

INTERNATIONAL STANDARD



2645

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

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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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.

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

Australia	Germany	Portugal
Austria	Hungary	Romania
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Canada	Israel	Turkey
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The Member Body of the following country expressed disapproval of the document on technical grounds :

U.S.A.

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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 properties;
- 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.

4.2 Welded process by resistance or flash

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,

1) In preparation.

- 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);
- g) length range (see 9.4);
- h) manufacturing process (seamless or welded);
- i) delivery date, shipping instructions and marking;
- j) mill inspection (if required).

5.2 The purchaser shall also state on the order his requirements concerning the following optional stipulations :

- normalizing of J 38 casing, and tubing, and of K 38 and N 56 casing;
- chemical, ladle and supplementary analyses;
- flattening test on grade H 28, seamless pipes;
- casing jointers;
- casing or tubing with couplings detached;
- coupling make-up (other than power-tight);
- pipe coating;
- non-destructive testing for class I and III pipes.

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

- 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.

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 X 5,7, K 38, range 2, seamless according to ISO 2645.

7 STEELS

7.1 Steelmaking

The only processes permitted by this International Standard are the following :

open-hearth, electric furnace or basic oxygen 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.

TABLE 1 — Chemical characteristics

Class	Grade of steel	C %	Si %	Mn %	P %	S %	Cr + Ni + Cu %	Cr %	Mo %
I	H 28 H 31 J 38 K 38 N 56				≤ 0,040	≤ 0,060			
II	P 72 P 76				≤ 0,040	≤ 0,060			
III	C 52 Type 1	≤ 0,50	≤ 0,35	≤ 1,90	≤ 0,040	≤ 0,060	≤ 0,50	0,80 to 1,10	0,15 to 0,30
	— Type 2	≤ 0,40	≤ 0,35	≤ 1,50	≤ 0,040	≤ 0,060			
	— Type 3	0,38 to 0,48		0,75 to 1,00	≤ 0,040	≤ 0,040			0,15 to 0,25
	C 66 ¹⁾	≤ 0,45	≤ 0,35	≤ 1,90	≤ 0,040	≤ 0,060			

- 1) In the case of quenching and tempering : C ≤ 0,40 with Mn ≤ 1,70
or C ≤ 0,45 with Mn ≤ 1,60

TABLE 2 — Mechanical characteristics

Class	Grade of steel	Proof stress, R_p	Minimum tensile strength R_m	Minimum elongation on $5,65 \sqrt{S_0}$ *
		N/mm ²	N/mm ²	%
I	H 28	$R_{p\ 0,5} \geq 276$	414	22,5
I	H 31	$R_{p\ 0,5} \geq 310$	483	19,3
I	J 38	$379 \leq R_{p\ 0,5} \leq 552$	517	18
I	K 38	$379 \leq R_{p\ 0,5} \leq 552$	655	14,3
III	C 52	$517 \leq R_{p\ 0,5} \leq 621$	655	14,3
I	N 56	$552 \leq R_{p\ 0,5} \leq 758$	689,5	13
III	C 66	$655 \leq R_{p\ 0,5} \leq 758$	724	12,8
II	P 72	$723 \leq R_{p\ 0,6} \leq 931$	827	11,3
II	P 76	$758 \leq R_{p\ 0,6} \leq 965$	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
I	K 38 J 38	Normalizing, if specified in the order
	N 56	Normalizing, or quenching and tempering
II	P 76	Quenching and tempering, or normalizing and tempering
III	C 52 types 1,3	Normalizing and tempering
	C 52 type 2	Quenching and tempering
III	C 66	Quenching and tempering (538 °C min.)
Class	Tubing	Heat treatment
I	J 38	Normalizing, if specified in the order
I	N 56	Normalizing, or quenching and tempering
II	P 72	Quenching and tempering, or normalizing and tempering
III	C 52 types 1,3	Normalizing and tempering
	C 52 type 2	Quenching and tempering
III	C 66	Normalizing and tempering, or quenching and tempering (538 °C min.)

8 PIPE CONDITION

8.1 Diameters, wall thicknesses and masses

The pipes supplied shall have the diameters, wall thicknesses and masses shown in tables 20, 22, 24, 25, 26 and 28.

8.2 Pipe ends

8.2.1 Casing

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

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.

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 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.

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);

— special end finish, according to previous written agreement between supplier and purchaser.

8.2.1.3 In certain cases pipes may be furnished with square-cut plain ends.

8.2.2 Tubing

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.

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.

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 facilitate 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.

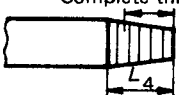
9 PERMISSIBLE DIMENSIONAL DEVIATIONS

9.1 Outside diameter

9.1.1 Pipe body

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

TABLE 4 — Tolerances on diameter

Pipe body		Pipe ends
Outside diameter	Tolerances	Complete threads 
$D < 114,3 \text{ mm}$	$\pm 0,79 \text{ mm}$	Permissible deviations These shall be such that length L_4 and the number of complete threads within this length conform to the tolerances given in ISO ...
$D \geq 114,3 \text{ mm}$	$\pm 0,75 \%$	

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.

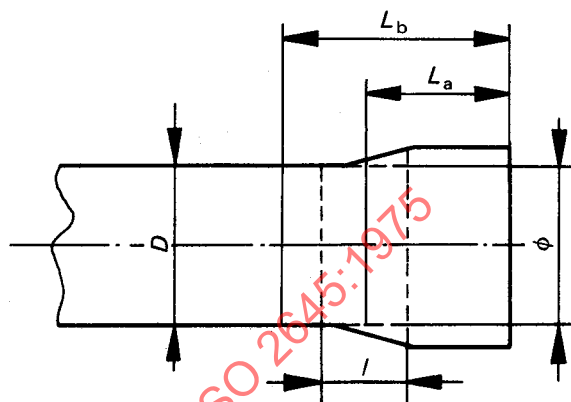


FIGURE 1 — Upset end

TABLE 5 — Tolerances on upset ends

Casing			
Outside diameter D mm	Tolerances		On length /
$D \leq 127,0$	$+ 2,8 \text{ mm} - 0,75 \% D$		127 mm
$139,7 \leq D \leq 219,1$	$+ 3,2 \text{ mm} - 0,75 \% D$		# D
$D \geq 244,5$	$+ 4,0 \text{ mm} - 0,75 \% D$		
Tubing			
Outside diameter mm	Length L_a^* mm	Tolerance on diameter at distance L_a mm	Length L_b^* 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.

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_{pe}L) + e_w

where

W_L is the calculated mass of a pipe of length L, in kilograms;

W_{pe} 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_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 ≤ 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 ⁰/_{-1,75} %.

NOTE — Tolerances per pipe lot or pipe wagon load are applicable simultaneously, except for loads less than 18 t where the tolerance ^{+6,5}/_{-3,5} % 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.

9.4.2 If so specified in the order, for round thread casing only, jointers (i.e. two pieces coupled to make a standard 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.

TABLE 6 — Length ranges

	Range 1		Range 2		Range 3	
	m	ft	m	ft	m	ft
Casing (jointers included)	4,9 to 7,6	16 to 25	7,6 to 10,4	25 to 34	10,4 and over ¹⁾	34 and over
On 95 % min. of a shipment (see table 8)						
— 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		

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

Nominal outside diameter D	Mandrel length	Minimum mandrel diameter ²⁾
Casing¹⁾		
$D \leq 219,1$	152	$d - 3,2$
$244,5 \leq D \leq 339,7$	305	$d - 4$
$D \geq 406,4$	305	$d - 4,8$
Tubing		
$D \leq 73$	1 067	$d - 2,4$
$D \geq 88,9$	1 067	$d - 3,2$

1) For Extreme-Line casing the mandrel minimum diameter is specified in column 5 of table 24.

