INTERNATIONAL STANDARD

Materials and equipment for petroleum and natural gas industries — Casing and tubing for oil or natural gas wells

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION MEXALHAPODHAS OPPAHUSALUS TO CTAHAPTUSALUS ORGANISATION INTERNATIONALE DE NORMALISATION

Matériel d'équipement pour les industries du pétrole et du gaz naturel — Tubes de cuvelage et tubes de production pour puits de pétrole ou de gaz naturel

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2645

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2645 was drawn up by Technical Committee ISO/TC 67, *Materials and equipment for petroleum and natural gas industries*, and circulated to the Member Bodies in December 1972 and arcs.iten.ai

It has been approved by the Member Bodies of the following countries:

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The Member Body of the following country expressed disapproval of the document on technical grounds :

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Materials and equipment for petroleum and natural gas industries — Casing and tubing for oil or natural gas wells

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard specifies the characteristics of casing and tubing used in the operation of oil or natural gas wells.

1.2 It also specifies the characteristics of threaded casing and tubing couplings, and thread protectors.

1.3 It specifies the sizes, diameters, wall thicknesses and grades of steel.

1.4 Casing and tubing are divided into three classes

- Class I : Steel pipes with standard mechanical properties;

- Class II : Steel pipes with high strength mechanical 1975 properties; https://standards.iteh.avcatalog/standards/sist/e4.221 Welded process by resistance or flash 3f14e1e395af/iso-2645-1975

- Class III : Steel pipes with reduced proof stress range.

1.5 The requirements concerning pipe and coupling threads and inspection methods and instruments are given in ISO...

1.6 This International Standard applies to both seamless and welded pipes.

2 REFERENCES

ISO/R 202, Flattening test on steel tubes.

ISO 375, Steel – Tensile testing of tube.

ISO/R 404, General technical delivery requirements for steel.

ISO..., Materials and equipment for petroleum and natural gas industries – Casing, tubing and line pipe threads – Threading, gauging and thread inspection.¹⁾

3 DEFINITIONS

3.1 casing : A pipe run from the surface and intended to line the walls of a drilled well.

3.2 tubing : A pipe placed within a productive well to serve as an exhaust or delivery duct.

4 MANUFACTURING PROCESSES

4.1 Seamless process

Applicable to Classes I, II, III. A seamless pipe is a steel tubular product manufactured by hot working from a solid steel blank and, if necessary, by cold finishing to produce the desired shapes, dimensions and properties.

Applicable by resistance or flash to Class I pipes, and by flash to casing in C 66 steel.

4.3 Electrically welded process

Applicable to Class 1 pipes and to casing in C 66 steel.

An electrically welded pipe is a pipe having one longitudinal seam formed by electric-flash welding or electric-resistance welding, without the addition of extraneous metal.

5 DATA TO BE GIVEN BY THE PURCHASER

5.1 In placing orders the purchaser shall specify the following:

- a) the reference number of this International Standard;
- b) quantity (length or number of lengths);
- c) type of pipe :

casing

- threaded or plain-end,

- thread type,
- with or without couplings;

tubing

- upset or non-upset,
- threaded or plain-end,
- thread type,
- with or without couplings;

d) size (outside diameter) in millimetres (see tables 20, 22, 24, 26 and 28);

e) mass per unit length in kilograms per metre, or wall thickness in millimetres (see tables 20, 22, 24, 26 and 28);

- f) class (I, II, III) and grade (see tables 1 and 2);
- length range (see 9.4); g)

and N 56 casing;

casing jointers;

pipe coating;

- h) manufacturing process (seamless or welded);
- delivery date, shipping instructions and marking; i)

chemical, ladle and supplementary analyses;

flattening test on grade H 28, seamless pipes;

casing or tubing with couplings detached;

coupling make-up (other than power-tight);

j)

6 **DESIGNATION**

A pipe manufactured according to this International Standard shall be designated by :

- a) its type:
- b) the type of its ends and the threads of the latter;
- c) its size (outside diameter) in millimetres;

d) its mass per unit length in kilograms per metre, or its wall thickness in millimetres;

- e) its grade;
- f) its length range;
- g) its manufacturing process;
- h) a reference to this International Standard.

