SIST

SLOVENSKI STANDARD
SIST EN 13480-3:2018/oprA3:2019

01-april-2019

Kovinski industrijski cevovodi - 3. del: Konstruiranje in izračun - Dopolnilo A3

Metallic industrial piping - Part 3: Design and calculation

Metallische industrielle Rohrleitungen - Teil 3: Konstruktion und Berechnung

Tuyauteries industrielles métalliques - Partie 3 : Conception et calcul

Ta slovenski standard je istoveten z: EN 13480-3:2017/prA3

iTeh STANDARD PREVIEW
(standards.iteh.ai)
Full standard:

ICS:

23.040.10	Železne in jeklene cevi	Iron and steel pipes
77.140.75	Jeklene cevi in cevni profili za posebne namene	Steel pipes and tubes for specific use

SIST EN 13480-3:2018/oprA3:2019 en,fr,de

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
Full standard:
https://standards.iteh.ai/catalog/standards/sist/4e3b1e70-4efd-483d-86c6-d5b72d3819ad/sist-en-13480-3-2018-opra3-2019

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
EN 13480-3:2017

prA3

March 2019

ICS 23.040.01

English Version

Metallic industrial piping - Part 3: Design and calculation

Tuyauteries industrielles métalliques - Partie 3 : Conception et calcul

Metallische industrielle Rohrleitungen - Teil 3: Konstruktion und Berechnung

This draft amendment is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 267.

This draft amendment A3, if approved, will modify the European Standard EN 13480-3:2017. If this draft becomes an amendment, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for inclusion of this amendment into the relevant national standard without any alteration.

This draft amendment was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

© 2019 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN 13480-3:2017/prA3:2019 E

SIST EN 13480-3:2018/oprA3:2019

Contents

Page

European foreword 3

1 Modification to Clause 2, *Normative references* 4

2 Modification to 5.2.4, *Steel castings* 4

3 Modification to 13.11.4, *Determination of component sizes* 4

4 Modification to Annex A, *Dynamic analysis* 4

5 Modification to subclause G.3, *Physical properties of steels* 26

6 Introduction of a new subclause G.4, *Material properties of carbon steel at elevated temperatures* 26

7 Introduction of a new Annex R, *Surveillance of components operating in the creep range* 27

8 Modification to Bibliography 30

iTeh STANDARD PREVIEW
(standards.iteh.ai)
Full standard:
https://standards.iteh.ai/catalog/standards/sist/4e3b1e70-4cd6-483d-86c6-d5b72d3819ad/sist-en-13480-3-2018-opra3-2019

SIST EN 13480-3:2018/oprA3:2019

European foreword

This document (EN 13480-3:2017/prA3:2019) has been prepared by Technical Committee CEN/TC 267 “Industrial piping and pipelines”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This document includes the text of the amendment itself. The amended/corrected pages of EN 13480-3:2017 will be published as Issue 2 of the European Standard.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
Full standard:
https://standards.iteh.ai/catalog/standards/sist/4e3b1e70-4efd-483d-86c6-d5b72d3819ad/sist-en-13480-3-2018-opra3-2019

SIST EN 13480-3:2018/oprA3:2019

1 Modification to Clause 2, *Normative references*

Add the following normative reference:

"EN 12516-2:2014, *Industrial valves — Shell design strength — Part 2: Calculation method for steel valve shells*".

2 Modification to 5.2.4, *Steel castings*

Sub-clause 5.2.4 shall read as follows:

"**5.2.4 Steel castings**

For steel castings, allowable stresses are specified in EN 12516-2:2014."

3 Modification to 13.11.4, *Determination of component sizes*

In 13.11.4.1, the 3rd sentence shall read as follows:

"For further guidance, see Annexes G.4, I, J, K, L and M.".

4 Modification to Annex A, *Dynamic analysis*

Replace the existing Annex A with the following: "

Annex A

(informative)

Dynamic effect

iTeh STANDARD PREVIEW
(standards.iteh.ai)
Full standard:
https://standards.iteh.ai/catalog/standards/sist/4e3b1e70-4efd-483d-a6e0-f5102a019dad/sist-en-13480-3-2018-opra3-2019

A.1 General

In addition to the static conditions and cyclic pressure and temperature loadings covered by 4.2, piping may be subjected to a variety of dynamic loadings. Dynamic events should be considered in the design of the piping. However, unless otherwise specified, such consideration may not require detailed analysis. The effects of significant dynamic loads should be added to the sustained stresses in the design of the piping. Continuous dynamic loads should be considered in a fatigue analysis.

Analysis methods are proposed in A.2.

However vibration may be more difficult to predict and recommendations for installations are also provided in a design guidelines A.1.1.