2) d = theoretical internal diameter.

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)

Order smaller than one wagon load	Order larger 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 ($\phi \leq 139,7$ mm) or 200 ($\phi \geq 168,3$ 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 in 10.2.2.

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).

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.

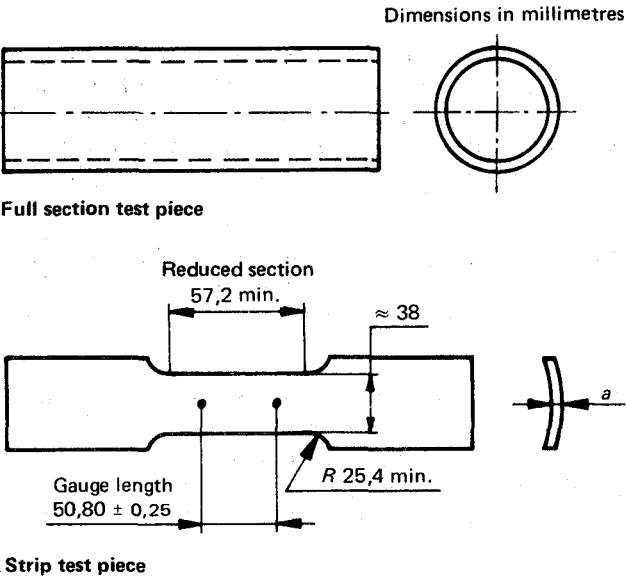


FIGURE 2 – Tensile test pieces

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.

TABLE 9 – Number of tests

Test	Number of tests		
	Class I	Class II	Class III
Tensile test on test piece	$D \leq 139,7$ mm : 1 per 400 lengths $D \geq 168,3$ mm : 1 per 200 lengths } 1)2)	Casing : 1 per 100 lengths Tubing : 1 per 200 lengths } 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⁾ 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.

TABLE 10 — Distance z between plates

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

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 be carried out in 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.

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

Grade of steel	Diameter of pipe D	Pressure p
H 28, H 31, J 38, K 38	$D \leq 244,5\text{ mm}$	$p = 0,914 \times p_E$ with 207 bar max.
—	$D \geq 273\text{ mm}$	$p = 0,685 \times p_E$ with 207 bar max.
Other grades		$p = 0,914 \times p_E$ with 689,5 bar max.

p = test pressure

p_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.

For diameters 406 mm and greater, hydrostatic testing before threading is permitted.

b) Couplings made-up handling-tight

The test shall be carried out as agreed in the order on plain end or threaded and coupled pipes. Minor leakage at the joint shall be disregarded in this case.

11.5.4 Special test

A higher pressure may be used if agreed between supplier and purchaser. In any case, the pressure shall never exceed the values given in annex B.

11.6 Non-destructive testing

11.6.1 Applications and options

In a case where such testing is specified (see table 12) in addition to visual inspection, casing and tubing shall be tested over their full length to detect longitudinal defects, by magnetic particle inspection, or by an ultrasonic method, or by an electromagnetic method. Furthermore the ends of upset pipes shall be inspected for transverse defects by the magnetic particle method. The location of the equipment in the mill will be at the discretion of the manufacturer. However, the non-destructive testing shall take place after all heat-treating operations, but may take place before cropping or threading.

11.6.2 Magnetic particle inspection

When magnetic particle inspection is employed for longitudinal defect detection, the entire outside surface of the pipe and the inside surface for a distance of 305 mm from the end of casing or of 152 mm from the end of tubing should be inspected. The inside and outside surfaces of the ends of upset pipes shall be inspected for transverse defects by the magnetic particle method. Magnetic particle

inspection of casing and tubing may be employed on inside surfaces after heat treatment and before end cropping.

If defects are found, further cropping is permissible provided that the inside surface is again inspected by the magnetic particle method as stipulated above. The depth of all defects revealed by this inspection shall be determined.

11.6.3 Electromagnetic or ultrasonic inspection

a) Equipment

For pipe inspection, any equipment utilizing the electromagnetic or ultrasonic principles may be used provided that it is capable of continuous and uninterrupted inspection of the outer surface of the pipe.

The equipment shall have sufficient sensitivity to indicate injurious defects and it shall be checked as prescribed in 11.6.3.b).

b) Reference standard

A reference standard taken from the pipes as supplied and having the same nominal diameter and wall thickness as the product being tested shall be used at least once every working turn to demonstrate the effectiveness of the inspection equipment.

The reference standard shall have any convenient length as determined by the manufacturer; it shall be scanned by the inspection unit in a manner simulating the inspection of the product.

c) Notch (see table 12)

Standard notches (types 12,5 % and 5 %) shall be made in the reference standards.

When using internal and external notches it is not necessary that they be farther apart than the distance required for signal differentiation.

TABLE 12 — Non-destructive testing

Class	Conditions	Standards						
		Ultrasonic inspection			Electromagnetic methods			
		Depth	Notch		Depth	Notch		Hole (diameter)
			width	length		width	length	
I and III	100 % by agreement	0,05 a	1 mm	50 mm	0,05 a	1 mm	38 mm	1,6 mm (0.062 5 in)
		0,125 a	1 mm	2 widths of probe	0,125 a	1 mm	38 mm	3,2 mm (0.125 in)
II	100 %	0,05 a	1 mm	50 mm	0,05 a	1 mm	38 mm	1,6 mm (0.062 5 in)

NOTE — The widths given for the notch are meant at full depth.
a : wall thickness in millimetres.

The notch sides shall be theoretically parallel and the bottom shall be theoretically perpendicular to the sides. The notch shall be cut on the external surface of the reference standard and shall be parallel to the pipe longitudinal axis except for seamless pipes, and at the option of the manufacturer it will possibly be oriented at an angle to allow maximum defect detection.

Lengths

- ultrasonic or diverted flux testing
 - α) 5 % *a* notch : 50 mm (2 in) min.
 - β) 12,5 % *a* notch : twice the probe length (total length).
 - eddy current testing
- total maximum length : 38 mm (1.5 in).

Width

1 mm (0.04 in) maximum.

Depth

Two types are used :

- α_1) 5 % *a* notch : 5 % of the specified wall thickness with a minimum of 0,3 mm (≈ 0.012 in).
- β_1) 12,5 % *a* notch : 12,5 % of the specified wall thickness with a minimum of 0,6 mm (≈ 0.024 in), with a depth tolerance ± 15 % and a minimum of $\pm 0,05$ mm (0.002 in).

11.6.4 Permissible depth of defects

For class II pipes and for class I and III pipes checked with 5 % *a* reference notch, all detected defects the depth of which is greater than 5 % but smaller than 12,5 % of the nominal wall thickness shall be removed by grinding or machining.

The maximum depth of grinding or machining is limited by the observance of the thickness tolerance, i.e. the remaining thickness at the bottom of the ground or machined part shall not be less than 87,5 % of the nominal thickness.

Where grinding or machining is done, use generous radii to prevent abrupt changes in wall thickness. After reducing these imperfections such areas shall be reinspected by one of the non-destructive testing methods specified above to verify complete removal of the defect.

