INTERNATIONAL STANDARD

ISO 11960

First edition
1996-07-01

Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells

Industries du pétrole et du gaz naturel — Tubes en acier utilisés comme tubes de cuvelage ou tubes de production dans les puits

Reference number
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Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 11960 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*, Subcommittee SC 5, *Casing, tubing and drill pipe*.

This first edition cancels and replaces ISO 2645:1975, which has been technically revised.

Annexes A, B and C form an integral part of this International Standard. Annex D is for information only.

Introduction

This International Standard includes requirements of various nature. These are identified by the use of certain words or phrases.

— **Shall** is used to indicate that a provision is mandatory.

— **Should** is used to indicate that a provision is not mandatory, but recommended as good practice.

— **May** is used to indicate that a provision is optional.

In addition, in certain cases, this International Standard offers **Alternative requirements**. These offer different options, either:

— **At purchaser's discretion** in which case such option shall be mentioned on the purchase order. These cases are recognized by the use of the words or phrases such as **alternative** or **at purchaser's discretion**.

— **At manufacturer's discretion** in which case such option shall be notified to the purchaser. Such cases are identified by the use of the phrase **at manufacturer's discretion.**

— **By agreement between purchaser and manufacturer**. Such cases are recognized by the use of the phrase **by agreement between interested parties.**

This International Standard, when this phrase is used, intends to

either

waive the application of a requirement (either mandatory or recommended) and leave it to both purchaser and manufacturer to use the requirement or not;

or

offer one (or several) alternative requirement(s), the selection of which is left to both purchaser and manufacturer.

Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells

1 Scope

1.1 This International Standard specifies the technical delivery conditions for steel pipes (casing, tubing and liners), pup-joints and connectors.

This International Standard is applicable to the following connections in accordance with ISO 10422:

— short, round-thread casing;

— long, round-thread casing;

— buttress-thread casing;

— extreme-line casing;

— non-upset tubing;

— external-upset tubing;

— integral-joint tubing.

The applicable types of end finishing for each size are described in annex A (tables A.1 to A.3).

For such connections, this International Standard specifies the technical delivery conditions for couplings and thread protection.

Threading requirements are not considered in this International Standard. Dimensional requirements on threads and thread gauges, stipulations on gauging practice, gauge specifications, as well as instruments and methods for inspection of threads are given in ISO 10422.

This International Standard may also be used for tubulars with connections not covered by ISO standards.

1.2 The products described by this International Standard are gathered in four groups as follows.

— Group 1: all casing and tubing in grades H, J, K and N.

— Group 2: all casing and tubing in restricted yield strength grades C, L and T.

— Group 3: all seamless casing and tubing and 139,70 mm and larger electric-welded (EW) casing in high strength grade P.

— Group 4: all special service casing in grade Q.

1.3 Supplementary requirements, that may be agreed between interested parties, for non-destructive inspection, coupling blanks, upset casing, electric-welded casing, impact testing, seal-ring couplings and certificates are specified in annex B.

2 Normative references

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

ISO 31-0:1992, *Quantities and units — Part 0: General principles.*

ISO 643:1983, *Steels — Micrographic determination of the ferritic or austenitic grain size.*

ISO 6506:1981, *Metallic materials — Hardness test — Brinell test.*

ISO 6508:1986, *Metallic materials — Hardness test — Rockwell test (scales A - B - C - D - E - F - G - H - K).*

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

ISO 7500-1:1986, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tensile testing machines.*

ISO 10422:1993, *Petroleum and natural gas industries — Threading, gauging, and thread inspection of casing, tubing and line pipe threads — Specification.*

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

API Bul 5A2:1988, *Bulletin on Thread Compounds for Casing, Tubing and Line Pipe.*

API Bul 5C2:1987, *Bulletin on Performance Properties of Casing, Tubing and Drill Pipe.*

ASTM A370-92, *Test Methods and Definitions for Mechanical Testing of Steel Products.*

ASTM A919-84 (1993), *Terminology relating to Heat Treatment of Metals.*

ASTM E23-94a, *Test Methods for Notched Bar Impact Testing of Metallic Materials.*

ASTM E83-94, *Practice for Verification and Classification of Extensometers.*

ASTM E165-94, *Practice for Liquid Penetrant Inspection.*

ASTM E213-93, *Practice for Ultrasonic Inspection of Metal Pipe and Tubing.*

ASTM E273-93, *Practice for Ultrasonic Examination of Longitudinal Welded Pipe and Tubing.*

ASTM E309-93a, *Practice for Eddy-Current Examination of Steel Tubular Products Using Magnetic Saturation.*

ASTM E570-91, *Practice for Flux Leakage Examination of Ferromagnetic Steel Tubular Products.*

ASTM E709-95, *Practice for Magnetic Particle Examination.*

NACE TM-01-77:1986, *Testing of Metals for Resistance to Sulfide Stress Cracking at Ambient Temperature.*

ASNT-TC-1A:1984, *Recommended Practice for Certification of NDT Personnel.*

3 Definitions

For all terms related to heat treatment operations, the definitions in ASTM A919 apply.

For the purposes of this International Standard, the following definitions apply.

3.1 product: Pipe, coupling, connector, coupling stock and coupling blank, either individually or collectively as applicable.

3.2 connection: Threaded assembly of tubular components.

3.3 pipe: Casing, tubing, plain-end casing liners, pup-joints and connectors, individually or as a group, as applicable.

3.4 coupling: Internally threaded cylinder for joining two lengths of threaded pipe.

3.5 connector: One-piece tubular section not including pipe or couplings, used for the purpose of joining or changing from one size, mass or type of thread connection to the same or another size, mass or type of threaded connection.

3.6 coupling stock: Tubular component used for the manufacture of coupling blanks.

3.7 coupling blank: Material used to produce an individual coupling.

NOTE 1 Coupling blanks may be obtained from coupling stock, forgings or centrifugal castings.

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

3.9 tubing: A pipe placed within a well to produce well fluids or to inject fluids.

3.10 plain-end casing liner: Casing provided unthreaded with a wall thickness often greater than that specified for J55.

3.11 pup-joint: Length of casing, tubing or plain-end casing liner shorter than Range 1.

3.12 seamless pipe: A wrought steel tubular product made without a welded seam, manufactured by hot working steel and, if necessary, by subsequently cold finishing the hot-worked tubular product to produce the desired shape, dimensions and properties.

3.13 electric-welded pipe: Pipe having one longitudinal seam formed by electric-resistance or electric-induction welding, without the addition of filler metal, wherein the edges to be welded are mechanically pressed together and the heat for welding is generated by the resistance to flow of electric current.

3.14 thread protector: Cap or insert used to protect threads and seals during handling, transportation and storage.

3.15 special processes: Final operations which are performed during pipe manufacturing that affect product attributes, except chemistry and dimensions.

NOTE 2 The special processes are:

Manufacturing condition	Special processes
Seamless:	
as-rolled	Final reheating practice and hot sizing or stretch reducing. If applicable, upsetting, cold finishing.
heat treated	Heat treatment
Electric welded:	
as-rolled	Sizing and seam welding. If applicable, seam heat treatment and upsetting.
heat treated	Seam welding and full body heat treatment

3.16 interested parties: The manufacturer and the purchaser of the products.

4 Information to be supplied by the purchaser

4.1 Casing

4.1.1 In placing orders for pipe to be manufactured in accordance with this International Standard, the purchaser shall specify the following on the purchase order.

Stipulation	Section
International Standard ISO 11960	—
Quantity	—
Type of pipe or couplings:	
Casing	
Threaded or plain-end	7.11
Type of connection — round (short or long), buttress, extreme-line threads, or other connection	table A.1, 7.11
With or without couplings	7.11
Special clearance couplings	tables 27, 28, A.1, 8.7
Liners	table A.2, 7.11
Size designation or outside diameter	tables A.1, A.2
Nominal mass or wall thickness	tables A.1, A.2
Grade and type where applicable	tables A.1, A.2
Length range	7.5, table 24
Seamless or electric welded	5.1, table 1
Material certification	12.1, SR15
Delivery date and shipping instructions	—
Inspection by purchaser	annex C

4.1.2 The purchaser should also state on the purchase order his requirements concerning the following stipulations, which are optional with the purchaser.

Stipulation	Section
Heat treatment	5.2
Heat and supplementary analyses	9.2
Casing jointers	7.6
Casing with couplings detached	7.12
Alternate drifting requirements	7.9
Coupling make-up (other than power-tight)	7.12
Pipe coatings	11.1
Seal-ring couplings	8.10, SR13.1, SR13.2
Coupling blanks	8.1, SR9
Statistical impact testing — Q125 grade	6.2.3.6, SR12
Additional markings	clause 10

4.1.3 The following stipulations are subject to agreement between interested parties.

Stipulation	Section
Hydrostatic pressure test for handling-tight make-up, connectors and group 4 pup-joints	9.4
Alternate hydrostatic test pressures	9.4
Thread and storage compound	7.12
Thread protectors	11.2
Marking requirements	10.1
Non-destructive inspection	9.7, SR1, SR2 and SR11
Alternate chemical analysis procedures — Q125 grade	9.2
Reduced section tensile specimens — Q125 grade	9.3.3
Alternate F factor in SR12 — Q125 grade	SR12.2
Cold rotary straightening — Q125 grade	5.3

Coupling blanks — Q125 grade only	SR9
Upset casing — Q125 grade only	SR10
Electric-welded casing — P110 and Q125 grade	SR11
Supplementary Coupling thread plating — Q125 grade only Sulfide stress cracking test — C90 and T95 grade Additional hardness testing — C90 and T95 grade	 8.16 6.2.13 9.3.2.3
Quality assurance requirements (e.g. one of the ISO 9000 series)	—

4.2 Tubing

4.2.1 In placing orders for pipe to be manufactured in accordance with this International Standard, the purchaser shall specify the following on the purchase order.

Stipulation	Section
International Standard ISO 11960	—
Quantity	—
Type of pipe or couplings:	
Tubing	
Non-upset, external-upset or integral-joint	table A.3
Threaded, plain-end, or special end	7.11
With or without couplings	7.11
Special bevel couplings	tables A.3 and 30, 8.11
Special clearance couplings	tables A.3, 29, 30, 8.7
Size designation or outside diameter	table A.3
Nominal mass or wall thickness	table A.3
Grade	table A.3
Length range	7.5, table 24
Seamless or electric welded	5.1, table 1
Material certification	12.1, SR15
Delivery date and shipping instructions	—
Inspection by purchaser	annex C

4.2.2 The purchaser should also state on the purchase order his requirements concerning the following stipulations, which are optional with the purchaser.

Stipulation	Section
Heat treatment	5.2
Heat and supplementary analyses	9.2
Coupling make-up (other than power-tight)	7.12
Pipe coatings	11.1
Seal-ring couplings	8.10, SR13.1, SR13.2
Tubing with couplings detached	7.12
Additional markings	clause 10

4.2.3 The following stipulations are subject to agreement between interested parties.

Stipulation	Section
Hydrostatic pressure test for handling-tight make-up and pup-joints	9.4
Alternate hydrostatic test pressures	9.4
Thread and storage compound	7.12
Thread protectors	11.2
Marking requirements	10.1
Non-destructive inspection	9.7, SR1, SR2 and SR11
Supplementary Sulfide stress cracking test — C90 and T95 grade Additional hardness testing — C90 and T95 grade	 6.2.13 9.3.2.3
Quality assurance requirements (e.g. one of the ISO 9000 series)	—

5 Process of manufacture

5.1 General

The various grades and groups of pipe furnished according to this International Standard shall be made to a fine grain practice. Steel made to a fine grain practice contains one or more grain refining elements, such as aluminium, niobium, vanadium or titanium in amounts intended to result in the steel having a fine austenitic grain size.

Pipe furnished according to this International Standard shall be made by the seamless or electric weld process as shown in table 1 and as specified on the purchase order. Pup-joints and connectors may be made from standard casing or tubing or by machining heavy wall casing, tubing or bar stock. Couplings shall be manufactured by one of the processes listed in 8.2. Cold-drawn tubular products without appropriate heat treatment are not acceptable.