A vibration risk assessment may be performed, based on the combined knowledge of vibration sources and the dynamic properties of the piping system (A.2.6).

The piping system dynamic properties may also be used to judge the dynamic quality of the layout, to locate vibration measures and damages.

A.1.1 Vibration design guidelines

The following guideline may be used to get a reduction in the number of pipework circuits that exceed vibratory acceptance criteria.

Three aspects are faced to optimize the vibrational behaviour of the piping system:

— the definition of the operation of circuits;

— the recommendation for pumps, valves, and orifice plates;

— the installation of piping and their supports.

SIST EN 13480-3:2018/oprA3:2019

A.1.1.1 Operation of the circuit

A.1.1.1.1 functional analysis

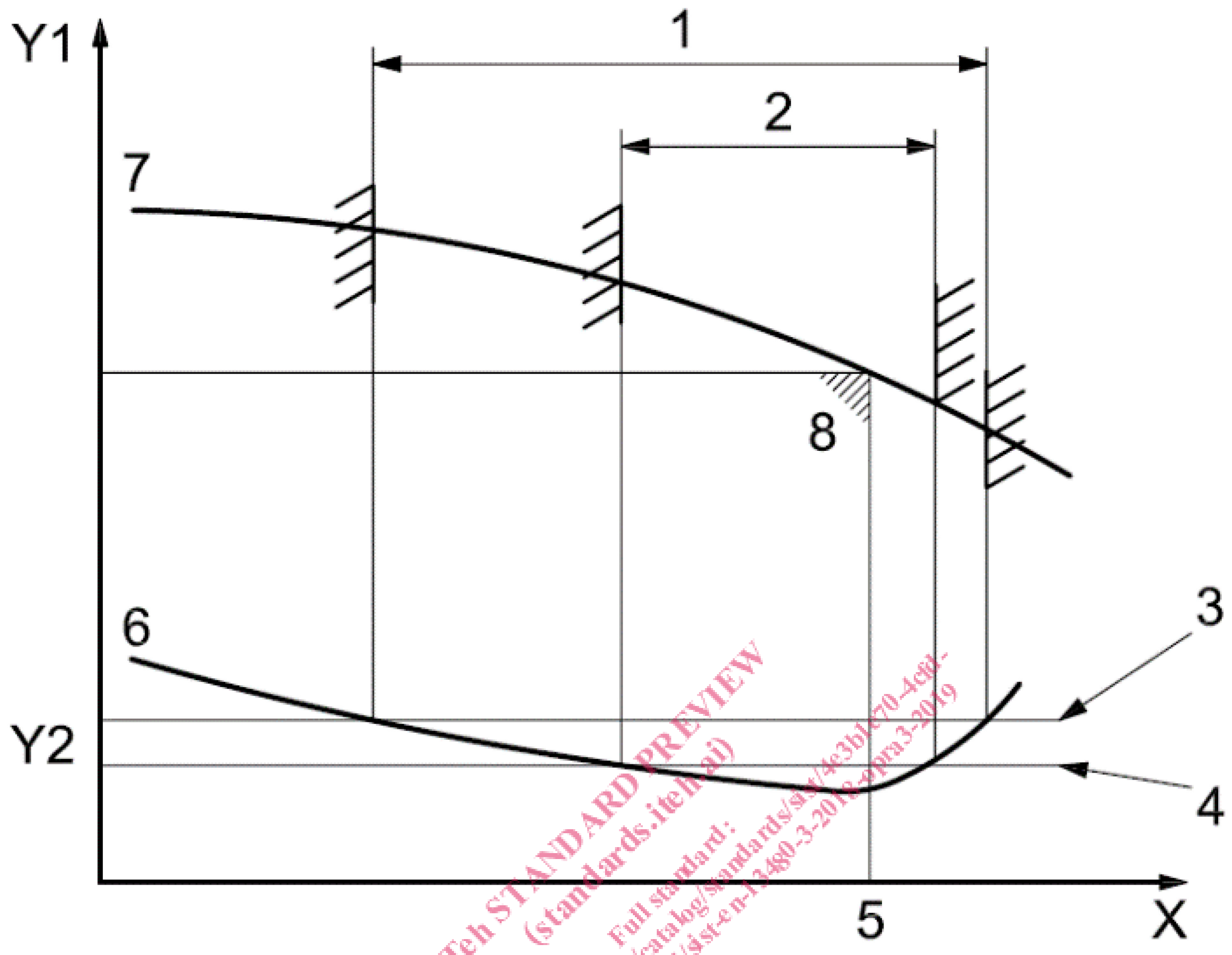
To avoid cracks apparition on connections of small pipe on big pipe or valve, it is essential to conduct a complete functional analysis of the system. This should include, in particular, the periodic testing and condition monitoring during operation and the ambient environment in extreme conditions. This procedure applies even if the operating times in some configurations are low (of the order of a few minutes per cycle).

