature and then brought into contact with one another.

6.3.2 Fusion temperature

The production of a strong fusion bond depends, among other things, on the fusion temperature of the polyamide material: overheating can degrade the material, and insufficient heating does not soften it adequately.

The temperature range over which any particular polyamide material may be satisfactorily jointed shall be considered. The jointing procedure shall specify the heating cycle and the temperature levels for the polyamide material selected.

Cold weather and wind can adversely affect the fusion temperature. Under these circumstances, special precautions, such as shielding, end caps and longer heating times shall be considered.

6.3.3 Fusion equipment

The butt fusion equipment used shall conform to ISO 12176-1.

As high-quality fusion joints cannot be made with fusion equipment in poor condition, maintenance of the fusion equipment is very important and shall be carried out on a regular basis. The cleanliness and integrity of the heating surfaces, the ability of the heating tools to produce the correct temperature and the correct alignment and operation of the equipment when used are of paramount importance.

The heating tools are designed to maintain uniform temperatures within the fusion temperature range of the particular polyamide material and shall have calibrated means of measuring and indicating the temperature. A precise temperature measurement device, such as a pyrometer or a digital thermometer with a surface temperature sensor, may be used to check the surface temperature of the heating tools, although additional care is necessary to avoid inconsistency of readings when such a device is used.

All heating tools used shall be electrically heated.