SLOVENSKI STANDARD
oSIST prEN ISO 21028-2:2017

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Kriogene posode - Zahteve za žilavost materialov pri kriogeni temperaturi - 2. del: Temperature med –80 °C in –20 °C (ISO/DIS 21028-2:2016)

Cryogenic vessels - Toughness requirements for materials at cryogenic temperature - Part 2: Temperatures between -80 degrees C and -20 degrees C (ISO/DIS 21028-2:2016)

Kryo-Behälter - Zähigkeitsanforderungen an Werkstoffe bei kryogenen Temperaturen - Teil 2: Temperaturen zwischen -80 °C und -20 °C (ISO/DIS 21028-2.2:2016)

Récipients cryogéniques - Exigences de ténacité pour les matériaux à température cryogénique - Partie 2: Températures comprises entre -80 degrés C et -20 degrés C (ISO/DIS 21028-2:2016)

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ICS:

23.020.40	Proti mrazu odporne posode (kriogenske posode)	Cryogenic vessels

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Cryogenic vessels — Toughness requirements for materials at cryogenic temperature —

Part 2: Temperatures between -80 °C and -20 °C

Récipients cryogéniques — Exigences de ténacité pour les matériaux à température cryogénique —

Partie 2: Températures comprises entre -80 °C et -20 °C

ICS: 23.020.40

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

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Foreword

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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. www.iso.org/directives

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The committee responsible for this document is ISO/TC 220, and CEN/TC 268 in collaboration.

This second edition cancels and replaces the first edition (ISO 21028-2:2004 and EN 1252-2:2001), which have been technically revised.

ISO 21028 consists of the following parts, under the general title *Cryogenic vessels — Toughness requirements for materials at cryogenic temperature*:

— *Part 1: Temperatures below -80 °C*

— *Part 2: Temperatures between -80 ° C and -20 °C*

Introduction

The use of materials at low temperatures entails special problems which have to be addressed. Consideration has to be given, in particular, to changes in mechanical characteristics, expansion and contraction phenomena and the thermal conduction of the various materials. The most important property to be considered is the material toughness at low temperature.

Cryogenic vessels — Toughness requirements for materials at cryogenic temperature —

Part 2:
Temperatures between -80 °C and -20 °C

1 Scope

This part of ISO 21028 specifies the toughness requirements of metallic materials for use at temperatures between – 20 °C and – 80 °C to ensure their suitability for cryogenic vessels. It is applicable to fine-grain and low-alloyed steels with specified yield strength ≤ 460 N/mm^2, aluminium and aluminium alloys, copper and copper alloys and austenitic stainless steels.

2 Normatives references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 148 (all parts), *Metallic materials — Charpy pendulum impact test*

EN ISO 15614-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys*

3 Terms and definitions

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

3.1
minimum metal temperature
T_M
lowest temperature defined for each of the conditions

— temperature during normal operation;

— temperature during start-up and shut down procedures;

— temperature which may occur during possible process upsets;

— temperature which may occur during pressure or leak testing; and

— ambient conditions

Note 1 to entry: See also 3.2 and 3.3.

3.2
temperature adjustment term
T_S
term relevant to the calculation of the **design reference temperature** T_R (3.3) and dependent on the pressure-induced principal membrane stress at the appropriate minimum metal temperature

3.3
design reference temperature
T_R
temperature used for determining the impact energy requirements, themselves determined by adding the **temperature adjustment term** T_S (3.2) to the **minimum metal temperature** T_M (3.1):

$$T_R = T_M + T_S$$

Note 1 to entry: All applicable combinations of the temperatures T_M and T_S are to be considered, and the lowest possible T_R value used for the determination of the required material *impact test temperature* (3.4).

3.4
impact test temperature
T_{KV}
temperature at which the required impact energy has to be achieved

Note 1 to entry: See Clause 5

3.5
impact energy
KV
energy determined from Charpy V-notch tests performed in accordance with EN ISO 148.

3.6
reference thickness
e_B
thickness of a component used to relate the **design reference temperature** T_R (3.3) of the component with its required **impact test temperature** T_{KV} (3.4)

SEE: Figures 1 to 5.

Note 1 to entry: The reference thickness is based on the nominal thickness (including corrosion allowance) and can be as defined in Table 6. For butt-welded components, it is the nominal wall thickness of the component at the edge of the weld preparation

4 Symbols

Symbol	Definition	Unit
T_M	Minimum metal temperature	°C
T_S	Temperature adjustment term	°C
T_R	Design reference temperature	°C
T_{KV}	Impact test temperature	°C
KV	Impact energy	J
e_B	Reference thickness	mm
R_p	Proof stress	N/mm^2 or J
R_{el}	Yield point	N/mm^2 or J
K_C	Stress intensity factor	J
σ	Stress coefficient	

a	Depth of the defect	
π	Coefficient	
β	Constant 1/60	
K_0	Constant 25 MPa√m	
ΔT_e	Correction term	°C
e	Wall thickness	mm
t	Component thickness	

5 Requirements for steels with specified yield strength ≤ 460 N/mm²

5.1 General

This method, based on fracture mechanics, may be used to determine the requirements to avoid brittle fracture in C, CMn, fine-grain and low-alloy steels with a specified minimum yield strength ≤ 460 N/mm².

In this procedure, the impact test temperature T_{KV} is not equal to the design reference temperature T_R.

Parent material, welds and HAZ shall meet the impact energy (KV) and impact test temperature T_{KV} requirements given in Table 1 for design reference temperatures T_R and reference thicknesses. Values of T_R shall be calculated from T_M using the values of T_S given in 4.2.

For materials with a specified minimum yield strength > 310 N/mm², the impact energy at T_{KV} given in Figure 1 and Figure 2 shall be 40 J.

Where 27 J is specified in the product standard, Figure 3 for the post-weld heat-treated condition applies.

For the as-welded case with minimum yield strength in the range > 310 N/mm² and ≤ 360 N/mm², Figure 4 applies.

For minimum yield strength > 360 N/mm², Figure 5 applies.

Table 1 — Impact energy requirements

Specified min. yield strength of base material N/mm²	Required impact energy KV (on 10 mm × 10 mm test pieces) J	Figure defining required T_{KV}	
		Non-welded/ Post-weld heat-treated (PWHT)	As-welded (A-W)
< 310	27	1	2
> 310, ≤ 360	40	1	2
	27	3	4
> 360	40	1	2
	27	3	5