Example :

Casing, Buttress, 114,3 × 5,7, K 38, range 2, seamless according to ISO 2645.

mill inspection (if required). iTeh STANDARI (standards.iteh

5.2 The purchaser shall also state on the order his optionalSO 267-11 Steelmaking requirements concerning following the

- stipulations : https://standards.itch.ai/catalog/standards/sist/aivd5 processes 4 permitted by this International normalizing of J 38 casing, and tubing, and of K 38 395al Standard are the following :
 - open-hearth, electric furnace or basic oxvaen steelmaking processes.

7.2 Chemical composition

The limits of the permissible chemical composition are given in table 1 for each grade concerned.

7.3 Mechanical properties

The limits of the test piece mechanical properties (see 11.3.1) are given in table 2 for each steel concerned.

7.4 Heat treatment

The compulsory or optional heat treatments are given in table 3 for each grade concerned.

After final heat treatment C 52 steel pipes shall not be cold worked except for normal straightening operations. After final heat treatment C 66 steel casing shall not be submitted to tensile straining or cold expansion, nor shall they be cold reduced by more than 3 %.

Forged class II and III pipes and pipes of grade N 56 shall be heat treated over their full length after forging.

5.3 Attention is also called to the following stipulations which are subject to agreement at the time of ordering :

non-destructive testing for class I and III pipes.

- test pressures for handling-tight make-up or higher alternatives;

- hydrostatic test at a value higher than the standard value;

- special threads or special finishes (see 8.2.1.2);
- thread compound;
- thread protectors;
- marking.

Class	Grad	e of steel	С %	Si %	Mn %	Р%	S %	Cr + Ni + Cu %	Cr %	Мо %
- - - -	H 28 K 38	H 31 J 38 N 56				≤ 0,040	≤ 0,060			
- 11	P 72	P 76				≤ 0,040	≤ 0,060			
	C 52 — C 66 ¹⁾	Туре 1 Туре 2 Туре 3	< 0,50 < 0,40 0,38 to 0,48 < 0,45	< 0,35 <0,35 < 0,35	< 1,90 < 1,50 0,75 to 1,00 < 1,90	 < 0,040 < 0,040 < 0,040 < 0,040 	 < 0,060 < 0,060 < 0,040 < 0,060 	≤ 0,50	0,80 to 1,10	0,15 to 0,30 0,15 to 0,25

TABLE 1 - Chemical characteristics

1) In the case of quenching and tempering : $C \le 0.40$ with Mn ≤ 1.70 or

 $C \le 0,45$ with Mn $\le 1,60$

TABLE 2 – Mechanical characteristics

Class	Grade (of steel nd 2	Grade of steel ndards.iten.ai)		Minimum elongation on 5,65 $\sqrt{S_0}^*$
	IQ	N/mm ²	N/mm ²	%
I h	tps://standard5.i 28 n.ai/catalog/s	andards/3jsto;st 257266-a4f4-	4b51-a33 414	22,5
I	н 31 3fl4e1e3	15af/iso-2645-1\$7310	483	19,3
I	J 38	379 ≤ R _{p 0,5} ≤ 552	517	18
I	К 38	379 ≤ <i>R</i> _{p 0,5} ≤ 552	655	14,3
III	C 52	517 ≤ R _{p 0,5} ≤ 621	655	14,3
I	N 56	552 ≤ R _{p 0,5} ≤ 758	689,5	13
u u	C 66	655 ≤ <i>R</i> _{p 0,5} ≤ 758	724	12,8
11	P 72	723 ≤ <i>R</i> _p _{0,6} ≤ 931	827	11,3
$\mathbf{H}^{\mathrm{reg}}$. The second	P 76	758 ≤ R _{p 0,6} ≤ 965	862	10,8

* If other gauge lengths are used, the corresponding elongation values shall be obtained according to ISO 2566. In cases of dispute, the gauge length of 5,65 $\sqrt{S_0}$ shall be used.

