

INTERNATIONAL
STANDARD

ISO
9329-3

First edition
1997-03-01

**Seamless steel tubes for pressure
purposes — Technical delivery
conditions —**

Part 3:

**Unalloyed and alloyed steels with specified
low temperature properties**

[ISO 9329-3:1997](#)

[https://standards.iteh.ai/catalog/standards/sist/0095aae1-556a-4d6c-94f8-](https://standards.iteh.ai/catalog/standards/sist/0095aae1-556a-4d6c-94f8-41d969f5afaa/iso-9329-3-1997)

[41d969f5afaa/iso-9329-3-1997](#)
*Tubes en acier sans soudure pour service sous pression — Conditions
techniques de livraison —*

*Partie 3: Aciers non alliés et alliés avec caractéristiques spécifiées à basse
température*



Reference number
ISO 9329-3:1997(E)

Contents

	Page
1 Scope	1
2 Normative references	1
3 Symbols and denominations	2
4 Information to be supplied by the purchaser	2
5 Manufacturing process	3
6 Metallurgical properties	3
7 Dimensions, masses and tolerances	9
8 Technical delivery conditions	10
9 Inspection and testing	10
10 Marking	16
11 Protection	16
12 Documents	16
13 Claims after delivery	16

ITeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 9329-3:1997](https://standards.iteh.ai/catalog/standards/sist/0095aae1-556a-4d6c-94f8-41d969f5afaa/iso-9329-3-1997)

<https://standards.iteh.ai/catalog/standards/sist/0095aae1-556a-4d6c-94f8-41d969f5afaa/iso-9329-3-1997>

© ISO 1997

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

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.

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.

International Standard ISO 9329-3 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 19, *Technical delivery conditions for steel tubes for pressure purposes*.

It cancels and replaces ISO 2604-2:1975, of which it constitutes a technical revision, together with parts 1, 2 and 4 of ISO 9329.

ISO 9329 consists of the following parts, under the general title *Seamless steel tubes for pressure purposes — Technical delivery conditions*:

- *Part 1: Unalloyed steels with specified room temperature properties*
- *Part 2: Unalloyed and alloyed steels with specified elevated temperature properties*
- *Part 3: Unalloyed and alloyed steels with specified low temperature properties*
- *Part 4: Austenitic stainless steels (Partial revision of ISO 2604-2:1975)*

iTeh STANDARD PREVIEW
This page intentionally left blank
(standards.iteh.ai)

ISO 9329-3:1997

<https://standards.iteh.ai/catalog/standards/sist/0095aae1-556a-4d6c-94f8-41d969f5afaa/iso-9329-3-1997>

Seamless steel tubes for pressure purposes — Technical delivery conditions —

Part 3:

Unalloyed and alloyed steels with specified low temperature properties

1 Scope

1.1 This part of ISO 9329 specifies the technical delivery conditions for seamless tubes of circular cross-section, made of unalloyed and alloyed steel with specified low temperature toughness properties.

These tubes are intended for low temperature piping systems.

The requirements of appropriate international application standards and relevant national legal regulations shall be taken into account by the user. For pressure containing equipment, ISO 5730 is available.

The following parts of ISO 9329 are now available or are being prepared:

- *Part 1: Unalloyed steels with specified room temperature properties* (partial revision of ISO 2604-2:1975).
- *Part 2: Unalloyed and alloyed steels with specified elevated temperature properties* (partial revision of ISO 2604-2:1975).
- *Part 4: Austenitic stainless steels* (partial revision of ISO 2604-2:1975).

NOTE 1 The English words "tube" and "pipe" are synonymous.

1.2 For the general technical delivery requirements, see ISO 404.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9329. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9329 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

- ISO 148:1983, *Steel — Charpy impact test (V-notch)*.
- ISO 377-1:1989, *Selection and preparation of samples and test pieces of wrought steels — Part 1: Samples and test pieces for mechanical test*.
- ISO 377-2:1989, *Selection and preparation of samples and test pieces of wrought steels — Part 2: Samples for the determination of the chemical composition*.
- ISO 404:1992, *Steel and steel products — General technical delivery requirements*.
- ISO 643:1983, *Steels — Micrographic determination of the ferritic or austenitic grain size*.
- ISO 1129:1980, *Steel tubes for boilers, superheaters and heat exchangers — Dimensions, tolerances and conventional masses per unit length*.
- ISO 2566-1:1984, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels*.