11.6.5 Surface inspection of "Extreme-Line" casing

The upset portions of Extreme-Line casing shall be examined visually for defects.

The maximum permissible depth of defects from the inside or outside surface is 12,5 % of the theoretical pipe body wall thickness, except in the following two cases :

- a) pin end : on the inside surface, from the end of the pipe to the plane of the external shoulder (bored) : 0,38 mm.
- b) box end : on the outside surface :
 - for 121 mm from the end ($\phi < 193,7$ mm) : 0,25 mm.
 - for 165 mm from the end ($\phi < 219,1$ mm) : 0,25 mm.

All machined surfaces of the box end shall be free from seams and cracks; the threads shall be free from any imperfections which break the continuity.

11.7 Re-tests

In a case where a test on a pipe sample representative of the lot is not satisfactory the manufacturer may decide to re-test the product using test pieces taken on two additional pipes in the same lot.

These test pieces shall be cut as indicated in 11.3 and 11.4. If these test pieces meet the requirements, then all pipes in the lot shall be accepted except the one initially selected and from which the first defective test piece was cut.

If one of the test pieces fails to meet the requirements of the re-test, the manufacturer may choose to test individually all remaining pipes in the lot. In this case the test shall be carried out only for those properties which were not satisfactory at the re-test.

In case of unsatisfactory flattening re-tests per lot, the manufacturer may decide to re-treat and then re-test the lot. In case of individual testing the manufacturer may re-test test pieces cut on the same pipe end until satisfactory results are obtained. However, the pipe length shall not then be less than 80 % of that before the first cropping.

12 INSPECTION RIGHTS

When pipes are accepted by an inspector representing the purchaser, acceptance shall be in accordance with the requirements of clause 5 of ISO/R 404.

Pipes which show injurious defects on mill inspection or subsequently when applied in service may be rejected, and the manufacturer notified so that he will have the possibility to check the justice of the claim.

If destructive inspection is made other than at the place of manufacture, the purchaser shall only pay for those products which meet the requirements of this International Standard and not for those which result from rejection of non-conforming parts.

13 TEST REPORTS

Test reports may be required by the purchaser. They shall conform to the requirements of clause 4 of ISO/R 404.

14 COUPLINGS

14.1 Couplings for pipes conforming to this International Standard shall be seamless and, unless otherwise specified in the order, of the same grade as the pipe. However, all grade H 28 and H 31 pipes and those grade J 38 pipes the nominal diameter of which is less than or equal to 339,7 mm can be supplied with grade K 38 and J 28 couplings respectively.

In the case of welded C 66 steel pipes, couplings may be supplied flash-welded.

In the case of class III pipes, the couplings shall be submitted to the same heat treatment as the pipes.

14.2 Mechanical properties

Couplings shall conform to the mechanical requirements specified in table 2 for the particular grade ordered. A tensile test shall be made on each steel heat from which couplings are produced. For Class II and III couplings a test shall also be made on one pipe in a lot of 100 pipes used for casing coupling manufacture and on one pipe in a lot of 200 pipes used for tubing coupling manufacture.

The manufacturer shall maintain a record of such tests; this record shall be open to inspection by the purchaser.

For tensile tests on finished class I couplings and on class II and III pipes intended for coupling manufacture, at the manufacturer's option, either round proportional test pieces or strips shall be used as prescribed in ISO/R 375.

14.3 Dimensions and tolerances

Couplings shall conform to the dimensions and tolerances given in tables 21, 23, 27 and 29.

Unless otherwise specified, threaded and coupled casing and tubing shall be supplied with normal clearance couplings.

14.3.1 Regular couplings

These couplings shall have diameters as shown in column 2 of tables 21, 23, 27 and 29.

The inside and outside edges of the bearing face shall be rounded or broken but shall not materially reduce dimension *b* so that sufficient thickness is left to support safely the weight of the pipe on the elevator. The ends of the couplings shall be faced true at right angles to the axis.

14.3.2 Special clearance couplings

These couplings (reduced outside diameter) may be furnished at the purchaser's request for Buttress casing and external upset tubing. They shall conform to the dimensions and tolerances given in tables 23 and 29.

Unless otherwise specified, special clearance couplings for tubing shall be bevelled on both ends.

14.3.3 Special bevel couplings

Special bevel couplings shall be furnished for tubing when specified in the order. They shall conform to the requirements of tables 27 and 29.

Unless otherwise specified, these couplings shall be bevelled 20° on both ends.

14.4 Threading

Coupling threads, gauging methods and instruments shall conform to the requirements of ISO . . .

Couplings shall not be expanded to provide the required taper for threads.

14.5 Surface texture

14.5.1 Finished couplings shall be free from all visible seams and cracks.

14.5.2 Class II and III couplings shall be inspected by the magnetic particle method (or any appropriate non-destructive process).

14.5.3 Finished couplings with pits, round-bottom gouges and similar imperfections shall not be rejected unless the depth of the imperfections exceeds the values given in table 13.

14.5.4 Finished couplings with grip marks, sharp-bottom gouges or imperfections shall not be rejected unless the depth of the imperfections exceeds the values given in table 13.

14.5.5 Couplings shall be free of imperfections on the inside which break the continuity of the thread.

14.6 Measurement of imperfections

The depth of imperfections shall be measured from the normal surface or contour of the coupling extended over the imperfection. The outside diameter of the coupling shall be measured from its normal surface or contour and not from the base of an acceptable imperfection.

14.7 Repair and removal of imperfections

Repair by welding is not permitted.

TABLE 13 – Permissible depth of defects

Values in millimetres

Pipe type	Diameter	Tolerances	
		according to 14.5.3	according to 14.5.4
Casing	$D \leq 139,7$	0,9	0,8
	$168,3 \leq D \leq 193,7$	1,1	1,0
	$D \leq 219,1$	1,6	
Tubing	$D \geq 73$	0,8	0,6
	$D \leq 88,9$	1,1	0,8

All defects shall be removed or reduced to admissible limits by grinding or machining on the outer surface, provided that the outside diameter after grinding or machining is within the tolerances given in table 13.

Machining or grinding shall be approximately faired into the outer contour of the coupling.

15 MINIMUM MECHANICAL CHARACTERISTICS

15.1 Pipe body

The body of the pipe shall show values of proof stress at least equal to those given in tables 20, 22, 24, 26 and 28. These tables also give collapse strength values for guidance. The method of calculation of these minimum values is given in annex A.

15.2 Joint

The pipe-coupling assembly shall show values of internal yield pressure, collapse strength and joint proof stress at least equal to those given in tables 20, 22, 24, 26 and 28. The method of calculation of these minimum values is indicated in annex B.

The pipe-coupling assembly shall show an efficiency at least equal to those given in tables 22, 24, 26 and 28. This efficiency is defined by the ratio of the proof stress of the coupling to that of the tube. The value in parentheses shows that the coupling is more resistant than the tube.

16 THREAD PROTECTORS

16.1 Application

The manufacturer shall apply external and internal thread protections of such design, material and mechanical

strength as to protect the thread and end of the pipe from damage under normal handling and transportation.

Thread protectors shall cover the full length of the thread.

Thread protectors shall exclude water and dirt from the thread during transportation and normal storage (a period of approximately one year).

The thread design shall be such that the pipe threads are not damaged by the protectors.

16.2 Material

Protector material shall contain no compounds capable of causing corrosion or promoting adhesion of the protectors to the threads.