5.2 Heat treatment

5.2.1 General

Product shall be heat treated in accordance with a documented procedure as stipulated in table 1 for the particular grade and type specified on the purchase order. Heat-treated upset pipe shall be heat treated the full length after upsetting. Pipe and coupling stock requiring heat treatment shall be heat treated the full length. Individually heat-treated coupling blanks are acceptable. All pipe processed through a hot stretch mill (i.e., stretch reduced) shall be considered normalized, provided the exit temperature be above the upper critical temperature (Ar_3) for the steel being processed, and the pipe be air cooled.

The weld seam of electric-welded pipe shall be heat treated after welding to a minimum temperature of 538 °C or processed in such a manner that no untempered martensite remains.

NOTE 3 Ar_3 refers to the critical temperature for the austenite-to-ferrite transformation on cooling.

5.2.2 Group 1

Grade N80 pipe and coupling stock shall be normalized or, at the manufacturer's discretion, shall be normalized and tempered. Grade N80Q pipe and coupling stock shall be quenched and tempered (including the interrupted quenching followed by controlled cooling method) the full length. Grade J55 and K55 casing and grade J55 tubing shall be heat treated if so specified on the purchase order.

NOTES

4 Interrupted quenching is quenching in which the pipe being quenched is removed from the quenching medium while the pipe is at a temperature substantially higher than that of the quenching medium.

5 Controlled cooling is cooling from an elevated temperature in a predetermined manner to avoid hardening, cracking or internal damage to produce a desired microstructure or mechanical properties.

Table 1 — Process of manufacture and heat treatment

Group	Grade	Type	Manufacturing process[1]	Heat treatment	Tempering temperature min. °C
1	H40	—	S or EW	none	—
	J55	—	S or EW	none [2]	—
	K55	—	S or EW	none [2]	—
	N80	—	S or EW	[3]	—
	N80	Q	S or EW	Q and T	—
2	L80[4]	1	S or EW	Q and T	566
	L80	9Cr	S	Q and T[5]	593
	L80	13Cr	S	Q and T[5]	593
	C90	1	S	Q and T	621
	C90	2	S	Q and T	621
	C95	—	S or EW	Q and T	538
	T95	1	S	Q and T	649
	T95	2	S	Q and T	649
3	P110	—	S or EW[6, 7]	Q and T	—
4	Q125	1	S or EW[7]	Q and T	—
	Q125	2	S or EW[7]	Q and T	—
	Q125	3	S or EW[7]	Q and T	—
	Q125	4	S or EW[7]	Q and T	—

1) S = seamless process; EW = electric welded process.

2) Full-length normalized, normalized and tempered (N and T), or quenched and tempered (Q and T), at the manufacturer's discretion or if so specified on the purchaser order.

3) Full-length normalized or normalized and tempered at the manufacturer's discretion.

4) The manufacturer shall use a process that is documented to yield not less than 50 % martensite.

5) Type 9Cr and 13Cr may be air quenched.

6) Special chemical requirements for electric-welded P110 casing are specified in table 2.

7) Special requirements unique to electric-welded P110 and Q125 casing are specified in annex B (SR11). When electric-welded P110 and Q125 casing is furnished, the provisions of SR11 are automatically in effect.

5.2.3 Group 2

When requested by the purchaser, the manufacturer shall produce evidence to show that the tempering practice will result in the pipe attaining the minimum tempering temperature.

5.2.4 Groups 3 and 4

Pipe and couplings furnished to this International Standard shall be quenched and tempered.

5.3 Straightening

5.3.1 Groups 1 and 3

No specific methods are required.

5.3.2 Group 2

Grade L80 shall not be subjected to cold working after the final tempering treatment, except for that which is incidental to normal straightening operations. Grade C90 and T95 pipe may be subjected to cold rotary straightening if, subsequent to the cold rotary straightening operation, the pipe is heated to a minimum temperature of 482 °C for stress relieving. When necessary, light gag straightening for grade C90 and T95 shall be permitted. Grade C95 pipe shall be subjected to no tensile or expansion cold working, except for that which is incidental to normal straightening operations, and to no more than 3 % compressive cold working, after the final tempering operation.

5.3.3 Group 4

Gag press straightening or hot rotary straightening (417 °C minimum at end of rotary straightening unless otherwise specified on purchase order) is acceptable. If hot rotary straightening is not possible, the pipe may be cold rotary straightened provided it is then stress relieved at 510 °C or higher. Pipe may be cold rotary straightened without subsequent stress relieving only by agreement between interested parties.

5.4 Traceability

5.4.1 General

The manufacturer shall establish and follow procedures for maintaining heat and/or lot identity until all required heat and/or lot tests are performed and conformance with specification requirements has been shown.

5.4.2 Serialization of group 2 (grades C90 and T95) and group 4

The serial number shall be marked on products as specified below. It is the responsibility of the manufacturer to maintain the identification of material until it is received by the purchaser.

5.4.2.1 Pipe — Group 2 (grades C90 and T95 only) and group 4

Each length of pipe shall be uniquely numbered so that test data may be related to individual lengths.

5.4.2.2 Pipe — Group 4 manufactured to SR12

In addition to the requirements in 5.4.2.1, when SR12 is specified, the number shall identify the sequence in which the lengths were tempered in order to allow retest per SR12.3.

5.4.2.3 Coupling, pup-joint and connector material

Each tube length of coupling, pup-joint or connector material shall be uniquely numbered so that test data may be related to individual lengths. When couplings, coupling blanks, or pup-joint and connector material are cut from material that has been treated full length, the pieces shall be marked with the serial number of the full length piece. When coupling, pup-joint, or connector material is heat treated in coupling blank or individual lengths, each heat treat lot (see 9.3.1.2.2) shall be uniquely numbered. Additionally, when coupling, pup-joint or connector material in coupling blank or individual lengths is heat treated on a unit in a continuous process run, the pieces within the lot shall be sequentially numbered in the order in which they are heat treated.

6 Material requirements

6.1 Chemical requirements

Pipe and couplings shall conform to the chemical requirements specified in table 2 for the grade and type specified.

6.2 Mechanical properties requirements

6.2.1 Tensile properties

6.2.1.1 Pipe and couplings shall conform to the tensile requirements specified in table 3.

When elongation is recorded or reported, the record or report shall show the nominal width of the test specimen when strip specimens are used, the diameter and gauge length when round bar specimens are used, or state when full section specimens are used.

The tensile properties, except elongation of the upset ends of upset casing and tubing, shall comply with the requirements given for the pipe body. In case of dispute, the properties (except elongation) of the upset shall be determined from a tensile test specimen cut from the upset. A record of such tests shall be made available to the purchaser.

6.2.1.2 The minimum elongation, for all groups, over 50,8 mm (gauge length of the tensile specimen) shall be that determined by the following formula:

$$e = 1\,944\,\frac{A^{0,2}}{U^{0,9}}$$

where

e is the minimum elongation over 50,8 mm, in percent rounded to the nearest 0,5 %;

A is the cross-sectional area of the tensile test specimen, in square millimetres, based on specified outside diameter or nominal specimen width and specified wall thickness rounded to the nearest 10 mm^2, or 490 mm^2, whichever is smaller;

U is the specified tensile strength, in newtons per square millimetre.

The minimum elongations for both round bar tensile specimens (the 8,9 mm diameter with 35,6 mm gauge length, and the 12,7 mm diameter with 50,8 mm length) shall be determined with an area A of 130 mm^2.

6.2.2 Yield strength

The yield strength shall be the tensile stress required to produce the following extension under load as determined by an extensometer.

Total extension under load of gauge length:

Grade	
H40	0,5 %
J55	0,5 %
K55	0,5 %
L80	0,5 %
N80	0,5 %
C90	0,5 %
C95, T95	0,5 %
P110	0,6 %
Q125	0,65 %

Table 2 — Chemical requirements %(*m/m*)

Group	Grade	Type	C		Mn		Mo		Cr		Ni	Cu	P	S	Si
			min.	max.	min.	max.	min.	max.	min.	max.	max.	max.	max.	max.	max.
1	H40	—	—	—	—	—	—	—	—	—	—	—	0,030	0,030	—
	J55	—	—	—	—	—	—	—	—	—	—	—	0,030	0,030	—
	K55	—	—	—	—	—	—	—	—	—	—	—	0,030	0,030	—
	N80	—	—	—	—	—	—	—	—	—	—	—	0,030	0,030	—
	N80	Q	—	—	—	—	—	—	—	—	—	—	0,030	0,030	—
2	L80	1	—	0,43[1]	—	1,90	—	—	—		0,25	0,35	0,030	0,030	0,45
	L80	9Cr	—	0,15	0,30	0,60	0,90	1,10	8,00	10,00	0,50	0,25	0,020	0,010	1,00
	L80	13Cr	0,15	0,22	0,25	1,00	—	—	12,00	14,00	0,50	0,25	0,020	0,010	1,00
	C90	1	—	0,35	—	1,00	0,25[2]	0,75	—	1,20	0,99	—	0,020	0,010	—
	C90	2	—	0,50	—	1,90	—	NL	—	NL	0,99	—	0,030	0,010	—
	C95	—	—	0,45[3]	—	1,90	—	—	—	—	—	—	0,030	0,030	0,45
	T95	1	—	0,35	—	1,20	0,25[4]	0,85	0,40	1,50	0,99	—	0,020	0,010	—
	T95	2	—	0,50	—	1,90	—	—	—	—	0,99	—	0,030	0,010	—
3	P110	S	—	—	—	—	—	—	—	—	—	—	0,030	0,030	—
	P110	EW	—	—	—	—	—	—	—	—	—	—	0,020	0,010	—
4	Q125	1	—	0,35	—	1,00	—	0,75	—	1,20	0,99	—	0,020	0,010	—
	Q125	2	—	0,35	—	1,00	—	N.L.	—	N.L.	0,99	—	0,020	0,020	—
	Q125	3	—	0,50	—	1,90	—	N.L.	—	N.L.	0,99	—	0,030	0,010	—
	Q125	4	—	0,50	—	1,90	—	N.L.	—	N.L.	0,99	—	0,030	0,020	—

NOTE — N.L. = No limit — elements shown shall be reported in product analysis.

1) The carbon content for L80 type 1 may be increased to 0,50 % maximum if the product is oil quenched.

2) The molybdenum content for grade C90 type 1 has no minimum tolerance if the wall thickness is less than 17,78 mm.

3) The carbon content for C95 may be increased to 0,55 % maximum if the product is oil quenched.

4) The molybdenum content for grade T95 type 1 may be decreased to 0,15 % minimum if the wall thickness is less than 17,78 mm.

Table 3 — Tensile and hardness requirements

Group	Grade	Type	Yield strength		Tensile strength	Hardness[1]		Specified wall thickness	Allowable hardness variation
			min.	max.	min.	max.			
			N/mm²	N/mm²	N/mm²	HRC	HBS	mm	HRC
1	H40	—	276	552	414	—	—	—	—
	J55	—	379	552	517	—	—	—	—
	K55	—	379	552	655	—	—	—	—
	N80	—	552	758	689	—	—	—	—
	N80	Q	552	758	689	—	—	—	—
2	L80	1	552	655	655	23	241	—	—
	L80	9Cr	552	655	655	23	241	—	—
	L80	13Cr	552	655	655	23	241	—	—
	C90	1,2	621	724	689	25,4	255	12,70 or less	3,0
	C90	1,2	621	724	689	25,4	255	12,71 to 19,04	4,0
	C90	1,2	621	724	689	25,4	255	19,05 to 25,39	5,0
	C90	1,2	621	724	689	25,4	255	25,40 and above	6,0
	C95	—	655	758	724	—	—	—	—
	T95	1,2	655	758	724	25,4	255	12,70 or less	3,0
	T95	1,2	655	758	724	25,4	255	12,71 to 19,04	4,0
	T95	1,2	655	758	724	25,4	255	19,05 to 25,39	5,0
	T95	1,2	655	758	724	25,4	255	25,40 and above	6,0
3	P110	—	758	965	862	—	—	—	—
4	Q125	—	862	1 034	931	—	—	12,70 or less	3,0
	Q125	—	862	1 034	931	—	—	12,71 to 19,04	4,0
	Q125	—	862	1 034	931	—	—	19,05 and above	5,0

1) In case of dispute, laboratory Rockwell C hardness tests shall be used as the referee method.