.

TABLE 3 - Heat treatments

Unless specified in the order, heat treatments shall be left to the discretion of the manufacturer.

Class Casing		Heat treatment
· · ·	K 38 J 38	Normalizing, if specified in the order
	N 56	Normalizing, or quenching and tempering
la de la H	P 76	Quenching and tempering, or normalizing and tempering
III C 52 types 1,3 Nor		Normalizing and tempering
	C 52 type 2	Quenching and tempering
111	C 66	Quenching and tempering (538 $^\circ$ C min.)
Class	Tubing	Heat treatment
	J 38	Normalizing, if specified in the order
ł	N 56	Normalizing, or quenching and tempering
II P 72 Quenchi		Quenching and tempering, or normalizing and tempering
11 - 12 - 11 - 12 - 12 - 12 - 12 - 12 -	III C 52 types 1,3 Normalizing and tempering	
C 52 type 2 Quenching and tempering		Quenching and tempering
		Normalizing and tempering, or quenching and tempering (538 °C min.)

8 PIPE CONDITION

8.2 Pipe ends

8.2.1 Casing

threads.

(standards, ispecial, and) finish, according to previous written agreement between supplier and purchaser.

8.1 Diameters, wall thicknesses and masses

180 2645.1075

The pipes supplied shall have the diameters, wall standards iteh ai/catalog/stand 8:2:1:3:/ Inj5certain4_cases pipes_may be furnished with thicknesses and masses shown in tables 20, 22, 24, 25, 26 395at square-cut plain ends. and 28.

Ends may be finished to accommodate the various types of threads.

8.2.2.1 Pipes may have upset ends. In principle these shall be furnished with a round thread (8 threads per inch) (see ISO . . .).

One end shall normally be fitted with a (normal or special) coupling made up as defined in 8.4.

Delivery may also be made without couplings or with a special handling-tight make-up.

8.2.2.2 In certain cases pipes may be furnished either with non-upset, square-cut plain ends or with upset, non-finished ends but with all burrs removed.

If so stated in the order, ends may have a special finish.

8.3 Threading of pipes and couplings

Threads and thread inspection methods shall conform to ISO..., except for special cases.

Ends shall not be rounded out by hammering to secure compliance with threading requirements.

delivered. In case the thread type is not stipulated on the purchase order, the manufacturer should be responsible for obtaining clarification from the purchaser. See clause 5.

NOTE - For grades H 28, H 31, J 38, K 38 where two thread types (long and short) are given in table 20, pipes with short thread will be

Ends may be finished to accommodate the various types of

8.2.1.1 Casing shall in principle be furnished with both

ends machined with a round thread (8 threads per inch) (see ISO...), one of the ends being fitted with a coupling.

Delivery may be made without couplings or with a (normal or special) coupling with special make-up as defined in 8.4.

8.2.1.2 If stated in the order, end finishes may be as follows :

Buttress threads¹⁾ with or without couplings;

- Extreme-Line threads¹⁾ in the so-called "integral" form without couplings (table 25);

¹⁾ See ISO . . .

The inside and outside edges of all pipe types shall be free of burrs.

8.4 Coupling make-up and thread protection

8.4.1 Regular clearance couplings shall be screwed onto the pipe power-tight. However, if so specified on the order they may be screwed on handling-tight or shipped separately.

8.4.2 Special clearance tubing couplings shall be screwed on handling-tight. If so required on the order they may, however, be shipped separately.

8.4.3 A high-grade thread compound shall be applied to cover the full surface of the engaged thread of either the pipe or the coupling.

Compound type and grade shall conform to the relevant requirements in national standards and may be specified on the order.¹⁾

8.4.4 The pipe ends without couplings and the non-engaged end of couplings shall be provided with thread protectors conforming to clause 15.

All exposed thread parts shall be coated with a high-grade thread compound.

Standards NOTE – Handling-tight is defined as sufficiently tight that the coupling cannot be removed except by the use of a wrench. The purpose of making-up couplings handling-tight is to <u>facilitate</u> removal of the couplings for cleaning and inspecting threads and applying fresh thread compound before using the pipe.