Protectors shall be suitable for service temperatures from -50°C to $+65^{\circ}\text{C}$.

17 SURFACE PROTECTION

Unless otherwise specified in the order, pipes shall be given a mill coating to protect them from rusting in transit.

If bare or specially coated pipes are required by the purchaser, this shall be specified in the order.

For special coatings the order shall state whether the coating is to be applied to the full length or whether a certain specified distance from the ends shall be left uncoated.

Unless otherwise specified, such bare ends shall be given a coating with oil for protection in transit.

18 MARKING

18.1 Pipes and couplings manufactured in accordance with this International Standard shall be marked by the manufacturer as specified below.

Markings shall be hot die-stamped (a cold alternative is allowed for classes I and II) or paint-stencilled according to 18.2; markings shall be paint-stencilled or in the case of 26,7 mm and 33,4 mm tubing marking shall be die-stamped on a metal tag attached to the bundle. Markings shall not overlap and shall be applied in such a manner as not to injure the pipes.

Paint-stencilled markings shall be placed on the outer surface of the pipe, starting 600 mm from the coupling, or box, or external threaded end (for pipes furnished without couplings), or from one end for plain-ended pipes.

Additional paint-stencilled or die-stamped markings are possible before final heat treatment, at the discretion of the manufacturer, or at the request of the purchaser.

18.2 The particulars shall be the following :

TABLE 14 — Marking particulars

Marking	Class		
	I	II	III
a) die stamping			
name or trade mark of manufacturer	X	X	
ISO mark	X	X	
wall thickness in millimetres	X	X	
grade of steel (possibly heat treatment : A = annealed; N = normalized; Q = quenched; T = tempered)	X	X	
b) paint-stencilling			
size (outside diameter in millimetres)	X	X	X
mass per unit length in kilograms per metre	X	X	X
grade of steel (possibly heat treatment : A = annealed; N = normalized; Q = quenched; T = tempered)	X	X	X
length in metres with two decimals	X	X	X
total mass in kilograms	X	X	X
thread type : round, Buttress, Extreme-Line	X	X	X
name or trade mark of manufacturer			X
ISO mark			X
thickness in millimetres			X

18.3 Coupling marking

The manufacturer's name (or mark), the class, grade and ISO mark shall be marked on each coupling (see 18.1).

For small diameter pipes, these data may be stencilled on a tag.

18.4 Colour identification

To make identification easier, each pipe shall be identified by one or several bands, 50 mm wide and of a colour as defined in table 15, encircling the pipe at a maximum distance of 600 mm from the coupling or the box. Couplings shall be painted all over their outer surface.

TABLE 15 — Colour identification

Grade	Pipe	Coupling
H 28	1 black band	black
H 31	1 grey band	grey
J 38	1 green band	green
K 38	2 green bands	green
C 52	1 blue band	blue
N 56	1 red band	red
C 66	1 brown band	brown
P 72	1 white band	white
P 76	1 white band	white

NOTE — In cases where special clearance couplings are used, these shall bear a black band in the middle in addition to the above marking.

ANNEX A

BASES FOR CALCULATING THE PIPE BODY CHARACTERISTICS

A.1 PIPE BODY PROOF STRESS

This value is calculated as the product of the theoretical pipe section by the minimum specified proof stress of the steel used :

$$P_v = \frac{\pi}{4} (D^2 - d^2) R_p$$

where

P_v is the pipe body proof stress, in newtons;

D is the specified outside diameter of the pipe, in millimetres;

d is the specified inside diameter of the pipe, in millimetres;

R_p is the minimum proof stress of the grade used, in newtons per square millimetre.

A.2 COLLAPSE STRENGTH

A.2.1 The accurate mathematical representation of the pipe collapse strength results in a homogenous but complicated formula for which it is preferable to substitute four empirical formulae which are simpler and established on the basis of over 2 000 tests.

This simplified representation has been obtained by overlooking very important unfavourable parameters such as lack of circularity, or ovality of the outside wall, and eccentricity. It is then advisable to rely on these values only when

- lack of circularity does not exceed 0,75 % of the outside diameter;
- lack of concentricity is within tolerances;
- average wall thickness is not below nominal thickness as a result of internal or external repair.

A.2.2 The formula for calculation varies with ratio D/a and the steel grade used. Different formulae correspond to the plastic or elastic range.

TABLE 16 — Plastic range with minimum yield strength limitation

Grade of steel	D/a
H 28	$\leq 16,44$
H 31	$\leq 15,89$
J 38, K 38	$\leq 14,80$
C 52	$\leq 13,67$
N 56	$\leq 13,38$
C 66	$\leq 12,83$
P 72	$\leq 12,56$
P 76	$\leq 12,42$

$$P_c = 2R_p \left[\frac{(D/a) - 1}{(D/a)^2} \right]$$

where

P_c is the collapse strength in newtons per square millimetre;

R_p is the minimum proof stress in newtons per square millimetre;

a is the minimum theoretical thickness in millimetres;

D is the minimum theoretical outside diameter in millimetres.

TABLE 17 — Plastic range

Grade of steel	D/a	A	B	C
H 28	16,44 to 26,62	2,950	0,046 3	52,02
H 31	15,89 to 26,08	2,963	0,048 9	62,35
J 38, K 38	14,80 to 24,99	2,990	0,054 1	83,02
C 52	13,67 to 23,09	3,060	0,064 2	124,36
N 56	13,38 to 22,46	3,070	0,066 7	134,70
C 66	12,83 to 21,21	3,125	0,074 5	165,70
P 72	12,56 to 20,66	3,162	0,079 5	186,03
P 76	12,42 to 20,29	3,180	0,082 0	196,71

$$P_c = R_p \left(\frac{A}{D/a} - B \right) - C$$

TABLE 18 — Transitional range
between plastic and elastic ranges

Grade of steel	<i>D/a</i>	<i>A</i>	<i>B</i>
H 28	26,62 to 42,70	2,047	0,031 25
H 31	26,08 to 40,87	2,028	0,032 8
J 38, K 38	24,99 to 37,20	1,990	0,036 0
C 52	23,09 to 32,05	1,985	0,041 7
N 56	22,46 to 31,05	1,998	0,043 4
C 66	21,21 to 28,25	2,047	0,049 0
P 72	20,66 to 26,88	2,052	0,051 5
P 76	20,29 to 26,20	2,075	0,053 5

$$P_c = R_p \left(\frac{A}{D/a} - B \right)$$

TABLE 19 — Elastic range

Grade of steel	<i>D/a</i>
H 28	> 42,70
H 31	> 40,87
J 38, K 38	> 37,20
C 52	> 32,05
N 56	> 31,05
C 66	> 28,25
P 72	> 26,88
P 76	> 26,20

$$P_c = \frac{0,323\,7 \times 10^6}{(D/a) [(D/a) - 1]^2}$$

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ANNEX B

BASIS FOR CALCULATING THE INTERNAL YIELD PRESSURE
OF PIPES AND COUPLINGS

B.1 For plain end pipes and Extreme-Line threaded casing the internal yield pressure is given by the formula

$$P_c = 175 R_p \frac{a}{D} 10^{-1}$$

where

P_c is the internal yield pressure, in bars;

R_p is the minimum proof stress of the pipe in newtons per square millimetre;

a is the minimum specified wall thickness in millimetres;

D is the minimum specified diameter in millimetres.

B.2 For threaded and coupled casing the yield pressure is determined by the above formula, but is limited due to the thread and coupling strengths.