6.2.3 Charpy V notch — General requirements (all groups)

A test shall consist of three specimens from a single tubular product length. The average value of the three impact specimens shall equal or exceed the absorbed energy requirement specified in 6.2.4 and 6.2.5. In addition, not more than one impact specimen shall exhibit an absorbed energy below the absorbed energy requirement, and in no case shall an individual impact specimen exhibit an absorbed energy below two-thirds of the absorbed energy requirement.

6.2.3.1 Critical thickness

The absorbed energy requirements are based on the critical thickness. The critical thickness for ISO couplings is defined as the thickness at the root of the thread at the middle of the coupling based on the specified coupling diameter and the specified thread dimensions. The critical thickness for all couplings is provided in table 4. For pipe, the critical thickness is the specified wall thickness. For other applications, the critical thickness and absorbed energy requirements shall be specified on the purchase order.

6.2.3.2 Specimen size

When full size (10 mm × 10 mm) transverse test specimens are not possible, the largest possible subsize transverse test specimen listed in table 5 shall be used. When it is not possible (or allowed as in 6.2.3.5) to test using any of these transverse test specimens, the largest possible longitudinal test specimen listed in table 5 shall be used.

When outside diameter or wall thickness precludes machining longitudinal impact test specimens 1/2 size or larger, the pipe need not be tested; however, the manufacturer shall use a chemical composition and processing that is documented and demonstrated to result in impact energy absorption in excess of the minimum specified requirement.

Table 4 — Critical thickness for couplings

Dimensions in millimetres

Pipe diameter, D	Critical thickness for couplings						
	NUE	EUE	EUE[1)]	BTC[1)]	BTC	LTC	STC
26,67	4,29	5,36	—	—	—	—	—
33,40	5,36	6,55	—	—	—	—	—
42,16	6,08	6,10	—	—	—	—	—
48,26	4,98	6,38	—	—	—	—	—
60,33	7,72	7,62	5,68	—	—	—	—
73,03	9,66	9,10	6,46	—	—	—	—
88,90	11,44	11,53	7,47	—	—	—	—
101,60	11,53	11,63	—	—	—	—	—
114,30	11,05	12,53	—	6,59	8,17	8,85	8,56
127,00	—	—	—	6,76	9,15	9,95	9,46
139,70	—	—	—	6,81	9,04	9,89	9,39
168,28	—	—	—	6,96	11,92	12,91	12,32
177,80	—	—	—	7,11	10,67	11,63	10,93
193,70	—	—	—	8,85	13,61	14,56	13,86
219,10	—	—	—	8,95	15,30	16,44	15,55
244,50	—	—	—	8,95	15,30	16,69	15,60
273,10	—	—	—	8,95	15,30	—	15,70
298,50	—	—	—	—	15,30	—	15,70
339,70	—	—	—	—	15,30	—	15,70
406,40	—	—	—	—	16,93	—	16,05
473,10	—	—	—	—	21,70	—	20,81
508,00	—	—	—	—	16,93	17,09	16,10

NOTE — The coupling blank thickness is greater than indicated above, due to thread height and manufacturing allowance to avoid black crested threads.

1) Special clearance.

Table 5 — Acceptable size impact specimens and absorbed energy reduction factor

Test specimen size	Specimen dimensions mm	Reduction factor
Full size	10 × 10	1,00
3/4 size	10 × 7,5	0,80
1/2 size	10 × 5	0,55

6.2.3.3 Hierarchy of test specimens

The hierarchy of test specimen orientation and size is specified in table 6.

6.2.3.4 Alternative size impact test specimens

At the manufacturer's discretion alternative size impact test specimens, listed in table 5, may be used in lieu of the minimum size specified in the tables referenced in 6.2.4 and 6.2.5. However, the alternative test specimen selected shall be higher on the hierarchy table (table 6) than the specified size, and the absorbed energy requirement shall be adjusted consistent with the impact specimen orientation and size.

6.2.3.5 Subsize specimens

The minimum Charpy V notch absorbed energy requirement for subsize test specimens shall be those specified for a full size test specimen multiplied by the reduction factor in table 5; however, in no event shall a subsize test specimen be used if the reduced absorbed energy requirement is less than 11 J.

6.2.3.6 Group 4 statistical impact testing

By agreement between interested parties, the supplemental requirements for group 4 statistical impact testing in annex B (SR12) shall apply.

Table 6 — Hierarchy of test specimen orientation and size

	Choice	Orientation
1st	Transverse	full
2nd	Transverse	3/4
3rd	Transverse	1/2
4th	Longitudinal	full
5th	Longitudinal	3/4
6th	Longitudinal	1/2

6.2.4 Charpy V notch — absorbed energy requirements for coupling stock, coupling blanks, couplings with ISO threads and connectors with internal ISO threads; except integral-joint ISO tubing connections and extreme-line casing connections (all groups)

Coupling stocks suitable for more than one type of connection may be qualified by a test to demonstrate conformance to the most stringent requirements. The test specimen orientation and size shall be the highest possible listed in the hierarchy table 6 and the absorbed energy requirement shall equal or exceed the applicable requirements.

6.2.4.1 Group 1, H40 only

There is no requirement for minimum absorbed energy.

6.2.4.2 Group 1, grades J55 and K55 only

The minimum full size transverse absorbed energy requirement, KV, is 20 J. The minimum full size longitudinal absorbed energy requirement is 27 J. The impact specimen orientation, minimum size, minimum absorbed energy requirement, and test temperature reduction (as applicable) for couplings are provided in table 7.

6.2.4.3 Group 1, grade N80 only, groups 2, 3 and 4

The impact specimen orientation, minimum size, and minimum absorbed energy requirement for couplings are provided in tables 8 to 12 based on the following equations.

In these equations, the following is applicable:

S is the maximum specified yield strength for the grade evaluated, in newtons per square millimetre;

t_1 is the critical wall thickness, in millimetres, based on the specified dimensions for couplings.

a) **Transverse requirement.** The minimum full size transverse absorbed energy requirement shall be as specified in table 13 for various critical wall thicknesses based on the following:

$$KV = S(0{,}00118t_1 + 0{,}01259)\ \text{J or 20 J, whichever is greater.}$$

b) **Longitudinal requirement.** The minimum full size absorbed energy requirement shall be as specified in table 14 for various critical wall thicknesses based on the following:

$$KV = S(0{,}00236t_1 + 0{,}02518)\ \text{J or 40 J, whichever is greater.}$$

6.2.5 Charpy V notch — Absorbed energy requirements for casing, pup-joints and externally threaded connector material, group 4

a) **Transverse requirement.** The minimum full size transverse absorbed energy requirement shall be as specified by the equation in 6.2.4.3 (see table 13). Table 15 provides the calculated wall thickness required to machine full size, 3/4 size and 1/2 size transverse impact test specimens. The impact test specimen size that shall be selected from table 15 is the largest impact test specimen having a calculated wall thickness that is less than the specified wall thickness for the pipe tested.

b) **Longitudinal requirement.** The minimum full size longitudinal absorbed energy requirement shall be as specified by the equation in 6.2.4.3 (see table 14). When the wall thickness does not permit machining full size longitudinal test specimens, the largest possible subsize longitudinal specimen specified in table 16 shall be used. Table 16 is construed and used in the same way as table 15.

6.2.6 Charpy V notch — Absorbed energy requirements for pipe, groups 1, 2 and 3

By agreement between interested parties, the provisions of annex B (SR16) shall apply.

Table 7 — Charpy impact test specimen requirements for couplings: Group 1, grades J55 and K55

Pipe diameter, D mm	Charpy specimen orientation — Size — Impact energy — Temperature reduction						
	NUE	EUE	EUE[1]	BTC[1]	BTC	LTC	STC
26,67	[2]	L-5-15-A	—	—	—	—	—
33,40	L-5-15-A	L-7-22-A	—	—	—	—	—
42,16	L-5-15-B	L-5-15-B	—	—	—	—	—
48,26	L-5-15-A	L-7-22-B	—	—	—	—	—
60,33	L-7-22-A	L-7-22-A	L-7-22-A	—	—	—	—
73,03	L-10-27-A	L-10-27-A	L-10-27-A	—	—	—	—
88,90	T-5-11-E	T-5-11-E	T-5-11-D	—	—	—	—
101,60	T-7-16-B	T-7-16-B	—	—	—	—	—
114,30	T-7-16-B	T-7-16-B	—	L-7-22-A	L-7-22-A	L-10-27-A	L-10-27-A
127,00	—	—	—	T-5-11-C	T-5-11-D	T-5-11-D	T-5-11-D
139,70	—	—	—	T-5-11-C	T-5-11-D	T-5-11-D	T-5-11-D
168,28	—	—	—	T-10-20-A	T-10-20-A	T-10-20-A	T-10-20-A
177,80	—	—	—	T-7-16-A	T-7-16-A	T-10-20-A	T-7-16-B
193,70	—	—	—	T-10-20-A	T-10-20-A	T-10-20-A	T-10-20-A
219,10	—	—	—	T-10-20-A	T-10-20-A	T-10-20-A	T-10-20-A
244,50	—	—	—	T-10-20-A	T-10-20-A	T-10-20-A	T-10-20-A
273,10	—	—	—	T-10-20-A	T-10-20-A	—	T-10-20-A
298,50	—	—	—	—	T-10-20-A	—	T-10-20-A
339,70	—	—	—	—	T-10-20-A	—	T-10-20-A
406,40	—	—	—	—	T-10-20-A	—	T-10-20-A
473,10	—	—	—	—	T-10-20-A	—	T-10-20-A
508,00	—	—	—	—	T-10-20-A	T-10-20-A	T-10-20-A

NOTE — In the above table, the specimen orientation (T or L) is followed by the minimum specimen size (10, 7 or 5) which is followed by the minimum absorbed energy requirement (J) and the temperature reduction in °C (A, B, C, D or E), according to the following code. Both the absorbed energy requirement and the test temperature reduction requirement are adjusted for the test specimen size indicated.

T = transverse specimen orientation (reference figure 11)
L = longitudinal specimen orientation (reference figure 11)

10 = full size (i.e. 10 mm × 10 mm)
7 = 3/4 size (i.e. 10 mm × 7,5 mm)
5 = 1/2 size (i.e. 10 mm × 5 mm)

A = no reduction
B = 3 °C
C = 6 °C
D = 8 °C
E = 11 °C

The above assumes that special clearance couplings are machined from standard couplings.

1) Special clearance.
2) Not thick enough to test.

Table 8 — Charpy impact test specimen requirements for couplings: Group 2, grade L80 only

Pipe diameter, D mm	Charpy specimen orientation — Size — Impact energy						
	NUE	EUE	EUE[1]	BTC[1]	BTC	LTC	STC
26,67	[2]	L-5-22	—	—	—	—	—
33,40	L-5-22	L-7-32	—	—	—	—	—
42,16	L-5-22	L-5-22	—	—	—	—	—
48,26	L-5-22	L-7-32	—	—	—	—	—
60,33	L-7-32	L-7-32	L-7-32	—	—	—	—
73,03	L-10-40	L-10-40	L-10-40	—	—	—	—
88,90	T-5-11	T-5-11	T-5-11	—	—	—	—
101,60	T-7-16	T-7-16	—	—	—	—	—
114,30	T-7-16	T-7-16	—	L-7-32	L-7-32	L-10-40	L-10-40
127,00	—	—	—	T-5-11	T-5-11	T-5-11	T-5-11
139,70	—	—	—	T-5-11	T-5-11	T-5-11	T-5-11
168,28	—	—	—	T-10-20	T-10-20	T-10-20	T-10-20
177,80	—	—	—	T-7-16	T-7-16	T-10-20	T-7-16
193,70	—	—	—	T-10-20	T-10-20	T-10-20	T-10-20
219,10	—	—	—	T-10-20	T-10-20	T-10-21	T-10-20
244,50	—	—	—	T-10-20	T-10-20	T-10-21	T-10-20
273,10	—	—	—	T-10-20	T-10-20	—	T-10-20
298,50	—	—	—	—	T-10-20	—	T-10-20
339,70	—	—	—	—	T-10-20	—	T-10-20
406,40	—	—	—	—	T-10-21	—	T-10-21
473,10	—	—	—	—	T-10-25	—	T-10-24
508,00	—	—	—	—	T-10-21	T-10-21	T-10-21

NOTE — In the above table, the specimen orientation (T or L) is followed by the minimum specimen size (10, 7 or 5) which is followed by the minimum absorbed energy requirement (J), consistent with the specimen size indicated, according to the following code:

T = transverse specimen orientation (reference figure 11)
L = longitudinal specimen orientation (reference figure 11)

10 = full size (i.e. 10 mm × 10 mm)
7 = 3/4 size (i.e. 10 mm × 7,5 mm)
5 = 1/2 size (i.e. 10 mm × 5 mm)

The above assumes that special clearance couplings are machined from standard couplings.