This procedure has been found to result in less chance of thread leakage, because mill-applied couplings made-up power-tight, although leak proof at the time of make-up, may not always remain so after transportation, handling and use.

9 PERMISSIBLE DIMENSIONAL DEVIATIONS

9.1 Outside diameter

9.1.1 Pipe body

The tolerances on the outside diameter of the pipe are given in table 4.

Pipe boo	ly	Pipe ends
Outside diameter	Tolerances	Complete threads
<i>D</i> < 114,3 mm	± 0,79 mm	Permissible deviations These shall be such that
<i>D</i> ≥ 114,3 mm	± 0,75 %	complete threads within this length conform to the tole- rances given in ISO

TABLE 4 - Tolerances on diameter

9.1.2 Upset ends

Close to the upset end at the part of the pipe affected by heating and upsetting, the outside diameter may be within the tolerances given in table 5.



FIGURE 1 - Upset end

TABLE 5 - Tolerances on upset ends

	Casing					
Outside diameter D mm	Tolerances	On length /				
ten. <u>0</u> <127,0	+ 2,8 mm – 0,75 % <i>D</i>	127 mm				
139,7 ≤ <i>D</i> ≤ 219,1	+ 3,2 mm – 0,75 % <i>D</i>	# D				
st <u>e1d51₽</u> b ∂-244 454b51-	<mark>,</mark> †34,0 mm 0,75 % <i>D</i>	# D				

	Tubing						
Outside diameter	Length L_a^*	Tolerance on diameter at distance L _a	Length L _b *				
mm	mm	mm	mm				
60,3	152,4	D + 2,4 - 0,8	254				
73	159	D + 2,4 - 0,8	260				
88,9	165	D + 2,4 - 0,8	267				
101,6	165	D + 2,8 - 0,8	267				
114,3	171,5	D + 2,8 - 0,75 % D	273				

* Lengths L_a and L_b are measured from the pipe end. L_b is the distance from which the tolerances given in 9.1 for the pipe body apply.

The alterations in the diameter between the points of measurement at distances L_a and L_b shall be smooth and progressive, not abrupt.

9.2 Wall thickness

9.2.1 Each length of pipe shall conform to the following specifications :

At any place the minimum thickness shall not be less than 87,5% of the tabulated thickness, the maximum thickness being limited by the mass tolerance (see 9.3.3).

1) An International Standard on compounds is in preparation; meanwhile reference may be made to API Bulletin 5 A2, latest edition.

ISO 2645-1975 (E)

Thickness measurements shall be made with a gauge fitted with contact pins having a diameter of 6,35 mm. The end of the pin contacting the inside surface of the pipe shall be rounded to a radius of 38 mm; the end of the pin contacting the outside surface shall be flat or rounded to a radius of 38 mm.

Thickness measurements can also be made using appropriately calibrated non-destructive equipment of adequate accuracy. In case of dispute the mechanical gauge measurement will, however, be relied upon.

9.3 Mass

9.3.1 Each casing and tubing shall be weighed separately. However, tubing of diameters less than or equal to 33.4 mm may be weighed in convenient lots. Threaded and coupled pipes may be weighed with their couplings attached.

Threaded pipes with or without couplings shall be weighed without thread protectors except for wagon load weighings where proper allowances must be made for the mass of the thread protectors in the total mass.

9.3.2 The masses determined shall conform to the specified (or adjusted calculated) masses for the end finishes provided for in the order within the tolerances stipulated in 9.3.3. Calculated masses shall be determined in accordance with the following formula :

 $W_L = (W_{\rm pe}L) + e_{\rm w}$

where

kilograms;

 $W_{\rm ope}$ is the plain end theoretical mass per unit length in kilograms per metre;

L is the length of pipe, as defined in 9.4, in metres;

 $e_{\rm w}$ is the mass gain or loss due to end finishing, in kilograms.

9.3.3 On one pipe or on one lot of pipes for lot-weighed pipes ($D \le 33,4$ mm) the tolerance shall be $^{+6,5}_{-3,5}$ %.