ISO 3205:1976, *Preferred test temperatures.*

ISO 4200:1991, *Plain end steel tubes, welded and seamless — General tables of dimensions and masses per unit length.*

ISO/TR 4949:1989, *Steel names based on letter symbols.*

ISO 5252:1991, *Steel tubes — Tolerance systems.*

ISO 5730:1992, *Stationary shell boilers of welded construction (other than water-tube boilers).*

ISO 6761:1981, *Steel tubes — Preparation of ends of tubes and fittings for welding.*

ISO 6892:1984, *Metallic materials — Tensile testing.*

ISO 7438:1985, *Metallic materials — Bend test.*

ISO 8492:1986, *Metallic materials — Tube — Flattening test.*

ISO 8493:1986, *Metallic materials — Tube — Drift expanding test.*

ISO 8495:1986, *Metallic materials — Tube — Ring expanding test.*

ISO 8496:1986, *Metallic materials — Tube — Ring tensile test.*

ISO 9302:1994, *Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes — Electromagnetic testing for verification of hydraulic leak-tightness.*

ISO 9303:1989, *Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes — Full peripheral ultrasonic testing for the detection of longitudinal imperfections.*

ISO 9305:1989, *Seamless steel tubes for pressure purposes — Full peripheral ultrasonic testing for the detection of transverse imperfections.*

ISO/TR 9769:1991, *Steel and iron — Review of available methods of analysis.*

ISO 10332:1994, *Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes — Ultrasonic testing for the verification of hydraulic leak-tightness.*

ISO 10474:1991, *Steel and steel products — Inspection documents.*

3 Symbols and denominations

3.1 Fundamental symbols

D = specified outside diameter

D_i = specified inside diameter

T = specified wall thickness

3.2 Symbols for tolerances

See ISO 5252.

3.3 Symbols for tests

3.3.1 Tensile test

See ISO 6892.

3.3.2 Flattening test

H = distance between platens

K = constant factor of deformation

3.3.3 Hydraulic test

PE = test pressure

σ = stress which occurs in the metal during the test

4 Information to be supplied by the purchaser

4.1 Mandatory information

The purchaser shall state on his enquiry and order the following information:

- the denomination "tube";
- whether tubes are to be supplied hot-finished or cold-finished (see 5.3);
- reference to the relevant dimensional standard;
- dimensions (outside diameter \times wall thickness) in millimetres (see 7.1);
- length (see 7.2);
- tolerances, if exact lengths greater than 12 m are ordered (see 7.3.2);
- reference to this part of ISO 9329;

- steel grade (see table 1);
- test category for unalloyed steels (see 9.2).

4.2 Optional information

Enquiries and orders for tubes in accordance with this part of ISO 9329 shall be supplemented, if it is deemed necessary by the purchaser, with the indication of one or more of the following optional requirements, which shall be the subject of special agreements:

- steelmaking process (see 5.1);
- special straightness requirements (see 7.3.3);
- product chemical analysis (see 9.3 and 9.10.1);
- leak-tightness test (see 9.5);
- specific marking (see 10.3);
- protective coating (see clause 11);
- type of inspection and testing and corresponding document (see 9.1 and clause 12).

4.3 Example of an order

Example of an order for a hot-finished seamless tube conforming to the dimensional standard ISO 4200, with an outside diameter of 168,3 mm, a wall thickness of 4 mm and a standard length (random length) of 4 m to 8 m, made of steel grade PL 21 with specified room temperature properties to be submitted to specific inspection and testing to test category II involving the issuing of an inspection certificate 3.1.B according to ISO 10474.

Tube hot-finished ISO 4200 - 168,3 × 4 - 4 to 8 - ISO 9329-3 - PL 21 - II - 3.1.B.

5 Manufacturing process

5.1 Steelmaking process

If requested, the purchaser shall be informed of the steelmaking process used.

Steels may be cast in ingots or may be strand cast. When steels of different grades are sequentially strand cast, identification of the resultant transitional material is required. The producer shall remove the transitional material by an established procedure that efficiently separates the grades.

5.2 Deoxidation process

Steels intended for the production of tubes covered by this part of ISO 9329 shall be fully killed.

5.3 Product-making process for tubes

Tubes covered by this part of ISO 9329 shall be manufactured by a seamless process, and may be hot-finished or cold-finished. The terms "hot-finished" and "cold-finished" apply to the condition of the tube before it is heat treated in accordance with 5.4.