1) Special clearance.
2) Not thick enough to test.

Table 9 — Charpy impact test specimen requirements for couplings: Group 2, grade C90 only

Pipe diameter, D mm	Charpy specimen orientation — Size — Impact energy						
	NUE	EUE	EUE[1]	BTC[1]	BTC	LTC	STC
26,67	[2]	L-5-22	—	—	—	—	—
33,40	L-5-22	L-7-32	—	—	—	—	—
42,16	L-5-22	L-5-22	—	—	—	—	—
48,26	L-5-22	L-7-32	—	—	—	—	—
60,33	L-7-32	L-7-32	L-7-32	—	—	—	—
73,03	L-10-40	L-10-40	L-10-40	—	—	—	—
88,90	T-5-11	T-5-11	T-5-11	—	—	—	—
101,60	T-7-16	T-7-16	—	—	—	—	—
114,30	T-7-16	T-7-16	—	L-7-32	L-7-32	L-10-40	L-10-40
127,00	—	—	—	T-5-11	T-5-11	T-5-11	T-5-11
139,70	—	—	—	T-5-11	T-5-11	T-5-11	T-5-11
168,28	—	—	—	T-10-20	T-10-20	T-10-20	T-10-20
177,80	—	—	—	T-7-16	T-7-16	T-10-20	T-7-16
193,70	—	—	—	T-10-20	T-10-21	T-10-22	T-10-21
219,10	—	—	—	T-10-20	T-10-22	T-10-23	T-10-22
244,50	—	—	—	T-10-20	T-10-22	T-10-23	T-10-22
273,10	—	—	—	T-10-20	T-10-22	—	T-10-23
298,50	—	—	—	—	T-10-22	—	T-10-23
339,70	—	—	—	—	T-10-22	—	T-10-23
406,40	—	—	—	—	T-10-24	—	T-10-23
473,10	—	—	—	—	T-10-28	—	T-10-27
508,00	—	—	—	—	T-10-24	T-10-24	T-10-23

NOTE — In the above table, the specimen orientation (T or L) is followed by the minimum specimen size (10, 7 or 5) which is followed by the minimum absorbed energy requirement (J), consistent with the specimen size indicated, according to the following code:

T = transverse specimen orientation (reference figure 11)
L = longitudinal specimen orientation (reference figure 11)

10 = full size (i.e. 10 mm × 10 mm)
7 = 3/4 size (i.e. 10 mm × 7,5 mm)
5 = 1/2 size (i.e. 10 mm × 5 mm)

The above assumes that special clearance couplings are machined from standard couplings.

1) Special clearance.
2) Not thick enough to test.

Table 10 — Charpy impact test specimen requirements for couplings: Group 1, grade N80 and group 2, grades C95 and T95

Pipe diameter, D mm	Charpy specimen orientation — Size — Impact energy						
	NUE	EUE	EUE[1]	BTC[1]	BTC	LTC	STC
26,67	[2]	L-5-22	—	—	—	—	—
33,40	L-5-22	L-7-32	—	—	—	—	—
42,16	L-5-22	L-5-22	—	—	—	—	—
48,26	L-5-22	L-7-32	—	—	—	—	—
60,33	L-7-32	L-7-32	L-7-32	—	—	—	—
73,03	L-10-40	L-10-40	L-10-40	—	—	—	—
88,90	T-5-11	T-5-11	T-5-11	—	—	—	—
101,60	T-7-16	T-7-16	—	—	—	—	—
114,30	T-7-16	T-10-21	—	L-7-32	L-7-32	L-10-40	L-10-40
127,00	—	—	—	T-5-11	T-5-11	T-5-11	T-5-11
139,70	—	—	—	T-5-11	T-5-11	T-5-11	T-5-11
168,28	—	—	—	T-10-20	T-10-20	T-10-21	T-10-21
177,80	—	—	—	T-7-16	T-7-16	T-10-20	T-7-16
193,70	—	—	—	T-10-20	T-10-22	T-10-23	T-10-22
219,10	—	—	—	T-10-20	T-10-23	T-10-24	T-10-23
244,50	—	—	—	T-10-20	T-10-23	T-10-24	T-10-24
273,10	—	—	—	T-10-20	T-10-23	—	T-10-24
298,50	—	—	—	—	T-10-23	—	T-10-24
339,70	—	—	—	—	T-10-23	—	T-10-24
406,40	—	—	—	—	T-10-25	—	T-10-24
473,10	—	—	—	—	T-10-29	—	T-10-28
508,00	—	—	—	—	T-10-25	T-10-25	T-10-24

NOTE — In the above table, the specimen orientation (T or L) is followed by the minimum specimen size (10, 7 or 5) which is followed by the minimum absorbed energy requirement (J), consistent with the specimen size indicated, according to the following code:

T = transverse specimen orientation (reference figure 11)
L = longitudinal specimen orientation (reference figure 11)

10 = full size (i.e. 10 mm × 10 mm)
7 = 3/4 size (i.e. 10 mm × 7,5 mm)
5 = 1/2 size (i.e. 10 mm × 5 mm)

The above assumes that special clearance couplings are machined from standard couplings.

1) Special clearance.
2) Not thick enough to test.

Table 11 — Charpy impact test specimen requirements for couplings: Group 3, grade P110

Pipe diameter, D mm	Charpy specimen orientation — Size — Impact energy						
	NUE	EUE	EUE[1]	BTC[1]	BTC	LTC	STC
26,67	[2]	L-5-22	—	—	—	—	—
33,40	L-5-22	L-7-32	—	—	—	—	—
42,16	L-5-22	L-5-22	—	—	—	—	—
48,26	L-5-22	L-7-32	—	—	—	—	—
60,33	L-7-34	L-7-34	L-7-32	—	—	—	—
73,03	L-10-46	L-10-45	L-10-40	—	—	—	—
88,90	T-5-14	T-5-14	T-5-12	—	—	—	—
101,60	T-7-20	T-7-20	—	—	—	—	—
114,30	T-7-20	T-7-21	—	L-7-32	L-7-34	L-10-44	L-10-44
127,00	—	—	—	T-5-11	T-5-13	T-5-13	T-5-13
139,70	—	—	—	T-5-11	T-5-12	T-5-12	T-5-13
168,28	—	—	—	T-10-20	T-10-26	T-10-26	T-10-26
177,80	—	—	—	T-7-16	T-7-19	T-10-25	T-7-20
193,70	—	—	—	T-10-22	T-10-28	T-10-29	T-10-28
219,10	—	—	—	T-10-22	T-10-30	T-10-31	T-10-30
244,50	—	—	—	T-10-22	T-10-30	T-10-31	T-10-30
273,10	—	—	—	T-10-22	T-10-30	—	T-10-30
298,50	—	—	—	—	T-10-30	—	T-10-30
339,70	—	—	—	—	T-10-30	—	T-10-30
406,40	—	—	—	—	T-10-31	—	T-10-30
473,10	—	—	—	—	T-10-37	—	T-10-36
508,00	—	—	—	—	T-10-31	T-10-32	T-10-30

NOTE — In the above table, the specimen orientation (T or L) is followed by the minimum specimen size (10, 7 or 5) which is followed by the minimum absorbed energy requirement (J), consistent with the specimen size indicated, according to the following code:

T = transverse specimen orientation (reference figure 11)
L = longitudinal specimen orientation (reference figure 11)

10 = full size (i.e. 10 mm × 10 mm)
7 = 3/4 size (i.e. 10 mm × 7,5 mm)
5 = 1/2 size (i.e. 10 mm × 5 mm)

The above assumes that special clearance couplings are machined from standard couplings.

1) Special clearance.
2) Not thick enough to test.

Table 12 — Charpy impact test specimen requirements for couplings: Group 4, grade Q125

Pipe diameter, D mm	Charpy specimen orientation — Size — Impact energy			
	BTC[1)]	BTC	LTC	STC
114,30	L-7-34	L-7-37	L-10-48	L-10-48
127,00	T-5-12	T-5-13	T-5-14	T-5-14
139,70	T-5-12	T-5-13	T-5-14	T-5-14
168,28	T-10-22	T-10-28	T-10-29	T-10-28
177,80	T-7-18	T-7-21	T-10-27	T-7-21
193,70	T-10-24	T-10-30	T-10-31	T-10-30
219,10	T-10-24	T-10-32	T-10-33	T-10-32
244,50	T-10-24	T-10-32	T-10-33	T-10-32
273,10	T-10-24	T-10-32	—	T-10-32
298,50	—	T-10-32	—	T-10-32
339,70	—	T-10-32	—	T-10-32
406,40	—	T-10-34	—	T-10-33
473,10	—	T-10-40	—	T-10-38
508,00	—	T-10-34	T-10-34	T-10-33

NOTE — In the above table, the specimen orientation (T or L) is followed by the minimum specimen size (10, 7 or 5) which is followed by the minimum absorbed energy requirement (J), consistent with the specimen size indicated, according to the following code:

T = transverse specimen orientation (reference figure 11)
L = longitudinal specimen orientation (reference figure 11)

10 = full size (i.e. 10 mm × 10 mm)
7 = 3/4 size (i.e. 10 mm × 7,5 mm)
5 = 1/2 size (i.e. 10 mm × 5 mm)

The above assumes that special clearance couplings are machined from standard couplings.

1) Special clearance.

Table 13 — Transverse Charpy absorbed energy requirements

Maximum critical thickness for various grades mm					Minimum transverse absorbed energy J
L80	C90	N80 C95 T95	P110	Q125	
15,85	13,32	12,24	7,33	6,11	20
17,14	14,49	13,36	8,20	6,93	21
18,43	15,66	14,48	9,08	7,75	22
19,73	16,83	15,59	9,96	8,56	23
21,02	18,00	16,71	10,84	9,38	24
22,31	19,17	17,83	11,72	10,20	25
23,61	20,34	18,95	12,59	11,02	26
24,90	21,51	20,07	13,47	11,84	27
26,20	22,68	21,19	14,35	12,66	28
	23,85	22,30	15,23	13,48	29
	25,02	23,42	16,11	14,30	30
	26,19	24,54	16,98	15,11	31
		25,66	17,86	15,93	32
			18,74	16,75	33
			19,62	17,57	34
			20,50	18,39	35
			21,38	19,21	36
			22,25	20,03	37
			23,13	20,85	38
			24,01	21,66	39
			24,89	22,48	40
			25,77	23,30	41
				24,12	42
				24,94	43
				25,76	44

NOTE — Critical wall thicknesses greater than 21,69 mm (i.e. 473 mm BTC) are not applicable for ISO couplings and are provided for information only for special applications. The round-off procedures were followed in the preparation of this table.

Table 14 — Longitudinal Charpy absorbed energy requirements

Maximum critical thickness for various grades mm					Minimum longitudinal absorbed energy J
L80	C90	N80 C95 T95	P110	Q125	
15,52	13,03	11,96	7,11	5,90	40
16,17	13,61	12,52	7,54	6,31	41
16,82	14,20	13,08	7,98	6,72	42
17,46	14,78	13,64	8,42	7,13	43
18,11	15,37	14,20	8,86	7,54	44
18,76	15,95	14,76	9,30	7,95	45
19,40	16,54	15,32	9,74	8,36	46
20,05	17,12	15,87	10,18	8,77	47
20,70	17,71	16,43	10,62	9,18	48
21,34	18,29	16,99	11,06	9,59	49
21,99	18,88	17,55	11,50	10,00	50
22,64	19,46	18,11	11,94	10,41	51
23,29	20,05	18,67	12,37	10,82	52
23,93	20,63	19,23	12,81	11,22	53
24,58	21,22	19,79	13,25	11,63	54
25,23	21,80	20,35	13,69	12,04	55
25,87	22,39	20,91	14,13	12,45	56
	22,97	21,46	14,57	12,86	57
	23,56	22,02	15,01	13,27	58
	24,14	22,58	15,45	13,68	59
	24,73	23,14	15,89	14,09	60
	25,31	23,70	16,33	14,50	61
	25,90	24,26	16,77	14,91	62
		24,82	17,20	15,32	63
		25,38	17,64	15,73	64
		25,94	18,08	16,14	65
			18,52	16,55	66
			18,96	16,96	67
			19,40	17,37	68
			19,84	17,77	69
			20,28	18,18	70

NOTE — Critical wall thicknesses greater than 9,5 mm (i.e. 73 mm EUE) are not applicable for ISO couplings and are provided for information only for special applications. The round-off procedures were followed in the preparation of this table.