On a complete wagon load (i.e. 18 t minimum) the tolerance shall be $\begin{array}{c} 0 \\ 1 \\ 75 \end{array}$ %.

NOTE - Tolerances per pipe lot or pipe wagon load are applicable simultaneously, except for loads less than 18 t where the tolerance + 6,5 % only is obligatory.

9.4 Length

9.4.1 Pipes shall be furnished in the length range specified in the order. The length ranges shall comply with table 6. When the pipe is furnished with threads and couplings, the length is measured from the outer face of the coupling to the opposite plain spigot end. For Extreme-Line casing, the length shall be measured from the box end to the opposite threaded spigot end.

ISO 2645:1975

https://standards.iteh.ai/catalog/standagda/2st/ff solsbecified ih the order, for round thread casing W_L is the calculated mass of a pipe of length L, in length) may be furnished to a maximum of 5% of the order. No length used in making a jointer shall be less than 1,52 m and the jointer total length shall conform to the standard length of the one-piece pipe.

	Ran	ge 1	Ran	ge 2	Ran	ge 3
and a second second Second second	m	ft ft	m	ft	m	ft
Casing (jointers included) On 95 % min. of a shipment (see table 8)	4,9 to 7,6	16 to 25	7,6 to 10,4	25 to 34	10,4 and over ¹⁾	34 and over
 maximum variation 	1,8	6	1,5	5	1,8	6
- minimum length	5,5	18	8,5	28	11,0	36
Tubing	6,10 to 7,3	20 to 24	8,5 to 9,7	28 to 32		
On 100 % min, of a shipment (see table 8)						
— maximum variation	0,6	2	0,6	2		
— minimum length	6,1	20	8,5	28		

TABLE 6 - Length ranges

1) By agreement at the time of ordering the upper limit may be stated by the purchaser.

9.5 Inside diameter

Each pipe shall be checked over its whole length with a cylindrical mandrel in conformity with table 7.

The front end of the mandrel shall be rounded to allow an easy fit in the pipe. The mandrel shall enter the pipe freely over its whole length with a reasonable effort. The pipe shall not be rejected as long as it is not tested free of foreign materials and supported to avoid collapse.

TABLE 7 -	- Dimensions	of check	mandrel
-----------	--------------	----------	---------

Values in millimetres Minimum Mandrel Nominal outside diameter mandrel D length diameter²⁾ Casing¹⁾ *D* ≤ 219,1 152 d - 3,2244,5 ≤ *D* ≤ 339,7 305 d-4*D* ≥ 406,4 305 d-4,8 Tubing i $D \leq 73$ 1 067 ST **nd-3,2** (D ≥ 88.9

1) For Extreme-Line casing the mandrel minimum diameter $3s_{1975}$ in 10.2.2. specified in column 5 of table 24. https://standards.iteh.ai/catalog/standards/sist/e1d51ab6-a4f4-4b51-a331-2) d = theoretical internal diameter. $3f_{14e1e395af}$ iso-2645-1975

9.6 Curvature

All pipes shall be delivered with a reasonable straightness.

9.7 Loads

Wagon loads shall comply with table 8.

TABLE 8	Wagon	loads	(see ranges -	table	6)	ļ
---------	-------	-------	---------------	-------	----	---

	Order larger than one wagon load				
Order smaller than one wagon load	Railway shipment direct from mill to final consignee	Railway shipment interrupted from mill to final consignee			
Total tolerances of ranges	Total variation on 5 % maximum of shipment, required per wagon load in the corresponding range	Total variation on 5 % maximum of shipment, required for total load in the corresponding range			

10 CHEMICAL ANALYSES

10.1 Ladle analysis

When requested by the purchaser, the manufacturer shall furnish a ladle analysis of each steel heat used. In addition,

the purchaser, upon request, shall be furnished with the results of such other chemical analyses as may be obtained. The analyses, so determined, shall conform to the requirements specified in 7.2.