Calculation formulae for maxima are as follows :

— round thread casing

$$P_c = R_p \frac{W - D_1}{W} 10^{-1}$$

$$D_1 = E_1 - (L_1 + A) T + H - 2S$$

where

W is the nominal outside diameter of the coupling in millimetres;

E_1 is the pitch diameter at hand-tight make-up level in millimetres;

L_1 is the pipe end length at hand-tight make-up level in millimetres;

A is the value of stand-off in millimetres;

T is the taper, 0,062 5;

H is the thread height, 2,749 mm;

S is the height of the truncated part of the threading 0,432 mm.

— Buttress thread casing

$$\text{Regular couplings : } P_c = R_p \frac{W - D_2}{W}$$

$$\text{special clearance couplings : } P_c = R_p \frac{W_c - D_2}{W_c}$$

$$D_2 = E_7 - (L_7 + J_h - J) T + H$$

where

W is the nominal outside diameter of the normal coupling in millimetres;

W_c is the nominal outside diameter of the special clearance coupling in millimetres;

E_7 is the pitch diameter in millimetres;

L_7 is the complete thread length in millimetres;

J_h is the distance of the pipe end to the hand-tight made-up coupling centre in millimetres;

J is the distance of the pipe end to the power-tight made-up coupling centre in millimetres;

T is the taper, $D \leq 339,7$ mm : 0,062 5,
 $D > 339,7$ mm : 0,083 3;

H is the height of one thread : 1,575 mm.

18

11) These values are given for guidance.

[illegible]

1) These values are given for guidance.

TABLE 20 — Round thread casing — Dimensions and characteristics (continued)

Outside diameter	Mass per unit length		Wall thickness		Inside diameter		Drift diameter		Mass				Grade of steel	Collapse 1)				Internal yield (87.5 % E)				Load corresponding to pipe body proof stress		Joint strength																									
									Plain end		Threads and coupling			e _w		N/mm ²		lb/in ²		bar								lb/in ²		bar		lb/in ²		daN		lbf													
																								Short		Long												Short		Long		Short		Long		Short		Long	
mm	in	kg/m	lb/ft	mm	in	mm	in	mm	in	kg/m	lb/ft	kg	lb	kg	lb	kg	lb	mm ²	lb/in ²	bar	lb/in ²	daN	lbf	daN	lbf	daN	lbf	daN	lbf																				
193,7	7.625	35,7	24,00	7,6	0.300	178,5	7,025	175,3	6,900	35,0	23,47	7,2	15,80					14,1	2 040	190	2 750	125 000	276 000	96 000	212 000																								
		39,3	26,40	8,3	0.328	177,0	6,969	173,8	6,844	38,1	25,56	6,9	15,20	8,6	19,00																																		
219,1	8.625	44,2	29,70	9,5	0.375	174,7	6,875	171,5	6,750	43,3	29,04	7,9	17,40					32,2	4 670	475	6 600	291 000	641 000	111 000	244 000																								
244,5	9.625	50,2	33,70	10,9	0.430	171,9	6,765	168,7	6,640	49,2	33,04	7,2	15,80					43,6	6 320	510	7 040	331 000	729 000	111 000	244 000																								
271,9	10.625	58,0	39,00	12,7	0.500	168,3	6,625	165,1	6,500	56,7	38,05	6,2	13,60					58,1	8 430	594	8 610	381 000	839 000	111 000	244 000																								
304,8	12.125	65,5	44,00	14,2	0.557	160,8	7,511	187,6	7,386	71,5	48,00	8,9	19,60					66,8	9 380	623	8 480	481 000	1 059 000	115 000	254 000																								
330,3	13.125	72,9	49,00	15,2	0.591	157,8	7,811	194,6	7,661	78,5	51,00	9,9	21,80					74,6	10 680	685	9 450	513 000	1 159 000	115 000	254 000																								

1) These values are given for guidance.

TABLE 20 — Round thread casing — Dimensions and characteristics (continued)

Outside diameter	Mass per unit length		Wall thickness		Inside diameter		Drift diameter		Mass			Grade of steel			Pressure				Load corresponding to pipe body proof stress		Joint strength	
	kg/m		mm		mm		mm		Plain end		Threads and coupling		Grade of steel	Collapse ¹⁾	Internal yield (87,5 % E)		daN	lbf	daN		daN	lbf
	mm	in	mm	in	mm	in	mm	in	W _{int}	kg/m	lb	kg			Short thread	Long thread						
244,5	9,625												C52	25,9	3 750		409	5 930	428 000	942 000	352 000	776 000
													N56	26,3	3 810		436	6 330	456 000	1 005 000	375 000	825 000
													C66	28,5	4 130		518	7 510	542 000	1 193 000	430 000	948 000
													P76	30,6	4 430		600	8 700	627 000	1 381 000	502 000	1 106 000
													C52	31,9	4 630		444	6 440	462 000	1 018 000	387 000	852 000
													N56	32,8	4 750		474	6 870	493 000	1 086 000	411 000	905 000
													C66	36,0	5 080		561	8 150	586 000	1 290 000	472 000	1 040 000
													P76	36,6	5 310		651	9 440	678 000	1 493 000	551 000	1 213 000
													C52	44,0	6 380		512	7 430	529 000	1 166 000	454 000	999 000
													N56	45,6	6 620		547	7 930	565 000	1 244 000	482 000	1 062 000
													C66	50,5	7 330		649	9 410	671 000	1 477 000	554 000	1 220 000
													P76	54,7	7 930		732	10 900	775 000	1 710 000	646 000	1 422 000

1) These values are given for guidance.

TABLE 20 — Round thread casing — Dimensions and characteristics (continued)