Table 15 — Transverse impact specimen size required for grade Q125 casing

Dimensions in millimetres

Pipe outside diameter	Calculated wall thickness required to machine transverse Charpy impact specimens		
	Full size	3/4 size	1/2 size
114,30	18,07	15,57	13,07
127,00	17,28	14,78	12,28
139,70	16,66	14,16	11,66
168,28	15,64	13,14	10,64
177,80	15,38	12,88	10,38
193,70	15,00	12,50	10,00
196,80	14,94	12,44	9,94
219,10	14,52	12,02	9,52
244,50	14,15	11,65	9,15
273,10	13,81	11,31	8,81
298,50	13,57	11,07	8,57
339,70	13,26	10,76	8,26
406,40	12,89	10,39	7,89
473,10	12,62	10,12	7,62
508,00	12,51	10,01	7,51

NOTE — The wall thicknesses that are in excess of the maximum ISO wall thicknesses are for information only. The above provides a 0,5 mm ID and a 0,5 mm OD machining allowance.

Table 16 — Longitudinal impact specimen size required for grade Q125 casing

Dimensions in millimetres

Pipe outside diameter	Calculated wall thickness required to machine longitudinal Charpy impact specimens		
	Full size	3/4 size	1/2 size
114,30	11,24	8,74	6,24
127,00	11,21	8,71	6,21
139,70	11,20	8,70	6,20
168,28	11,16	8,66	6,16
177,80	11,16	8,66	6,16
193,70	11,15	8,65	6,15
196,80	11,14	8,64	6,14
219,10	11,13	8,63	6,13
244,50	11,12	8,62	6,12
273,10	11,11	8,61	6,11
298,50	11,10	8,60	6,10
339,70	11,09	8,59	6,09
406,40	11,08	8,58	6,08
473,10	11,07	8,57	6,07
508,00	11,07	8,57	6,07

NOTE — The wall thicknesses that are in excess of the maximum ISO wall thicknesses are for information only. The above provides a 0,5 mm ID and a 0,5 mm OD machining allowance.

6.2.7 Hardness maxima

6.2.7.1 Group 2 — Casing, tubing, couplings, pup-joints and connectors

a) **Grade L80 all types**

Each tensile specimen required for all types of grade L80 pipe prepared in accordance with 9.8.2 shall be tested for hardness and shall comply with the requirements given in table 3.

b) **Grade C90 and grade T95**

Any hardness value (see figure 10) not exceeding 25,4 HRC is acceptable. If any hardness reading exceeds 27 HRC, the piece shall be rejected. Hardness values falling between these limits require retest. Hardness tests shall be taken on each ring in accordance with figure 10 to provide three hardness values in one quadrant for non-upset pipe and in each of four quadrants for upset pipe.

6.2.7.2 Group 4 — Casing, couplings, pup-joints and connectors

There is no upper or lower hardness limit for this material.

6.2.8 Hardness variation — Group 2, grades C90 and T95 and group 4, grade Q125

Material shall conform to the hardness variation requirements given in table 3. Hardness variation is defined as the difference between any two hardness values within one quadrant. This criterion shall not apply between specimens.

6.2.9 Process control — Group 2, grades C90 and T95 and group 4, grade Q125

All individually heat treated coupling blanks, pup-joints or connectors shall be hardness tested to verify process control. Hardness test results need not be provided by manufacturer or processor unless specified on the purchase order.

6.2.10 Hardenability — Group 2, grades C90 and T95

A full body as-quenched sample shall be taken to characterize the hardening response for a particular size, mass, chemistry and austenitize/quench combination. Hardness values shall equal or exceed the hardness corresponding to 90 % minimum martensite as determined by the following equation:

$$HRC_{min} = 58 \times \%\ C + 27$$

6.2.11 Grain size — Group 2, grades C90 and T95

Prior austenitic grain size shall be ISO grain size 5 or finer.

6.2.12 Flattening — Electric-welded pipe (all groups)

All products that are produced by the electric weld process of manufacture shall comply with the flattening requirements shown in table 17.

Table 17 — Distance between plates for electric weld flattening tests

Grade	D/t ratio	Distance between plates max. mm
H40	⩾ 16	0,5D
	< 16	D(0,83 − 0,020 6D/t)
J55 and K55	⩾ 16	0,65D
	3,93 to 16	D(0,98 − 0,020 6D/t)
	< 3,93	D(1,104 − 0,051 8D/t)
N80[1)]	9 to 28	D(1,074 − 0,019 4D/t)
L80	9 to 28	D(1,074 − 0,019 4D/t)
C95[1)]	9 to 28	D(1,080 − 0,017 8D/t)
P110[2)]	All	D(1,086 − 0,016 3D/t)
Q125[2)]	All	D(1,092 − 0,014D/t)

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

t is the specified wall thickness of the pipe, in millimetres.

1) If the flattening test fails at 12 o'clock or 6 o'clock, the flattening shall continue until the remaining portion of the specimen fails at the 3 o'clock or 9 o'clock position. Premature failure at 12 o'clock or 6 o'clock shall not be considered basis for rejection.

2) See annex B (SR11). Flattening shall be at least 0,85D.

6.2.13 Sulfide stress cracking test — Group 2, grades C90 and T95

It is the responsibility of the purchaser (and/or user) of grade C90 and T95 pipe to determine the level of resistance to sulfide stress cracking (i.e., threshold stress) necessary for the end use of the pipe, and to determine the manufacturers who are capable of manufacturing grade C90 and T95 pipe to meet this resistance level.

The details of a manufacturer's qualification, frequency of sulfide stress cracking testing, retest procedures, and testing practices should be addressed by the purchaser and manufacturer prior to placement or acceptance of a purchase order.

Manufacturers can qualify to make C90 and T95 pipe by complying with the requirements of this International Standard, and in addition for each heat shall demonstrate an absolute minimum threshold stress, as defined in the latest edition of NACE TM-01-77, of 496 N/mm^2 for C90 and 524 N/mm^2 for T95 pipe (80 % of the specified minimum yield strength). If the user requires a threshold stress higher than this minimum, agreement shall be reached between interested parties.

7 Dimensions, masses, tolerances and pipe ends

In the dimensional tables in this clause, pipe is designated by labels and by outside diameter. The outside diameter size of external-upset pipe is the outside diameter of the body of the pipe, not the upset portion.

7.1 Dimensions and masses

Pipe shall be furnished in the sizes, wall thicknesses and masses (as shown in tables 18 to 23) as specified on the purchase order except grades C90, T95 and Q125 which may be furnished in other sizes, masses and wall thickness as agreed upon between interested parties. All dimensions shown without tolerances are related to the basis for design and are not subject to measurement to determine acceptance or rejection of product.

7.2 Diameter

The outside diameter shall be within the tolerances specified in 7.10. For threaded pipe, the outside diameter at the threaded ends shall be such that the thread length L_T, and the full crest thread length L_C, are within the dimensions and tolerances specified in ISO 10422. (Inside diameters are governed by the outside diameter and weight tolerances.)

7.3 Wall thickness

The wall thickness at any position shall not be less than the tabulated thickness, t, minus the permissible under-tolerance specified in 7.10.

7.4 Mass

The masses determined as described in 9.5.5 shall conform to the calculated masses as specified herein (or adjusted calculated masses) for the end finish specified on the purchase order, within the tolerances stipulated in 7.10. Calculated masses shall be determined in accordance with the following formula:

$$m_L = (m_{pe} \times L) + m_w$$

where

m_L is the calculated mass of a piece of pipe length L in kilograms;

m_{pe} is the plain end mass in kilograms per metre;

L is the length of pipe, including end finish, as defined in 7.5 in metres;

m_w is the mass gain or loss due to end finishing in kilograms.

For plain-end non-upset pipe, m_w equals zero.

NOTE 6 The densities of martensitic chromium steels (L80 types 9Cr and 13Cr) are different from carbon steels. The masses shown are therefore not accurate for martensitic chromium steels. A mass correction factor of 0,989 may be used.

Table 18 — Dimensions and masses — Round-thread, buttress-thread and extreme-line casing

Labels		Outside diameter, D	Nominal[1, 2] mass of threads and couplings	Wall thickness, t	Inside diameter, d	Drift diameter	Calculated mass[2]						
							Plain end m_{pe}	Mass gain or loss due to end finishing[3], m_w					
								round-thread		buttress-thread		extreme-line	
1	2							short	long	regular outside diameter	special clearance coupling	standard	optional
		mm	kg/m	mm	mm	mm	kg/m	kg	kg	kg	kg	kg	kg
4-1/2	9,5	114,30	14,14	5,21	103,89	100,71	14,02	1,91	—	—	—	—	—
4-1/2	10,5	114,30	15,63	5,69	102,92	99,75	15,24	1,72	—	2,27	1,16	—	—
4-1/2	11,6	114,30	17,26	6,35	101,60	98,43	16,91	1,54	1,72	2,09	0,98	—	—
4-1/2	13,5	114,30	20,09	7,37	99,57	96,39	19,44	—	1,45	1,81	0,71	—	—
4-1/2	15,1	114,30	22,47	8,56	97,18	94,00	22,32	—	1,27	1,45	0,34	—	—
5	11,5	127,00	17,11	5,59	115,82	112,65	16,74	2,45	—	—	—	—	—
5	13	127,00	19,35	6,43	114,15	110,97	19,12	2,18	2,63	2,99	1,10	—	—
5	15	127,00	22,32	7,52	111,96	108,79	22,16	1,91	2,36	2,63	0,73	2,09	—
5	18	127,00	26,79	9,19	108,61	105,44	26,70	—	1,91	2,00	0,10	0,64	—
5	21,4	127,00	31,85	11,10	104,80	101,62	31,73	—	1,34	1,12	−0,78	—	—
5	23,2	127,00	34,53	12,14	102,72	99,54	34,39	—	1,04	0,93	−0,95	—	—
5	24,1	127,00	35,86	12,70	101,60	98,43	35,80	—	0,88	0,56	−1,33	—	—