10.2 Check analysis

10.2.1 Two finished pipe lengths shall be analysed by the manufacturer from each lot of 400 ($\phi \le 139,7$ mm) or 200 ($\phi \ge 168,3$ mm) pipes of the same diameter. For multiple-length seamless pipes, a length is considered as all of the sections cut from a particular multiple length.

10.2.2 The samples shall be composed of cuttings or drillings representing the full wall thickness of the pipe. If drillings are used the minimum drill size shall be 12,7 mm.

10.2.3 If the check analysis on one length representing the lot fails to conform to the requirements of 7.2, the manufacturer will be allowed to re-test two supplementary lengths. If the re-check is satisfactory, the lot shall be accepted except for the defective length. If both lengths representing the lot, or one (or both) length(s) of the re-check analysis fail, at the manufacturer's option the entire lot shall be rejected or individual re-check analyses carried out. These re-check analyses shall be made on defective elements only. Samples shall be taken as specified

10.3 Mill-control check analyses

A ladle analysis of each steel heat used shall be made by the manufacturer. A record of such analyses shall be available to the purchaser.

11 MECHANICAL AND NON-DESTRUCTIVE TESTS

11.1 Nature of tests

Class I, II and III pipes shall be tested for tensile strength and flattening strength. They shall also be submitted to hydrostatic tests. Class II pipes shall be submitted to non-destructive inspection. This inspection is optional for class I and III pipes.

11.2 Number of tests

The number of tests shall conform to the requirements of table 9.

11.3 Tensile tests

11.3.1 Tensile tests shall be carried out in accordance with ISO 375. Proof stress values shall be calculated for an elongation under load of 0,5 % or 0,6 % (see table 2).

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Test pieces, at the manufacturer's option, shall be either full sections or strips with the same heat treatment as the pipe (see figure 2). A test piece shall represent the full thickness of the pipe from which it is taken; it must not be flattened before testing. In the case of welded pipes the test piece shall be taken approximately 90° from the weld.

Dimensions in millimetres



Full section test piece



Strip test piece

FIGURE 2 - Tensile test pieces

In the case of heat treated pipes, the test piece shall be submitted to the same treatment as the finished pipe.

The mechanical properties of upset ends shall meet the requirements for the pipe body. In case of dispute the minimum tensile strength and the proof stress shall be determined on a test piece taken from an upset end.

11.3.2 The width of the test piece gauge length shall be about 38 mm if suitable face testing grips are used or if the ends of the test piece are machined to reduce the curvature in the grip area; otherwise it shall be approximately 19 mm for pipes 88,9 mm and smaller, 25,4 mm for pipes from 101,6 to 193,7 mm, and approximately 38 mm for pipes 219,1 mm and larger. In no case shall the width of the test piece gauge length be greater than four times the thickness of the test piece.

11.3.3 If any tensile test piece shows defective machining or develops flaws, it may be discarded and another test piece substituted. When the elongation of any tensile test piece is less than that specified, a re-test is allowed if any part of the fracture is outside the middle third of the gauge length as indicated by scribe scratches marked on the test piece before testing.

<u>ISO 2645:1975</u>

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TABLE 9 - Number of tests

Test	Number of tests				
	Class I	Class II	Class III		
Tensile test on test piece	$ \left. \begin{array}{c} D \leqslant 139,7 \text{ mm}: \\ 1 \text{ per 400 lengths} \\ D \geqslant 168,3 \text{ mm}: \\ 1 \text{ per 200 lengths} \end{array} \right\} 1) 2) $	Casing : 1 per 100 leng Tubing : 1 per 200 leng	ths } 1) 2)		
Mill-control tensile test		1 per heat			
Flattening test on test piece	On non-upset or untreated pipes : on each end of each pipe ^{3) 4)}	an an an Arran an Ar Arran an Arran an Arr Arran an Arran an Arr			
	On upset and treated pipes : test pieces shall be taken at each end of each pipe before upsetting and treatment or on pipes at the rate of 1 per 20 lengths (casing) and 1 per 100 lengths (tubing). In this case test pieces shall be treated in a similar way to that specified for the grade concerned.				
Hydrostatic test	On each pipe				
Non-destructive inspection	Optional	On the whole length of each pipe	Optional		

1) In the case of treated pipes, all pipes in a lot shall have been submitted to the same treatment.