5.4 Delivery condition

Tubes covered by this part of ISO 9329 shall be supplied suitably heat treated over their full length. The following heat treatments shall be used, depending on the type of steel (see table 7):

- normalizing;
- normalizing and tempering;
- quenching and tempering.

6 Metallurgical properties

6.1 Chemical composition

6.1.1 Heat analysis

On heat analysis, the steel shall show the composition given in table 1 appropriate to the steel grade specified.

6.1.2 Product analysis

If a check analysis on the product is required (see 9.3), the permissible deviations given in table 2 shall apply to the heat analysis specified in table 1.

Other than when maxima only are specified, the deviations apply either above or below the specified limits of the range, but not both above and below, for the same element from different sample products from the same heat.

When maxima only are specified, the deviations are always positive.

When minima only are specified, the deviations are always negative.

6.2 Mechanical properties

6.2.1 The mechanical and technological properties of the tubes covered by this part of ISO 9329, measured at room temperature ($23\text{ °C} \pm 5\text{ °C}$, see ISO 3205), to be obtained on test pieces selected, prepared and tested in accordance with clause 9, shall comply with the requirements of table 3.

6.2.2 Table 4 gives minimum values for the impact energy, as determined on ISO V-notch test pieces, used to characterize the cold-toughness of the various steel grades at low temperature (see also footnote 2 to table 4).

Impact tests shall be carried out at the lowest temperature indicated in table 4 for each steel grade (see also 9.10.7.1), except that higher temperatures shown may be agreed upon between the purchaser and the manufacturer.

6.3 Weldability

Steels intended for the production of tubes covered by this part of ISO 9329 are regarded as being weldable. However, account should be taken of the fact that the behaviour of the steel during and after welding is dependent not only on the steel, but also essentially on the conditions of preparing and carrying out the welding.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 9329-3:1997](https://standards.iteh.ai/catalog/standards/sist/0095aae1-556a-4d6c-94f8-41d969f5afaa/iso-9329-3-1997)

<https://standards.iteh.ai/catalog/standards/sist/0095aae1-556a-4d6c-94f8-41d969f5afaa/iso-9329-3-1997>

Table 1 — Chemical composition (heat analysis) % (m/m)

Steel grade ¹⁾	C	Si	Mn	P	S	Al (total) min.	Cr	Mo	Ni	V	Nb
				max.	max.					max.	max.
Unalloyed steels											
PL 21	≤ 0,17	≤ 0,35	0,40 to 1,00	0,030	0,025	0,015 ²⁾	—	—	—	—	—
PL 23	≤ 0,17	≤ 0,35	0,40 to 1,00	0,030	0,025	0,015 ²⁾	—	—	—	—	—
PL 25	≤ 0,17	≤ 0,35	0,40 to 1,00	0,030	0,025	0,015 ²⁾	—	—	—	—	—
PL 26	≤ 0,20	≤ 0,35	0,80 to 1,40	0,030	0,025	0,015 ²⁾	—	—	—	—	—
26 CrMo 4	0,22 to 0,29	≤ 0,35	0,50 to 0,80	0,030	0,025	—	0,90 to 1,20	0,15 to 0,30	—	—	—
11 MnNi 5-3	≤ 0,14	≤ 0,50	0,70 to 1,50	0,030	0,025	0,020 ³⁾	—	—	0,30 ⁴⁾ to 0,80	0,05	0,05
13 MnNi 6-3	≤ 0,18	≤ 0,50	0,85 to 1,65	0,030	0,025	0,020 ³⁾	—	—	0,30 ⁴⁾ to 0,85	0,05	0,05
12 Ni 14	≤ 0,15	0,15 to 0,35	0,30 to 0,85	0,025	0,020	—	—	—	3,25 to 3,75	0,05	—
X 12 Ni 5	≤ 0,15	≤ 0,35	0,30 to 0,80	0,025	0,020	—	—	—	4,50 to 5,30	0,05	—
X 10 Ni 9	≤ 0,13	0,15 to 0,35	0,30 to 0,80	0,025	0,020	—	—	≤ 0,10	8,50 to 9,50	0,05	—
<p>NOTE — Elements not included in this table may not be intentionally added without the agreement of the purchaser, except for elements which may be added for deoxidation and finishing of the heat. All reasonable precautions shall be taken to prevent the addition of elements from scrap or other materials used in the manufacture; however residual elements may be tolerated, provided that the mechanical properties and applicability are not adversely affected.</p> <p>If the amount of residual elements is likely to affect the weldability of the steel, the content of such elements (heat analysis) shall be stated in the documents mentioned in clause 12.</p>											
<p>1) Designation according to ISO/TR 4949.</p> <p>2) Metallic aluminium content. Where the total aluminium content is determined, the result shall be deemed to meet this requirement, provided the total aluminium content value obtained is not less than 0,018 % (m/m). In cases of dispute, the metallic aluminium content shall be determined. Alternatively, an austenitic grain size of 6 or finer, determined in accordance with ISO 643, can be agreed upon. By agreement between the interested parties, aluminium may be replaced by other elements having a similar effect.</p> <p>3) Total aluminium content. By agreement between the interested parties, aluminium may be replaced by other elements having a similar effect.</p> <p>4) The lower limit value for the nickel content may be reduced to not less than 0,15 % (m/m) for tubes with wall thickness not exceeding 10 mm.</p>											