The adequacy of the equipment and the installation for every operation modification is recommended to be analysed.

A.1.1.1.2 Partial flow or overflow operation

The operation of pumps with partial flow or overflow leads to significant flow fluctuations. Partial flow or overflow refers to an operation of the pumps outside of the field of maximum efficiency (areas 1 and 2 of Figure A.1.1.1-1), in theory close to the nominal value (point 8 of Figure A.1.1.1-1), and leading to a high fluid excitation source (curve 6 of Figure A.1.1.1-1) compared with the nominal value.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
Full standard:
https://standards.iteh.ai/catalog/standards/sist/4e3b1e70-4efd-483d-86c6-d5b72d3819ad/sist-en-13480-3-2018-opra3-2019



iTeh STANDARD PREVIEW
(standards.iteh.ai)
Full standard:

Key

X	flowrate
Y1	head
Y2	vibration
1	allowable operating region of flow
2	preferred operating region of flow
3	maximum allowable vibration limit at flow limit
4	basic vibration limit
5	best efficiency point, flowrate
6	typical vibration vs. flowrate curve showing maximum allowable vibration
7	head-flowrate curve
8	best efficiency point, head and flowrate

Figure A.1.1.1-1 — Relationship between flow and vibration

The operation of pumps with partial flow or overflow should be avoided. The periodic testing should be positioned where possible in the operating conditions that are least damaging from a vibratory stand point. When these configurations cannot be achieved, the operating times should be limited.

Pump by-passes (feedback of the discharge to the vacuum or to the tank) fitted with ahead loss unit may be implemented, but should ensure that regulation of the flow during discharge remains close to the nominal value. In this case, particular care should be taken to ensure that the vibratory design of these by-pass lines comply with the rules for valves and installation.

SIST EN 13480-3:2018/oprA3:2019

— Size the zero flow rate lines used in the context of the pump periodic testing to be on an operating level close to the nominal value in accordance with the periodic testing rules.

The pump should have a flow rate so that:

$0,7\ Q_n < Q < 1,1\ Q_n$

If the equipment is known, the partial flow rate may possibly be defined by the manufacturer.

A.1.1.1.3 Cavitation

Cavitation is known to lead to excessive vibrations in the pipework circuits (cavitation of orifice plates, cavitation of butterfly valves and vacuum orifice plates under vacuum conditions).

It is important to note that in cavitation conditions, the operating conditions cannot be ranked. The experience feedback from vacuum conditions or from the operation of plants, does indeed show that changes in vibratory levels are not correlated with the increase or decrease in cavitation indexes from the literature.

Cavitation should be prevented or at least limited. This rule is generally complied with through the choice of equipment (A.1.1.2). However, it is absolutely necessary for the operation managers to provide the consultants with the worst case head losses and flow rates. To this end, it should take into account all the operating configurations (normal, disturbed, occasional, accidental, periodic testing) in accordance with A.1.1.1.1.

The Installation Rules for water hammer recommendations concerning the cavitation should be applied.

A.1.1.1.4 Connected small bore pipes

The reduction in the number of connected small bore pipes leads directly to the reduction of the risk of cracking by vibratory fatigue, thus the number of functional connected small bore pipes should be minimized.

Slope reversals should be reduced so as to minimize the number of connected small bore pipes for drains and vents.

A.1.1.1.5 Flow velocity

The following flow velocity values are recommended.

For liquids:

— Normal velocity < 3 m/s;

— Exceptional velocity or pressure greater than 50 bar < 5 m/s.

For air and gases:

— Flow velocity < 40 m/s.

For steam as function of specific volume:

— 0,02 m^3/kg: 35 – 45 m/s;

— 0,05 m^3/kg: 40 – 50 m/s;

— 0,1 m^3/kg: 45 – 55 m/s;

— 0,2 m^3/kg: 50 – 60 m/s.

iTeh STANDARD PREVIEW (standards.iteh.ai) Full standard: https://standards.iteh.ai/catalog/standards/sist/4e3be70-4cfd-483d-86ce-d5b72d3819ad/sist-en-13480-3-2018-opra3-2019

SIST EN 13480-3:2018/oprA3:2019

A.1.1.2 Equipment

A.1.1.2.1 Pumps and compressors

The cracking of connected small bore pipes may be due to excessive vibrations of such components. The damage from these vibrations is amplified when they coincide with the vibratory modes of the piping.

The vibratory design rules of pumping/compression systems, should be taken into account, in particular the non-concurrence of frequency between the pump/compressor peaks and the vibratory modes of pump/compressor-header assemblies.