2) In the case of seamless pipes in multiple lengths, a length is classed as the sum of the sections obtained from this multiple length.

3) The test shall not be carried out for seamless pipes of grade H 28 and H 31.

4) In the case of seamless pipes in multiple lengths cut in sections, tests shall be made at each end of the multiple length.

Pressure p

 $p = 0.914 \times p_{\rm E}$

with 207 bar max.

 $p = 0.685 \times p_{\rm E}$ with 207 bar max.

 $p = 0.914 \times p_{\rm E}$

with 689,5 bar max

Grade of steel	Distance <i>z</i> with					
	D/a < 3,93	3,93 <i>≤ D/a</i> < 16	<i>D/a</i> ≥ 16			
Н 28	(0,83 – 0,020 6 <i>D/a</i>) <i>D</i>	(0,83 - 0,020 6 <i>D/a</i>) D	0,5 <i>D</i>			
Н 31	(0,88 – 0,020 6 <i>D/a</i>) <i>D</i>	(0,88 0,020 6 <i>D/a</i>) <i>D</i>	0,55 <i>D</i>			
J 38, K 38	(1,104 – 0,051 8 <i>D/a) D</i>	(0,98 0,020 6 <i>D/a</i>) <i>D</i>	0,65 <i>D</i>			
	9 ≤ <i>D/a</i> ≤ 25					
C 52, N 56	(1,074 – 0,019 4 <i>D/a</i>) <i>D</i>					
C 66	(1,080 – 0,017 8 <i>D/</i> a) <i>D</i>					
P 72, P 76	(1,086 – 0,016 3 <i>D/a</i>) <i>D</i>					

TABLE 10 - Distance z between plates

D = outside diameter in millimetres

a = wall thickness in millimetres

11.4 Flattening test

This test is applicable for all grades except H 28 and H 31 in the case of seamless pipes.

11.4.1 The flattening test shall accordance with ISO/R 202.

No cracks or breaks shall occur anywhere in the test piece. until the distance between plates z is less than that specified in table 10. 3f14e1e395af/iso-264

be

carried out in

If a test piece representing class II or III pipes or grade N 56 pipes is shown defective at a point of maximum bending (12 h and 6 h), the test shall be pursued until the remaining part of the test piece breaks at 90° from the point of maximum bending (3 h or 9 h).

Premature fracture at the point of maximum bending shall not be taken into account for the possible rejection of the pipes.

11.4.2 In the case of welded pipes, the weld shall be placed at the point of maximum bending. At the discretion of the inspector, separate tests shall be made with the weld 90° from the point of maximum bending.

Evidence must not appear of poor texture, incomplete fusion in the weld, laminations, burnt metal or extruded metal.

11.5 Hydrostatic test

11.5.1 Test pressure

Each length shall be hydrostatically tested at the manufacturer's works, unless otherwise specified in the order.

The test shall be carried out at the pressures given in table 11.

TABLE 11 - Test pressures

Diameter of pipe D

D ≤ 244,5 mm

D ≥ 273 mm

D	=	test	pressure	

eh.ai)

Grade of steel

H 28, H 31, J 38, K 38

Other grades - 44f4-4b51-a

 $\rho_{\rm E}$ = internal yield pressure specified in table 20, 22, 24, 26 or 28 for the adopted end type.

If so specified in the order, class I and II pipes may, however, be tested at the pressure given by the formula, no account being taken of the maximum limit.

The test pressure shall be held for at least 5 s. No leakage shall then occur.

11.5.2 Welded pipes

While under pressure, welded pipes shall be struck at both ends near the weld with a 1 kg hammer or its equivalent.

Pressure shall then be reduced to not less than one-half and maintained for a sufficient period to permit thorough inspection of the weld for leakage or sweats.

11.5.3 Threaded pipes with couplings

a) Couplings made-up power-tight

For diameters less than 406 mm, the test shall be carried out with the coupling.