Table 18 *(continued)*

Labels		Outside diameter, D	Nominal[1, 2] mass of threads and couplings	Wall thickness, t	Inside diameter, d	Drift diameter	Calculated mass[2]						
							Plain end m_{pe}	Mass gain or loss due to end finishing[3], m_w					
								round-thread		buttress-thread		extreme-line	
1	2							short	long	regular outside diameter	special clearance coupling	standard	optional
		mm	kg/m	mm	mm	mm	kg/m	kg	kg	kg	kg	kg	kg
5-1/2	14	139,70	20,83	6,20	127,30	124,13	20,41	2,45	—	—	—	—	—
5-1/2	15,5	139,70	23,07	6,99	125,73	122,56	22,88	2,18	2,63	2,90	0,95	2,63	1,91
5-1/2	17	139,70	25,30	7,72	124,26	121,08	25,13	2,00	2,45	2,63	0,68	2,18	1,45
5-1/2	20	139,70	29,76	9,17	121,36	118,19	29,52	—	2,00	2,09	0,14	0,64	−0,09
5-1/2	23	139,70	34,23	10,54	118,62	115,44	33,57	—	1,45	1,54	−0,41	0,00	−0,73
5-1/2	26,8	139,70	39,88	12,70	114,30	111,13	39,78	—	—	—	—	—	—
5-1/2	29,7	139,70	44,20	14,27	111,15	107,98	44,14	—	—	—	—	—	—
5-1/2	32,6	139,70	48,51	15,88	107,95	104,78	48,49	—	—	—	—	—	—
5-1/2	35,3	139,70	52,53	17,45	104,80	101,63	52,61	—	—	—	—	—	—
5-1/2	38	139,70	56,55	19,05	101,60	98,43	56,68	—	—	—	—	—	—
5-1/2	40,5	139,70	60,27	20,62	98,45	95,28	60,55	—	—	—	—	—	—
5-1/2	43,1	139,70	64,14	22,23	95,25	92,07	64,40	—	—	—	—	—	—
6-5/8	20	168,28	29,76	7,32	153,64	150,47	29,06	4,99	6,17	6,53	1,08	—	—
6-5/8	24	168,28	35,72	8,94	150,39	147,22	35,13	4,35	5,44	5,72	0,26	1,54	0,82
6-5/8	28	168,28	41,67	10,59	147,09	143,92	41,18	—	4,63	4,81	−0,64	0,09	−0,64
6-5/8	32	168,28	47,62	12,07	144,15	140,97	46,50	—	3,99	4,08	−1,37	−0,64	−1,36
7	17	177,80	25,30	5,87	166,10	162,89	24,89	4,54	—	—	—	—	—
7	20	177,80	29,76	6,91	164,00	160,81	29,12	4,26	—	—	—	—	—
7	23	177,80	34,23	8,05	161,70	158,52	33,70	3,63	4,72	4,99	0,73	2,72	1,91
7	26	177,80	38,69	9,19	159,40	156,24	38,21	3,27	4,26	4,35	0,09	1,27	0,45
7	29	177,80	43,16	10,36	157,10	153,90	42,78	—	3,63	3,72	−0,54	0,27	−0,54
7	32	177,80	47,62	11,51	154,80	151,61	47,20	—	2,99	3,08	−1,18	−0,27	−1,09
7	35	177,80	52,09	12,65	152,50	149,33	51,52	—	2,54	2,54	−1,72	0,45	−0,82
7	38	177,80	56,55	13,72	150,40	147,19	55,52	—	2,00	1,91	−2,36	−0,09	−1,36
7	42,7	177,80	63,54	15,88	146,10	142,88	63,41	—	—	—	—	—	—
7	46,4	177,80	69,05	17,45	142,90	139,73	69,01	—	—	—	—	—	—
7	50,1	177,80	74,56	19,05	139,70	136,52	74,58	—	—	—	—	—	—
7	53,6	177,80	79,77	20,62	136,60	133,38	79,93	—	—	—	—	—	—
7	57,1	177,80	84,97	22,23	133,40	130,18	85,29	—	—	—	—	—	—
7-5/8	24	193,70	35,72	7,62	178,40	175,26	34,97	7,17	—	—	—	—	—
7-5/8	26,4	193,70	39,29	8,33	177,00	173,84	38,08	6,89	8,62	9,34	2,82	2,90	1,81
7-5/8	29,7	193,70	44,20	9,53	174,60	171,45	43,28	—	7,89	8,53	2,00	1,18	0,09
7-5/8	33,7	193,70	50,15	10,92	171,80	168,66	49,22	—	7,17	7,71	1,18	0,00	−1,09
7-5/8	39	193,70	58,04	12,70	168,30	165,10	56,69	—	6,17	6,62	0,10	−1,00	−2,09
7-5/8	42,8	193,70	63,69	14,27	165,10	161,95	63,14	—	5,45	5,17	−1,37	—	—
7-5/8	45,3	193,70	67,41	15,11	163,40	160,27	66,55	—	5,01	5,01	−1,52	—	—
7-5/8	47,1	193,70	70,19	15,88	161,90	158,75	69,64	—	4,61	4,19	−2,35	—	—
7-5/8	51,2	193,70	76,19	17,45	158,80	155,60	75,85	—	—	—	—	—	—
7-5/8	55,3	193,70	82,30	19,05	155,60	152,40	82,05	—	—	—	—	—	—
7-3/4	46,1	196,90	68,60	15,11	166,60	165,10[4]	67,74	—	—	—	—	—	—
7-3/4	46,1	196,90	68,60	15,11	166,60	163,45	67,74	—	—	—	—	—	—

Table 18 *(continued)*

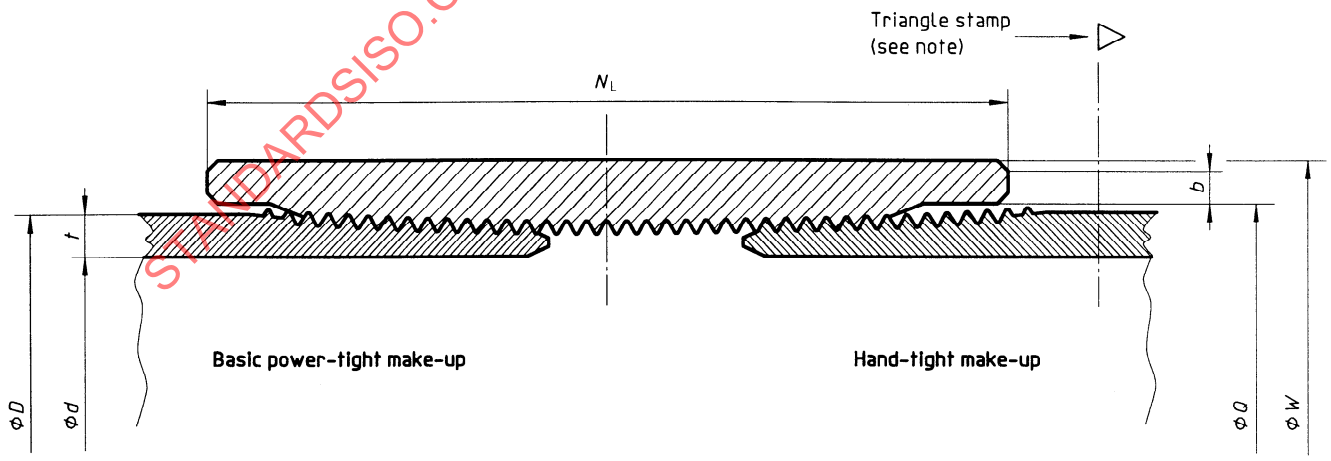
Labels		Outside diameter, D	Nominal[1, 2] mass of threads and couplings	Wall thickness, t	Inside diameter, d	Drift diameter	Calculated mass[2]						
							Plain end m_{pe}	Mass gain or loss due to end finishing[3], m_w					
								round-thread		buttress-thread		extreme-line	
1	2							short	long	regular outside diameter	special clearance coupling	standard	optional
		mm	kg/m	mm	mm	mm	kg/m	kg	kg	kg	kg	kg	kg
8-5/8	24	219,10	35,72	6,71	205,70	202,49	35,15	10,70	—	—	—	—	—
8-5/8	28	219,10	41,67	7,72	203,60	200,46	40,24	10,07	—	—	—	—	—
8-5/8	32	219,10	47,62	8,94	201,20	198,02	46,33	9,43	12,52	12,79	2,74	5,99	3,99
8-5/8	32	219,10	47,62	8,94	201,20	200,02[4]	46,33	9,43	12,52	12,79	2,74	5,99	3,99
8-5/8	36	219,10	53,57	10,16	198,80	195,58	52,35	8,80	11,61	11,88	1,83	3,45	1,91
8-5/8	40	219,10	59,53	11,43	196,20	193,04	58,54	—	10,80	10,98	0,92	1,81	0,27
8-5/8	44	219,10	65,48	12,70	193,70	190,50	64,64	—	9,89	10,07	0,01	0,73	−0,82
8-5/8	49	219,10	72,92	14,15	190,80	187,60	71,52	—	8,89	8,98	−1,08	−0,36	−1,91
9-5/8	32,3	244,50	48,07	7,92	228,60	224,66	46,21	11,07	—	—	—	—	—
9-5/8	36	244,50	53,57	8,94	226,60	222,63	51,93	10,43	14,51	14,06	2,94	—	—
9-5/8	40	244,50	59,53	10,03	224,40	220,45	58,00	9,71	13,61	13,15	2,03	4,81	3,27
9-5/8	43,5	244,50	64,74	11,05	222,40	218,41	63,62	—	12,79	12,34	1,22	2,45	0,91
9-5/8	47	244,50	69,94	11,99	220,50	216,54	68,75	—	12,07	11,61	0,49	1,00	−0,54
9-5/8	53,5	244,50	79,62	13,84	216,80	212,83	78,73	—	10,61	10,16	−0,96	−0,54	−2,09
9-5/8	53,5	244,50	79,62	13,84	216,80	215,90[4]	78,73	—	10,61	10,16	−0,96	−0,54	−2,09
9-5/8	58,4	244,50	85,48	15,11	214,25	210,29	85,48	—	9,77	9,15	−2,00	—	—
9-5/8	58,4	244,50	85,48	15,11	214,25	212,75[4]	85,48	—	9,77	9,15	−2,00	—	—
9-5/8	59,4	244,50	88,40	15,47	213,50	209,58	87,38	—	—	—	—	—	—
9-5/8	64,9	244,50	96,58	17,07	210,30	206,38	95,74	—	—	—	—	—	—
9-5/8	70,3	244,50	104,62	18,64	207,20	203,23	103,83	—	—	—	—	—	—
9-5/8	75,6	244,50	112,51	20,24	204,00	200,02	111,94	—	—	—	—	—	—
10-3/4	32,75	273,10	48,74	7,09	258,90	254,91	46,51	13,15	—	—	—	—	—
10-3/4	40,5	273,10	60,27	8,89	255,30	251,31	57,93	11,97	—	15,60	3,27	—	—
10-3/4	45,5	273,10	67,71	10,16	252,70	248,77	65,88	10,93	—	14,42	2,09	9,62	—
10-3/4	45,5	273,10	67,71	10,16	252,70	250,82[4]	65,88	10,93	—	14,42	2,09	9,62	—
10-3/4	51	273,10	75,90	11,43	250,20	246,23	73,76	10,25	—	13,34	1,00	8,35	—
10-3/4	55,5	273,10	82,59	12,57	247,90	243,94	80,76	9,43	—	12,25	−0,09	7,17	—
10-3/4	60,7	273,10	90,33	13,84	245,40	241,40	88,49	8,53	—	11,07	—	5,90	—
10-3/4	65,7	273,10	97,77	15,11	242,80	238,86	96,14	7,62	—	9,98	—	—	—
10-3/4	73,2	273,10	108,93	17,07	238,90	234,95	107,78	—	—	—	—	—	—
10-3/4	79,2	273,10	117,86	18,64	235,80	231,80	116,97	—	—	—	—	—	—
10-3/4	85,3	273,10	126,94	20,24	232,60	228,60	126,21	—	—	—	—	—	—
11-3/4	42	298,50	62,50	8,46	281,50	277,50	60,51	13,43	—	—	—	—	—
11-3/4	47	298,50	69,94	9,53	279,40	275,44	67,91	12,52	—	16,24	—	—	—
11-3/4	54	298,50	80,36	11,05	276,40	272,39	78,33	11,34	—	14,70	—	—	—
11-3/4	60	298,50	89,29	12,42	273,60	269,65	87,63	10,25	—	13,43	—	—	—
11-3/4	65	298,50	96,73	13,56	271,30	269,88[4]	95,29	—	—	—	—	—	—
11-3/4	65	298,50	96,73	13,56	271,30	267,36	95,29	—	—	—	—	—	—
11-3/4	71	298,50	105,66	14,78	268,90	264,92	103,42	—	—	—	—	—	—
13-3/8	48	339,70	71,43	8,38	323,00	319,00	68,47	15,06	—	—	—	—	—
13-3/8	54,5	339,70	81,10	9,65	320,40	316,46	78,55	13,97	—	18,23	—	—	—

Table 18 *(concluded)*

Labels		Outside diameter, D	Nominal[1, 2] mass of threads and couplings	Wall thickness, t	Inside diameter, d	Drift diameter	Calculated mass[2]						
							Plain end m_{pe}	Mass gain or loss due to end finishing[3], m_w					
								round-thread		buttress-thread		extreme-line	
1	2							short	long	regular outside diameter	special clearance coupling	standard	optional
		mm	kg/m	mm	mm	mm	kg/m	kg	kg	kg	kg	kg	kg
13-3/8	61	339,70	90,78	10,92	317,90	313,92	88,54	12,88	—	16,69	—	—	—
13-3/8	68	339,70	101,19	12,19	315,30	311,38	98,46	11,70	—	15,24	—	—	—
13-3/8	72	339,70	107,15	13,06	313,60	311,15[4]	105,20	10,98	—	14,33	—	—	—
13-3/8	72	339,70	107,15	13,06	313,60	309,65	105,20	10,98	—	14,33	—	—	—
16	65	406,40	96,73	9,53	387,40	382,57	93,27	19,32	—	—	—	—	—
16	75	406,40	111,61	11,13	374,10	397,37	108,49	17,33	—	20,68	—	—	—
16	84	406,40	125,01	12,57	381,30	376,48	122,09	15,51	—	17,96	—	—	—
16	109	406,40	162,21	16,66	373,10	368,30	160,13	—	—	—	—	—	—
18-5/8	87,5	473,10	130,21	11,05	451,00	446,20	125,91	33,38	—	39,19	—	—	—
20	94	508,00	139,89	11,13	485,70	480,97	136,38	21,32	27,76	24,86	—	—	—
20	106,5	508,00	158,49	12,70	482,60	477,82	155,13	18,87	24,86	21,95	—	—	—
20	133	508,00	197,93	16,13	475,70	470,97	195,66	13,61	18,42	15,97	—	—	—

NOTE — See figures 1, 2, 3 and 7.