Piston pumps and compressors cause strong pressure pulses inducing high vibrations. The experience feedback shows that post installation, it is very difficult to limit the vibrations of headers and connected small bore pipes induced by this type of component.

In general, the use of piston pumps/compressors should be avoided.

However, if strong functional requirements impose the use of this type of component, validated pulsation dampers or acoustical filters should be proposed by the manufacturer.

In general, adding head losses in a circuit is equivalent to increasing the level of vibratory sources, reducing efficiency and therefore increasing operating cost.

The use of orifice plates in order to adjust the pump characteristics for the pipework circuit head losses is not recommended. However, for some pipework circuits, the opening of valves may be limited in order to prevent the operation of pumps outside their normal range.

Furthermore, the impeller diameter reduction automatically leads to a reduction in pump performance and an increase in the corresponding hydro acoustic source it is recommended to avoid where possible the use of oversized pumps leading to the pointless addition of head losses in the pipework circuit. The characteristics of pumps (flow rate, pressure) should be specified based on a functional analysis of the system.

The specifications of pump characteristics (flow rate, pressure) should be estimated as accurately as possible based on the characteristics of the pipework circuit and operating conditions.

A.1.1.2.2 Valves

The experience shows that cavitation in control valves, in particular butterfly valves leads to high vibratory levels in the pipework circuits. The switch to cavitation conditions leads to a sudden increase of these levels.

Cavitation should be prohibited on control valves, especially for butterfly valves.

For other valves, excluding control valves, there is no indication of cavitation leading to high levels of vibration. It is preferable to limit the risk of cavitation on the other types of valves.

The limitation of cavitation and associated criteria are the responsibility of valve Manufacturers, in accordance with the application of current standards.

A.1.1.2.3 Orifice plates

The single hole orifice plates present risks of air ‘whistling’ at a higher frequency, between vortex release at the orifice and an acoustic cavity of the piping. Outside of a possible acoustic discomfort, this air ‘whistling’ can present a fairly high energy vibratory source that may lead to damage.

The frequency of vortex release is characterized by the Strouhal number:

$$S_r = \frac{ft}{V}$$

where

SIST EN 13480-3:2018/oprA3:2019

S_r depends on the studied geometry and remains in the region of 0,2 for a mono-hole orifice plate of ratio $t/D_{\text{hole}} < 1$;

f is the frequency of vortices;

t is the thickness of the diaphragm;

V is the flow velocity in the orifice;

D_{hole} is the elementary diameter of the orifice plate hole(s).

For a plate with N holes:

$$S_r = \frac{\pi D_{hole}^2 Nft}{4Q}$$

where

Q is the flowrate.

The example of system single and multi-hole orifice plates with identical head loss coefficients shows that the increase in the number of holes has little impact on the frequency of vortex release at Q = 30 m³/s with S_r = 0,2

— Orifice plate single-hole N = 1, D_{hole} = 22,3 mm, f = 304 Hz;

— Orifice plate multi-holes N = 47, D_{hole} = 3 mm, f = 358 Hz.

However, the multi-hole orifice plate does not make any air 'whistling'. This observation can be explained by the ratio $t/D_{\text{hole}} >> 1$ which leads to $S_r >> 0,2$.

The multi-hole plates also enable the level of turbulence to be reduced by reducing the scale of vortices and decorrelating them.

However, the use of multi-hole plates only enables a moderate reduction of cavitation and its vibratory effects.

Orifice plates such as single-hole plates should be prohibited except for flow rate measurement orifice plates. It is recommended to implement multi-hole plates, maximizing the number of holes with a minimum diameter of a few millimetres, but not so small that flow is blocked by particles in the flow. Purging and filters can be applied to avoid this.

Many single-stage orifice plates in plants are cavitating. The multistage technology is widely used in plants and the sizing methods of valve Manufacturers have been validated.

The use of orifice plates with several plates in series enables head losses to be distributed while maintaining pressures downstream of every plate sufficiently high not to cause cavitation. The critical plate is generally the last as it should withstand a low headloss and its critical Tullis number is the lowest.

The flow rate orifice plates generally have low head losses which explains why cavitation experience feedback from this type of component is reduced or even non-existent. The sizing should still be checked if they do not cavitate. If they cavitate, two solutions exist. Either reduce their head loss, or increase their downstream pressure (p_2) by moving them in the pipework circuit. Furthermore, the validity of the flow rate measurement taken at the terminals of a cavitating orifice plate can be questioned.

It is recommended to size the orifice plates taking account of the risk of cavitation Implement multi-stage multi-hole orifice plates to prevent this risk, except for flow rate measurement orifice plates.