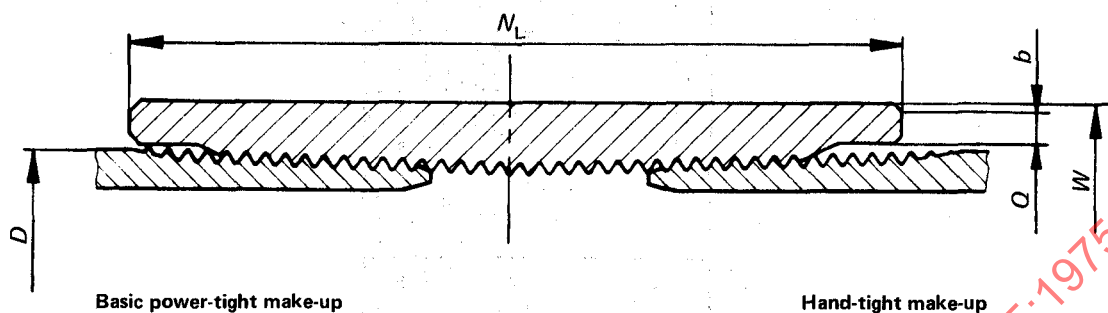
Outside diameter	Mass per unit length		Wall thickness		Inside diameter		Drift diameter		Mass			Grade of steel	Collapse ¹⁾		Pressure		Load corresponding to pipe body proof stress		Joint strength (short)			
	mm	lb/ft	mm	in	mm	in	mm	in	W _{pe}	Threads and coupling (short)			N/mm ²	lb/in ²	bar	lb/in ²	daN	lbf	daN	lbf		
										Plain end	e _w											
273	10.750	48,7	32.75	7,1	0.279	258,9	10.192	254,9	10.036	46,5	31.20	13,2	29.00	H28	6,1	880	126	1.820	167.000	367.000	93.000	205.000
		60,3	40.50	8,9	0.350	255,3	10.050	251,3	9.894	57,9	38.88	12,0	26.40	J28	9,8	1.420	157	2.280	207.000	457.000	143.000	314.000
		67,7	45.50	10,2	0.400	252,7	9.950	248,7	9.794	65,9	44.22	11,1	24.40	K38	10,9	1.580	216	3.130	286.000	629.000	191.000	420.000
		75,9	51.00	11,4	0.450	250,2	9.850	246,2	9.694	73,7	49.50	10,3	22.60	J38	14,4	2.090	247	3.580	325.000	715.000	204.000	450.000
298,5	11.750	82,6	55.50	12,6	0.495	247,9	9.760	243,9	9.604	80,8	54.21	9,4	20.80	K38	18,6	2.700	278	4.030	364.000	801.000	256.000	565.000
		90,3	60.70	13,0	0.545	245,4	9.660	241,4	9.504	88,5	59.40	8,5	19.30	C52	21,6	3.100	278	4.030	364.000	801.000	275.000	606.000
		97,8	65.70	15,1	0.595	242,8	9.560	238,8	9.404	96,1	64.53	7,6	16.80	N56	22,2	3.220	404	5.860	529.000	1.165.000	343.000	756.000
		62,5	42.00	8,5	0.333	281,5	11.084	277,5	10.928	60,5	40.60	13,4	29.60	P76	31,9	4.630	611	8.860	796.000	1.754.000	546.000	1.203.000
339,7	13.375	69,9	47.00	9,5	0.375	279,4	11.000	275,4	10.844	67,9	45.56	12,5	27.60	J28	10,4	1.510	212	3.070	335.000	737.000	217.000	477.000
		80,4	54.00	11,1	0.435	276,3	10.880	272,3	10.724	78,3	52.57	11,4	25.00	K38	14,3	2.070	245	3.560	386.000	850.000	258.000	568.000
		89,3	60.00	12,4	0.489	273,6	10.772	269,6	10.616	87,6	58.81	10,3	22.60	J38	18,3	2.660	276	4.010	432.000	952.000	295.000	649.000
		101,2	68.00	12,2	0.480	315,3	12.415	311,3	12.259	98,5	66.11	11,7	25.80	C52	21,2	3.070	376	5.460	589.000	1.298.000	315.000	693.000
406,4	16.000	107,1	72.00	13,1	0.514	313,6	12.347	309,6	12.191	105,2	70.60	11,0	24.20	N56	21,9	3.070	402	5.830	628.000	1.384.000	419.000	924.000
		111,6	75.00	11,1	0.438	384,1	15.124	379,4	14.938	108,3	72.72	17,3	38.20	C66	23,7	3.440	477	6.920	746.000	1.643.000	484.000	1.066.000
		125,0	84.00	12,6	0.495	381,3	15.010	376,5	14.822	122,1	81.97	15,5	34.20	J38	13,4	1.950	238	3.450	485.000	1.069.000	306.000	675.000
		130,2	87.50	11,1	0.435	451,0	17.75	446,2	17.567	125,9	84.51	33,4	73.60	C52	17,9	2.590	348	5.040	707.000	1.558.000	444.000	978.000
473,1	18.625	130,2	87.50	11,1	0.435	451,0	17.75	446,2	17.567	125,9	84.51	33,4	73.60	N55	18,4	2.670	371	5.380	754.000	1.661.000	472.000	1.040.000
		130,2	87.50	11,1	0.435	451,0	17.75	446,2	17.567	125,9	84.51	33,4	73.60	H28	4,6	670	113	1.640	334.000	736.000	199.000	439.000
		130,2	87.50	11,1	0.435	451,0	17.75	446,2	17.567	125,9	84.51	33,4	73.60	J38	7,0	1.020	181	2.630	535.000	1.178.000	322.000	710.000
		130,2	87.50	11,1	0.435	451,0	17.75	446,2	17.567	125,9	84.51	33,4	73.60	K38	9,7	1.410	205	2.980	602.000	1.326.000	371.000	817.000
540,0	22.500	157,8	104.00	14,0	0.551	424,8	16.700	419,8	16.500	157,8	104.00	14,0	104.00	H28	11,3	1.510	212	3.070	335.000	737.000	217.000	477.000
		165,1	110.00	14,6	0.575	433,1	17.050	428,1	16.950	165,1	110.00	14,6	110.00	K38	12,7	1.660	238	3.450	485.000	1.069.000	306.000	675.000
		172,4	115.00	15,0	0.591	438,4	17.260	433,4	17.160	172,4	115.00	15,0	115.00	C52	19,1	2.740	371	5.380	754.000	1.661.000	472.000	1.040.000
		180,0	120.00	15,4	0.606	442,9	17.430	437,9	17.330	180,0	120.00	15,4	120.00	H28	12,7	1.660	238	3.450	485.000	1.069.000	306.000	675.000

1) These values are given for guidance.

TABLE 20 — Round thread casing — Dimensions and characteristics (concluded)

Outside diameter	Mass per unit length	Wall thickness	Inside diameter		Drift diameter		Mass				Grade of steel	Pressure				Load corresponding to pipe body proof stress		Joint strength																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
			mm	in	mm	in	Plain end	Threads and coupling		Collapse ¹⁾		Internal yield (87,5 % E)		Short thread	Long thread			daN	lbf	daN	lbf																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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mm	in	kg/m	lb/ft	mm	in	mm	in	kg/m	lb/ft	kg	lb	kg	lb	N/mm ²	lbf/in ²	bar	lbf/in ²	daN	lbf	daN	lbf																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
508	20,000	139,9	94,00	11,1	0,438	485,7	19,124	481,0	18,936	136,2	91,41	22,3	49,00	28,7	63,20	J38	K38	3,6	520	145	2,110	145	2,110	145	2,110	672 000	1 480 000	374 000	824 000	784 000	356 000	264 000	581 000	411 000	907 000																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					

TABLE 21 — Round thread casing — Dimensions and masses of couplings



1		2		3		4		5		6		7		8	
Nominal size ¹⁾		Outside diameter <i>W</i> ²⁾		Length <i>N_L</i>				Diameter of recess <i>Q</i>		Width of bearing face <i>b</i>		Mass			
				Short		Long						Short		Long	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb	kg	lb
114,3	4.500	127	5.000	158,8	6.25	177,8	7.00	116,7	4.59	4,0	0.15	3,65	8.05	4,12	9.07
127	5.000	141,3	5.563	165,1	6.50	196,8	7.75	129,4	5.09	4,8	0.18	4,62	10.18	5,70	12.56
139,7	5.500	153,7	6.050	171,4	6.75	203,2	8.00	142,1	5.59	3,2	0.12	5,19	11.44	6,37	14.03
168,3	6.625	187,7	7.390	184,2	7.25	222,2	8.75	170,7	6.71	6,4	0.25	9,07	19.97	11,27	24.82
177,8	7.000	194,5	7.650	184,2	7.25	228,6	9.00	180,2	7.09	4,8	0.18	8,33	18.34	10,75	23.67
193,7	7.625	215,9	8.500	190,5	7.50	235,0	9.25	196,1	7.71	6,4	0.25	12,23	26.93	15,54	34.23
219,1	8.625	244,5	9.625	196,8	7.75	254,0	10.00	221,5	8.71	7,1	0.28	16,15	35.58	21,56	47.48
244,5	9.625	269,9	10.625	196,8	7.75	266,7	10.50	246,9	9.71	7,1	0.28	17,94	39.51	25,32	55.77
273	10.750	298,5	11.750	203,2	8.00	.....	.....	275,4	10.84	7,1	0.28	20,67	45.53	.....	.....
298,5	11.750	323,9	12.750	203,2	8.00	.....	.....	300,8	11.84	7,1	0.28	22,52	49.61	.....	.....
339,7	13.375	365,1	14.375	203,2	8.00	.....	.....	342,1	13.46	7,9	0.31	25,53	56.23	.....	.....
406,4	16.000	431,8	17.000	228,6	9.00	.....	.....	408,8	16.09	7,9	0.31	35,86	78.98	.....	.....
473	18.625	508	20.000	228,6	9.00	.....	.....	475,5	18.71	7,9	0.31	54,00	118.94	.....	.....
508	20.000	533,4	21.000	228,6	9.00	292,1	11.50	510,4	20.09	7,9	0.31	44,61	98.25	57,54	126.74