iTech STANDARD PREVIEW
(standards.itech.ai)

Table 2 — Permissible deviations from the specified chemical composition limits given in table 1

Element	Content specified for the heat analysis % (m/m)	Permissible deviation % (m/m)
C	$\leq 0,29$	$\pm 0,03$
Si	$\leq 0,50$	$\pm 0,05$
Mn	$\leq 1,65$	$\pm 0,10$
P	$\leq 0,030$	+ 0,005
S	$\leq 0,025$	+ 0,005
Al	$\geq 0,015$	- 0,005
Cr	$\leq 1,20$	$\pm 0,10$
Mo	$\leq 0,30$	$\pm 0,04$
Ni	$\leq 0,85$	$\pm 0,05$
	$> 0,85 \leq 3,75$	$\pm 0,07$
	$> 3,75 \leq 5,30$	$\pm 0,10$
	$> 5,30 \leq 9,50$	$\pm 0,15$
V	$\leq 0,05$	+ 0,01
Nb	$\leq 0,05$	+ 0,01

ISO 9329-3:1997
<https://standards.iteh.ai/catalog/standards/cis/0095aae1-556a-4d6c-94f8-41d969f5afaa/iso-9329-3-1997>

Table 3 — Mechanical properties at room temperature

Steel grade	Reference heat treatment ¹⁾	Tensile test				Flattening test	Bend test	Drift expanding test		Ring expanding test					
		Tensile strength	Upper yield stress or proof stress					Elongation for wall thicknesses ≤ 40 mm ²⁾	Percentage increase of D for D _i /D		Percentage increase of D for D _i /D				
		R _m	for wall thicknesses in mm ²⁾			K	Diameter of mandrel		for D _i /D		for D _i /D				
		N/mm ²	T ≤ 13	13 < T ≤ 25	25 < T ≤ 40			A _{min}		≤ 0,6	> 0,6	≤ 0,5	> 0,5	≤ 0,6	> 0,6
			N/mm ²	N/mm ²	N/mm ²	%	mm								
Unalloyed steels															
PL 21	N	360 to 480	215	215	3)	24	4T	12	15	30	25	15	10	8	
PL 23	N	410 to 530	235	235	3)	22	4T	10	12	30	25	15	10	8	
PL 25	Q + T	360 to 490	255	255	235	21	—	—	—	—	—	—	—	—	
PL 26	N	460 to 580	265	275	3)	21	4T	8	10	30	25	15	10	8	
Alloyed steels															
26 CrMo 4	Q + T	560 to 740	440	440	420	16	—	—	—	—	—	—	—	—	
11 MnNi 5-3	N	410 to 530	285	275	265	22	—	—	—	—	—	—	—	—	
13 MnNi 6-3	N	490 to 610	355	345	335	20	—	—	—	—	—	—	—	—	
12 Ni 14	Q+T	440 to 590	245	245	245	16	—	6	8	12	—	—	—	—	
X 12 Ni 5	Q+T	510 to 710	390	390	380	17	—	—	—	—	—	—	—	—	
X 10 Ni 9	Q+T	690 to 840	510	510	510	15	—	6	8	12	—	—	—	—	

iteh STANDARD PREVIEW
 (standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/sist/095aae1-5561-4d6c-94f8-41d969f5afaa/iso-9-3-1997>

1) See 8.3 (N = Normalizing; Q+T = Quenching + Tempering).
 2) For wall thicknesses greater than 40 mm, the values to be obtained shall be the subject of agreement between the purchaser and the manufacturer at the time of ordering.
 3) To be agreed upon at the time of ordering.