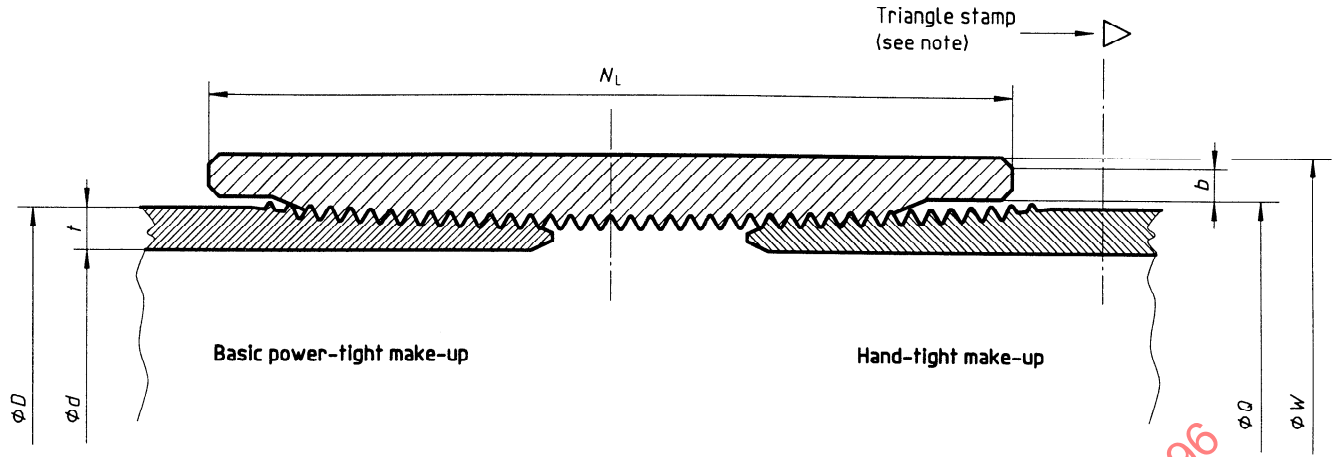
1) Nominal masses of threads and couplings are shown for information only.
2) The densities of martensitic chromium steels (L80, types 9Cr and 13Cr) are different from carbon steels. The masses shown are therefore not accurate for martensitic chromium steels. A mass correction factor of 0,989 may be used.
3) Mass gain or loss due to end finishing, see 7.4.
4) Drift diameter for most common bit size. In these masses the drift diameter shall be specified on the purchase order and marked on the pipe. See 7.9 for drift requirements.



NOTE — A 9,52 mm high equilateral triangle die stamp shall be placed at a distance of L_4 + 1,59 mm from each end of a 406,4 mm to 473,1 mm and 508,00 mm, short round-thread casing in grades H40, J55 and K55.

See table 18 for pipe dimensions, table 27 for coupling dimensions and ISO 10422 for thread details.

Figure 1 — Short round-thread casing and coupling

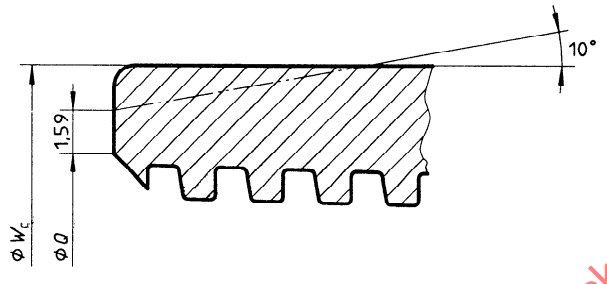


NOTE — A 9,52 mm high equilateral triangle die stamp shall be placed at a distance of L_4 + 1,59 mm from each end of a 508,00 mm long round-thread casing in grades H40, J55 and K55.

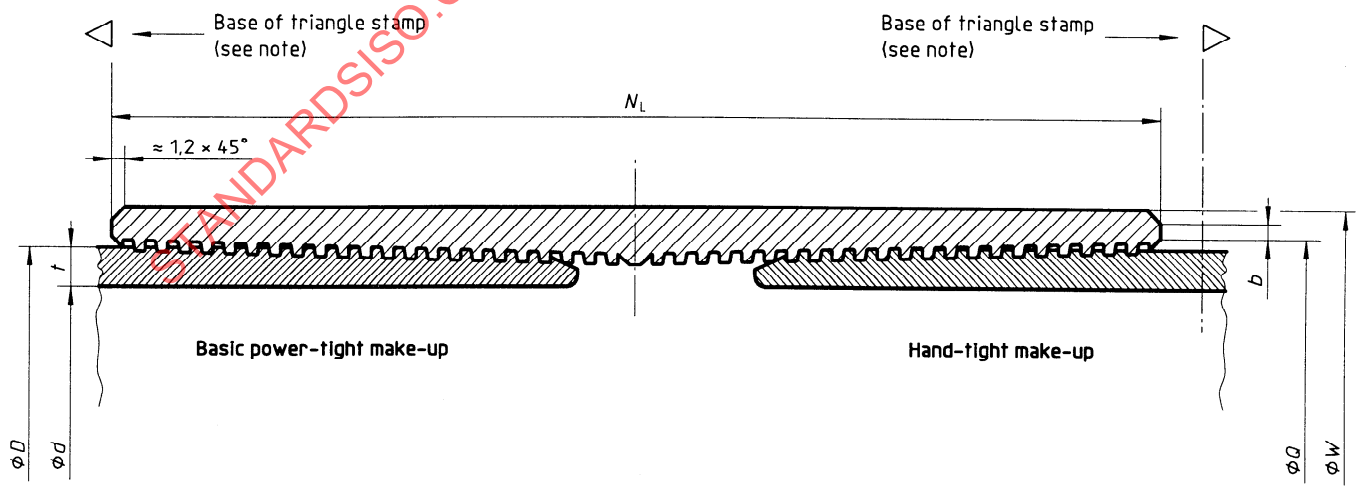
See table 18 for pipe dimensions, table 27 for coupling dimensions and ISO 10422 for thread details.

Figure 2 — Long round-thread casing and coupling

Dimensions in millimetres



Special clearance coupling:
1) All corners rounded or broken;
2) 10° bevel (both ends) furnished only when specified on order.



NOTE — A 9,52 mm high equilateral triangle die stamp or paint band shall be placed at a distance of A1 mm from each end of buttress casing.

See table 18 for pipe dimensions, table 28 for coupling dimensions and ISO 10422 for thread details.

Figure 3 — Buttress-thread casing and coupling

Table 19 — Dimensions and masses, non-upset, external-upset and integral-joint tubing

Labels[1]				Nominal masses[2, 3]						Calculated mass[3]				
											Mass gain or loss due to end finishing[4], m_{ew}			
											non-upset	external-upset		integral-joint
1	2a	2b	2c	Outside diameter, D	Non-upset threads and couplings	External-upset threads and couplings	Integral-joint	Wall thickness, t	Inside diameter, d	Plain end m_{pe}		regular	special clearance	
				mm	kg/m	kg/m	kg/m	mm	mm	kg/m	kg	kg	kg	kg
1,050	1,14	1,20	—	26,67	1,70	1,79	—	2,87	20,93	1,68	0,09	0,64	—	—
1,050	1,48	1,54	—	26,67	2,20	2,29	—	3,91	18,85	2,19	—	0,60	—	—
1,315	1,70	1,80	1,72	33,40	2,53	2,68	2,56	3,38	26,64	2,50	0,18	0,64	—	—
1,315	2,19	2,24	—	33,40	3,26	3,33	—	4,55	24,31	3,24	—	0,61	—	—
1,660	—	—	2,10	42,16	—	—	3,13	3,18	35,81	3,06	—	—	—	0,09
1,660	2,30	2,40	2,33	42,16	3,42	3,57	3,47	3,56	35,05	3,39	0,36	0,73	—	0,09
1,660	3,03	3,07	—	42,16	4,51	4,57	—	4,85	32,46	4,46	—	0,68	—	—
1,900	—	—	2,40	48,26	—	—	3,57	3,18	41,91	3,54	—	—	—	0,09
1,900	2,75	2,90	2,76	48,26	4,09	4,32	4,11	3,68	40,89	4,05	0,27	0,91	—	0,09
1,900	3,65	3,73	—	48,26	5,43	5,55	—	5,08	38,10	5,41	—	0,92	—	—
1,900	4,42	—	—	48,26	6,58	—	—	6,35	35,56	6,56	—	—	—	—
1,900	5,15	—	—	48,26	7,66	—	—	7,62	33,02	7,64	—	—	—	—
2,063	—	—	3,25	52,40	—	—	4,84	3,96	44,48	4,73	—	—	—	0,09
2,063	—	—	—	52,40	—	—	—	5,72	40,97	6,58	—	—	—	—
2-3/8	4,00	—	—	60,33	5,95	—	—	4,24	51,84	5,87	0,73	—	—	—
2-3/8	4,60	4,70	—	60,33	6,85	6,99	—	4,83	50,67	6,61	0,73	1,81	1,34	—
2-3/8	5,80	5,95	—	60,33	8,63	8,85	—	6,45	47,42	8,57	0,64	1,63	1,16	—
2-3/8	6,60	—	—	60,33	9,82	—	—	7,49	45,34	9,76	—	—	—	—
2-3/8	7,35	7,45	—	60,33	10,94	11,09	—	8,53	43,26	10,90	—	—	—	—
2-7/8	6,40	6,50	—	73,03	9,52	9,67	—	5,51	62,00	9,17	1,45	2,54	1,71	—
2-7/8	7,80	7,90	—	73,03	11,61	11,76	—	7,01	59,00	11,41	1,27	2,63	1,78	—
2-7/8	8,60	8,70	—	73,03	12,80	12,95	—	7,82	57,38	12,58	1,18	2,27	1,43	—
2-7/8	9,35	9,45	—	73,03	13,91	14,06	—	8,64	55,75	13,72	—	—	—	—
2-7/8	10,50	—	—	73,03	15,63	—	—	9,96	53,11	15,49	—	—	—	—
2-7/8	11,50	—	—	73,03	17,11	—	—	11,18	50,67	17,05	—	—	—	—
3-1/2	7,70	—	—	88,90	11,46	—	—	5,49	77,93	11,29	2,45	—	—	—
3-1/2	9,20	9,30	—	88,90	13,69	13,84	—	6,45	76,00	13,12	2,27	4,17	2,45	—
3-1/2	10,20	—	—	88,90	15,18	—	—	7,34	74,22	14,76	2,18	—	—	—
3-1/2	12,70	12,95	—	88,90	18,90	19,27	—	9,53	69,85	18,65	1,81	3,72	2,00	—
3-1/2	14,30	—	—	88,90	21,28	—	—	10,92	67,06	21,00	—	—	—	—
3-1/2	15,50	—	—	88,90	23,07	—	—	12,09	64,72	22,90	—	—	—	—
3-1/2	17,00	—	—	88,90	25,30	—	—	13,46	61,98	25,04	—	—	—	—
4	9,50	—	—	101,60	14,14	—	—	5,74	90,12	13,57	2,81	—	—	—
4	—	11,00	—	101,60	—	16,37	—	6,65	88,29	15,57	—	4,81	—	—
4	13,20	—	—	101,60	19,64	—	—	8,38	84,84	19,27	—	—	—	—
4	16,10	—	—	101,60	23,96	—	—	10,54	80,52	23,67	—	—	—	—
4	18,90	—	—	101,60	28,13	—	—	12,70	76,20	27,84	—	—	—	—
4	22,20	—	—	101,60	33,04	—	—	15,49	70,61	32,89	—	—	—	—