1) The nominal size of the coupling is equal to the corresponding outside pipe diameter *D*.

2) Tolerance on outside diameter *W*, ± 1 %, but not greater than ± 3,18 mm (1/8 in).

[illegible]

[illegible]

Meas	Threads and coupling
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[illegible]

[illegible]

29

TABLE 22 — Buttress thread casing — Dimensions and characteristics (continued)

Outside diameter	Mass per unit length	Wall thickness	Inside diameter	Drift diameter	Mass				Grade of steel	Collapse				Internal yield (87.5 x E)				Load corresponding to pipe body proof stress				Joint efficiency				Joint strength																																																																																																																																																																																																																																																																																																																																																																											
					Plain and	Threads and coupling		Grade of steel		Normal coupling		Special clearance coupling		Same grade	Higher grade	daN	lb/in ²	bar	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in ²	daN	lb/in ²	bar	lb/in

TABLE 22 — Buttress thread casing — Dimensions and characteristics (continued)

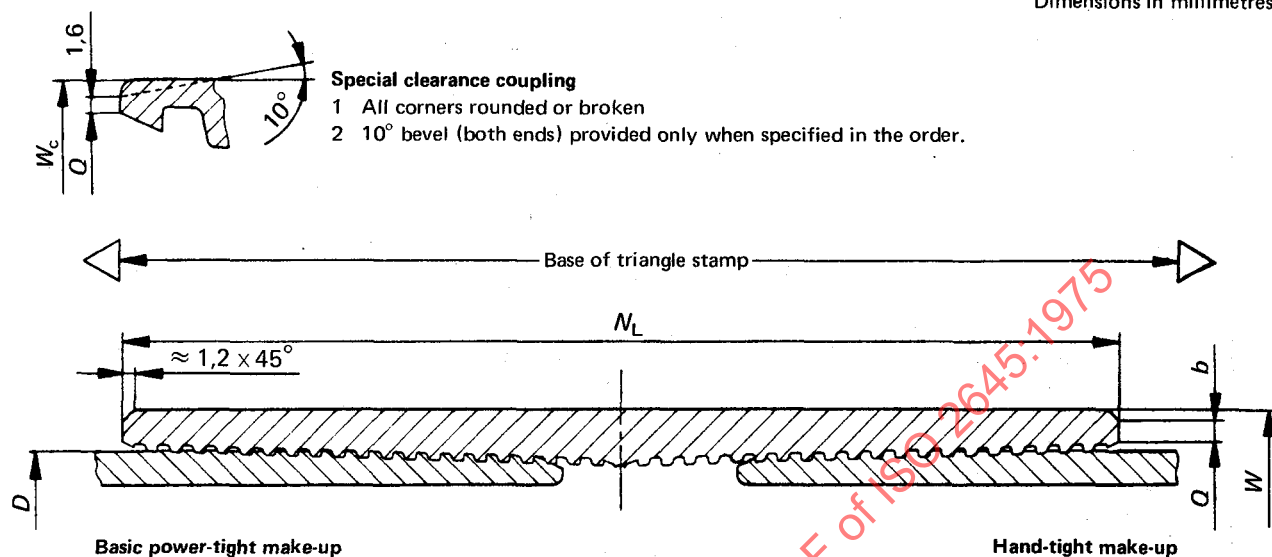
Outside diameter	Mass per unit length	Wall thickness	Inside diameter		Drift diameter		Mass			Grade of steel	Pressure				Load corresponding to pipe body proof stress		Joint efficiency		Joint strength																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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298.5	69.9	47.00	9.5	0.375	279.4	11.000	275.4	10.844	67.9	16.56	35.80	J38	10.4	1 513	212	3 070	212	3 070	335 000	737 000	100 (163)	100 (266)	366 000	807 000	366 000	807 000																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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TABLE 22 — Buttress thread casing — Dimensions and characteristics (concluded)

Outside diameter	Mass per unit length		Wall thickness		Inside diameter		Drift diameter		Mass			Grade of steel	Pressure				Load corresponding to pipe body proof stress		Joint efficiency		Joint strength								
									Plain end	Threads and coupling normal			Collapse	Internal yield (87.5 % E)		Same grade									Higher grade				
										W _{pe}	e _w			lb/ft	kg											lb			
																											kg/m	lb/in ²	bar	lb/in^{2}
mm	in	kg/m	lb/ft	mm	in	mm	in	mm	in	kg/m	lb/ft	kg	lb	N/mm ²	lb/in ²	bar	lb/in ²	daN	lb _f	%	Normal coupling	Same grade	Higher grade	daN	lb _f	daN	lb _f		
406.4	16.000	125.0	84.00	12.6	0.495	381.3	15.010	376.5	14.822	122.1	81.97	12.0	39.60	9.7	1 410	205	2 980	205	2 980	602 000	1 326 000	100 (122)	100 (178)	100 (122)	100 (178)	613 000	1 351 000	613 000	1 351 000
															9.7	1 410	205	2 980	205	2 980	602 000	1 326 000	100 (122)	100 (178)	100 (122)	100 (178)	681 000	1 499 000	681 000
473	18.62													3.1	458	113	1 640	113	1 640	395 000	996 000	100 (194)	100 (194)	100 (194)	100 (194)				
		130.3	87.50	11.05	0.435	451.0	17.755	446.20	17.567	125.88	84.51	39.20	86.30	4.3	630	155	2 250	155	2 250	621 000	1 370 000	100 (194)	100 (194)	100 (194)	100 (194)	603 000	1 329 000	603 000	1 329 000
														4.3	630	155	2 250	155	2 250	621 000	1 370 000	100 (194)	100 (194)	100 (194)	100 (194)	648 000	1 427 000	648 000	1 427 000
508	20.000													2.6	380	106	1 530	106	1 530	488 000	1 080 000	100 (150)	100 (211)	100 (150)	100 (211)				
		140.0	94.0	11.13	0.438	485.7	19.124	480.97	18.936	136.16	91.41	24.74	54.50	3.6	520	145	2 110	145	2 110	672 000	1 480 000	100 (150)	100 (204)	100 (150)	100 (204)	637 000	1 402 000	637 000	1 402 000
														3.6	520	145	2 110	145	2 110	672 000	1 480 000	100 (150)	100 (218)	100 (150)	100 (218)	671 000	1 479 000	671 000	1 479 000
														3.9	560	121	1 750	121	1 750	557 000	1 225 000	100 (132)	100 (182)	100 (132)	100 (182)				
		158.6	106.50	12.70	0.500	482.6	19.000	477.82	18.812	155.15	104.13	21.92	48.30	5.3	770	166	2 410	166	2 410	765 000	1 685 000	100 (132)	100 (180)	100 (132)	100 (180)	725 000	1 596 000	725 000	1 596 000
														5.3	770	166	2 410	166	2 410	765 000	1 685 000	100 (132)	100 (192)	100 (132)	100 (192)	764 000	1 683 000	764 000	1 683 000
														7.5	1 010	153	2 225	153	2 225	702 000	1 545 000	100 (104)	100 (143)	100 (104)	100 (143)				
		198.1	133.00	16.13	0.635	475.7	18.730	470.97	18.542	195.62	131.33	15.94	35.10	10.3	1 500	211	3 060	211	3 060	965 000	2 125 000	100 (104)	100 (142)	100 (104)	100 (142)	913 000	2 012 000	913 000	2 012 000
														10.3	1 500	211	3 060	211	3 060	965 000	2 125 000	100 (104)	100 (151)	100 (104)	100 (151)	964 000	2 123 000	964 000	2 123 000

TABLE 23 — Buttress thread casing — Dimensions and masses of couplings

Dimensions in millimetres



1		2		3		4		5		6		7		8	
Nominal size ¹⁾		Outside diameter				Length <i>N_L</i>		Diameter of recess <i>Q</i>		Width of bearing face <i>b</i>		Mass			
		Normal <i>W</i> ²⁾		Special clearance <i>W_C</i> ³⁾								Normal		Special clearance	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb	kg	lb
114,3	4.500	127	5.000	123,8	4.87	225,4	8.87	117,9	4.64	3,2	0.12	4,59	10.11	3,48	7.67
127	5.000	141,3	5.563	136,5	5.37	231,8	9.12	130,6	5.14	4,0	0.15	5,90	12.99	4,00	8.81
139,7	5.500	153,7	6.050	149,2	5.87	235,0	9.25	143,3	5.64	4,0	0.15	6,42	14.14	4,47	9.84
168,3	6.625	187,7	7.391	177,8	7.00	244,5	9.62	171,8	6.76	6,4	0.25	11,10	24.46	5,65	12.44
177,8	7.000	194,5	7.650	187,3	7.37	254,0	10.00	181,4	7.14	5,6	0.21	10,54	23.22	6,27	13.82
193,7	7.625	215,9	8.500	206,4	8.12	263,5	10.37	197,2	7.76	7,9	0.31	15,82	34.84	9,28	20.45
219,1	8.625	244,5	9.625	231,8	9.12	269,9	10.62	222,6	8.76	9,5	0.37	20,86	45.94	10,79	23.77
244,5	9.625	269,9	10.625	257,2	10.12	269,9	10.62	248,0	9.76	9,5	0.37	23,15	50.99	12,02	26.47
273	10.750	298,5	11.750	285,8	11.25	269,9	10.62	276,6	10.89	9,5	0.37	25,73	56.68	13,39	29.49
298,5	11.750	323,9	12.750	.....	.....	269,9	10.62	302,0	11.89	9,5	0.37	28,03	61.74	.....	.....
339,7	13.375	365,1	14.375	.....	.....	269,9	10.62	343,3	13.51	9,5	0.37	31,76	69.95	.....	.....
406,4	16.000	431,8	17.000	.....	.....	269,9	10.62	410,3	16.15	9,5	0.37	39,75	87.56	.....	.....
473,1	18.625	508	20.000	.....	.....	269,9	10.62	477,0	18.78	9,5	0.37	62,67	138.05	.....	.....
508	20.000	533,4	21.000	.....	.....	269,9	10.62	511,9	20.15	9,5	0.37	50,10	110.34	.....	.....

1) The nominal size of the coupling is equal to the corresponding outside pipe diameter D .2) Tolerance on outside diameter $W \pm 1\%$, but not greater than $\pm 3,18$ mm ($1/8$ in).3) Tolerance on outside diameter W_c is $+0,8$ mm ($+1/32$ in), $-0,4$ mm ($-1/64$ in).

TABLE 24 — "Extreme-Line" casing — Dimensions and characteristics

Outside diameter	Mass per unit length		Wall thickness		Inside diameter		Drift diameter		Mass				Grade of steel		Pressure		Load corresponding to pipe body proof stress		Joint strength		Joint efficiency	
	kg/m	lb/ft	mm	in	mm	in	mm	in	W _{pe}	Plain end		E _w	Upset and threads		Collapse	Internal yield (87.5 % E)	daN	lbf	Normal		Special	
										kg/m	lb/ft		Normal	Special					daN	lbf	daN	lbf
127	22,3	15,00	7,5	0.296	112,0	4.408	105,4	4.151	22,2	14,87	2,1	4.60			38,3	5 550	393	5 700	149 000	328 000	149 000	328 000
															38,3	5 550	393	5 700	189 000	416 000	189 000	416 000
															48,1	6 970	536	7 770	189 000	416 000	189 000	416 000
															50,0	7 250	572	8 290	198 000	437 000	198 000	437 000
															55,8	8 090	678	9 840	208 000	459 000	208 000	459 000
															60,9	8 630	786	11 400	248 000	547 000	248 000	547 000
															69,0	10 000	655	9 500	202 000	446 000	202 000	446 000
															72,3	10 490	699	10 140	213 000	469 000	213 000	469 000
															63,0	12 040	830	12 040	223 000	492 000	223 000	492 000
															92,7	13 450	961	13 940	266 000	587 000	266 000	587 000
139,7	23,1	15,50	7,0	0.225	125,7	4.950	118,2	4.653	22,86	15,35	2,6	5.80	1,9	4.20	27,9	4 040	332	4 810	154 000	339 000	154 000	339 000
															27,9	4 040	332	4 810	195 000	429 000	195 000	429 000
															33,9	4 910	367	5 320	169 000	372 000	169 000	372 000
															33,9	4 910	367	5 320	214 000	471 000	214 000	471 000
															41,9	6 070	500	7 258	214 000	471 000	214 000	471 000
	25,3	17,00	7,7	0.304	124,3	4.892	118,2	4.653	25,1	16,87	2,2	4.80	1,5	3.20	43,3	6 280	534	7 740	225 000	496 000	225 000	496 000
															47,8	6 930	634	9 190	236 000	521 000	236 000	521 000
															51,4	7 460	734	10 640	281 000	620 000	281 000	620 000
															58,2	8 440	594	8 610	226 000	497 000	217 000	479 000
															60,9	8 830	634	9 190	229 000	504 000	229 000	504 000
	29,8	20,00	9,2	0.361	121,4	4.778	118,2	4.653	29,5	19,81	0,6	1.40	0,1	-0.20	69,0	10 000	753	10 915	250 000	550 000	241 000	530 000
															76,4	11 080	872	12 640	297 000	654 000	286 000	630 000
															72,1	10 460	683	9 900	249 000	549 000	217 000	479 000
															76,9	11 160	728	10 560	262 000	577 000	229 000	504 000
															89,1	12 920	885	12 540	275 000	606 000	241 000	530 000
	34,2	23,00	10,5	0.415	118,7	4.670	115,4	4.545	33,6	22,54	0	0	-0,7	-1.60	100,1	14 520	1 001	14 520	328 000	722 000	286 000	630 000