Table 19 *(concluded)*

Labels[1]				Nominal masses[2, 3]						Calculated mass[3]				
				Outside diameter, D	Non-upset threads and couplings	External-upset threads and couplings	Integral-joint	Wall thickness, t	Inside diameter, d	Plain end m_{pe}	Mass gain or loss due to end finishing[4], m_w			
											non-upset	external-upset		integral-joint
1	2a	2b	2c									regular	special clearance	
				mm	kg/m	kg/m	kg/m	mm	mm	kg/m	kg	kg	kg	kg
4-1/2	12,6	12,75	—	114,30	18,75	18,97	—	6,88	100,53	18,23	2,72	5,99	—	—
4-1/2	15,2	—	—	114,30	22,62	—	—	8,56	97,18	22,32	—	—	—	—
4-1/2	17	—	—	114,30	25,30	—	—	9,65	95,00	24,90	—	—	—	—
4-1/2	18,9	—	—	114,30	28,13	—	—	10,92	92,46	27,84	—	—	—	—
4-1/2	21,5	—	—	114,30	32,00	—	—	12,70	88,90	31,82	—	—	—	—
4-1/2	23,7	—	—	114,30	35,27	—	—	14,22	85,85	35,10	—	—	—	—
4-1/2	26,1	—	—	114,30	38,84	—	—	16,00	82,30	38,79	—	—	—	—
5	15	—	—	127,00	22,32	—		7,52	111,76	22,16	2,36	—	—	—
5	18	—	—	127,00	26,79	—	—	9,19	108,61	26,70	1,91	—	—	—
5	21,4	—	—	127,00	31,85	—	—	11,10	104,80	31,73	1,34	—	—	—
5	23,2	—	—	127,00	34,53	—	—	12,14	102,72	34,39	1,04	—	—	—
5	24,1	—	—	127,00	35,86	—	—	12,70	101,60	35,80	0,88	—	—	—
5-1/2	15,5	—	—	139,70	23,07	—	—	6,99	125,73	22,88	2,63	—	—	—
5-1/2	17	—	—	139,70	25,30	—	—	7,72	124,26	25,13	2,45	—	—	—
5-1/2	20	—	—	139,70	29,76	—	—	9,17	121,36	29,52	2,00	—	—	—
5-1/2	23	—	—	139,70	34,23	—	—	10,54	118,62	33,57	1,45	—	—	—
7	23	—	—	177,80	34,23	—	—	8,05	161,70	33,70	4,72	—	—	—
7	26	—	—	177,80	38,69	—	—	9,19	159,40	38,21	4,26	—	—	—
7	29	—	—	177,80	43,16	—	—	10,36	157,10	42,78	3,63	—	—	—
7	32	—	—	177,80	47,62	—	—	11,51	154,80	47,20	2,99	—	—	—
7	35	—	—	177,80	52,09	—	—	12,65	152,50	51,52	2,54	—	—	—
7	38	—	—	177,80	56,55	—	—	13,72	150,40	55,52	1,91	—	—	—

NOTE — See figures 4, 5 and 6.

1) Labels: 2a = non-upset threaded and coupled;
2b = external-upset threaded and coupled;
2c = integral-joint.

2) Nominal masses of threads and couplings are shown for information only.

3) The densities of martensitic chromium steels (L80, types 9Cr and 13Cr) are different from carbon steels. The masses shown are therefore not accurate for martensitic chromium steels. A mass correction factor of 0,989 may be used.

4) Mass gain or loss due to end finishing, see 7.4.

Table 20 — Extreme-line casing upset end — Dimensions and masses

Labels		Outside diameter, D	Nominal mass, upset and threaded	Pin and box dimensions, finished[1]								
				Pin and box outside diameter (turned) M +0,51 −0,25		Pin inside diameter (bored) B +0,38 −0,38	Box inside diameter (bored) d +0,76 −0,00	Pin and box, made-up[2] (power-tight)			Drift diameter for finish bored upset members	Drift diameter[3] for full length drifting min.
								Outside diameter[4] +0,51 −0,25		Inside diameter +0,25 −0,13		
1	2	mm	kg/m	standard mm	optional mm	standard/ optional mm	standard/ optional mm	standard mm	optional mm	standard/ optional mm	standard/ optional mm	standard/ optional mm
5	15	127,00	22,32	136,14	—	106,88	107,57	136,14	—	106,63	106,25	105,44
5	18	127,00	26,79	136,14	—	106,88	107,57	136,14	—	106,63	106,25	105,44
5-1/2	15,5	139,70	23,07	148,84	146,81	120,55	121,23	148,84	146,81	120,29	119,91	118,19
5-1/2	17	139,70	25,30	148,84	146,81	119,66	120,35	148,84	146,81	119,41	119,02	118,19
5-1/2	20	139,70	29,76	148,84	146,81	119,66	120,35	148,84	146,81	119,41	119,02	118,19
5-1/2	23	139,70	34,23	148,84	146,81	117,32	118,03	148,84	146,81	117,09	116,71	115,44
6-5/8	24	168,28	35,72	177,80	176,02	147,12	147,78	177,80	176,02	146,83	146,46	145,54
6-5/8	28	168,28	41,67	177,80	176,02	145,82	146,51	177,80	176,02	145,57	145,19	143,92
6-5/8	32	168,28	47,62	177,80	176,02	142,85	143,56	177,80	176,02	142,62	142,24	140,97
7	23	177,80	34,23	187,71	185,67	157,02	157,68	187,71	185,67	156,74	156,36	156,24
7	26	177,80	38,69	187,71	185,67	157,02	157,68	187,71	185,67	156,74	156,36	156,24
7	29	177,80	43,16	187,71	185,67	155,80	156,46	187,71	185,67	155,52	155,14	153,90
7	32	177,80	47,62	187,71	185,67	153,47	154,15	187,71	185,67	153,21	152,83	151,61
7	35	177,80	52,09	191,26	187,71	151,10	151,82	191,26	187,71	150,87	150,50	149,33
7	38	177,80	56,55	191,26	187,71	149,07	149,78	191,26	187,71	148,84	148,46	147,19
7-5/8	26,4	193,70	39,29	203,45	201,17	172,26	172,90	203,45	201,17	171,96	171,58	171,45
7-5/8	29,7	193,70	44,20	203,45	201,17	172,26	172,90	203,45	201,17	171,96	171,58	171,45
7-5/8	33,7	193,70	50,15	203,45	201,17	170,59	171,25	203,45	201,17	170,31	169,93	168,66
7-5/8	39	193,70	58,04	203,45	201,17	167,00	167,69	203,45	201,17	166,75	166,37	165,10
8-5/8	32	219,10	47,62	231,65	229,36	196,52	197,16	231,65	229,36	196,21	195,83	195,58
8-5/8	36	219,10	53,57	231,65	229,36	196,52	197,16	231,65	229,36	196,21	195,83	195,58
8-5/8	40	219,10	59,53	231,65	229,36	194,92	195,58	231,65	229,36	194,64	194,26	193,04
8-5/8	44	219,10	65,48	231,65	229,36	192,40	193,09	231,65	229,36	192,15	191,77	190,50
8-5/8	49	219,10	65,48	231,65	229,36	189,48	190,20	231,65	229,36	189,26	188,87	187,60
9-5/8	40	244,50	59,53	256,54	254,51	220,40	221,03	256,54	254,51	219,84	219,71	218,41
9-5/8	43,5	244,50	64,73	256,54	254,51	220,40	221,03	256,54	254,51	219,84	219,71	218,41
9-5/8	47	244,50	69,94	256,54	254,51	219,28	219,91	256,54	254,51	218,97	218,59	216,54
9-5/8	53,5	244,50	79,62	256,54	254,51	215,52	216,20	256,54	254,51	215,27	214,88	212,83
10-3/4	45,5	273,10	67,71	291,08	—	249,66	250,29	291,08	—	249,40	249,02	248,77
10-3/4	51	273,10	75,90	291,08	—	247,12	247,75	291,08	—	246,86	246,48	246,23
10-3/4	55,5	273,10	82,59	291,08	—	244,83	245,47	291,08	—	244,58	244,20	243,94
10-3/4	60,7	273,10	90,33	291,08	—	242,29	242,92	291,08	—	242,04	241,66	241,40

NOTE — See figure 7.

1) Due to the nature of extreme-line casing, certain dimensional symbols and nomenclature differ from those for similar details for other pipes covered by this International Standard.

2) Shown for reference.

3) See table 18.

4) Made-up joint D is same as outside diameter dimension M.

Table 21 — External-upset tubing — Groups 1, 2 and 3 — Upset end dimensions and masses

Labels[1]		Outside diameter of pipe body, D	Nominal[2] mass of threads and couplings	Upset			
1	2			Outside[3] diameter, D_4 + 1,59	Length (end of pipe to start of taper) L_{eu} + 0, – 25,4	Length (end of pipe to end of taper) L_a	Length (end of pipe to start of pipe body) L_b max.
		mm	kg/m	mm	mm	mm	mm
1,050	1,20	26,67	1,79	33,40	60,33	—	—
1,315	1,80	33,40	2,68	37,31	63,50	—	—
1,660	2,40	42,40	3,57	46,02	66,68	—	—
1,900	2,90	48,26	4,32	53,19	68,26	—	—
2-3/8	4,70	60,33	6,99	65,89	101,60	152,40	254,00
2-3/8	5,95	60,33	8,85	65,89	101,60	152,40	254,00
2-7/8	6,50	73,03	9,67	78,59	107,95	158,75	260,35
2-7/8	7,90	73,03	11,76	78,59	107,95	158,75	260,35
2-7/8	8,70	73,03	12,95	78,59	107,95	158,75	260,35
3-1/2	9,30	88,90	13,84	95,25	114,30	165,10	266,70
3-1/2	12,95	88,90	19,27	95,25	114,30	165,10	266,70
4	11,00	101,60	16,37	107,95	114,30	165,10	266,70
4-1/2	12,75	114,30	18,97	120,65	120,65	171,45	273,05

NOTE — See figure 5.

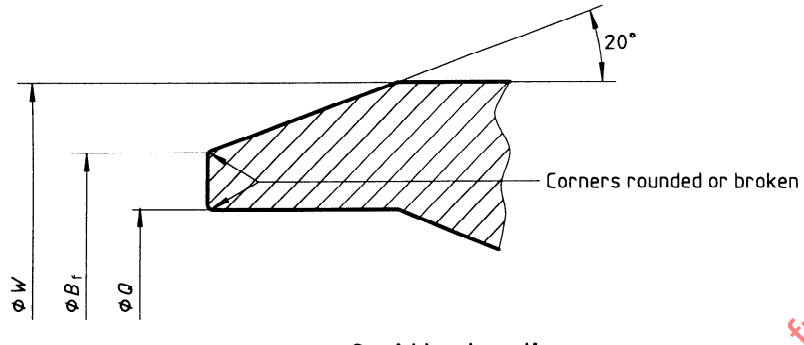
1) For information only.
2) The densities of martensitic chromium steels (L80-types 9Cr and 13Cr) are different from carbon steels.
3) The minimum outside diameter of upset, D_4, is limited by the minimum length of full-crest threads. See ISO 10422.
4) For pup-joints only the length tolerance on L_{eu} is + 101,6 mm, – 25,4 mm. The length on L_b may be 101,6 mm longer than specified.

Table 22 — Integral-joint tubing — Groups 1 and 2 — Upset end dimensions and masses

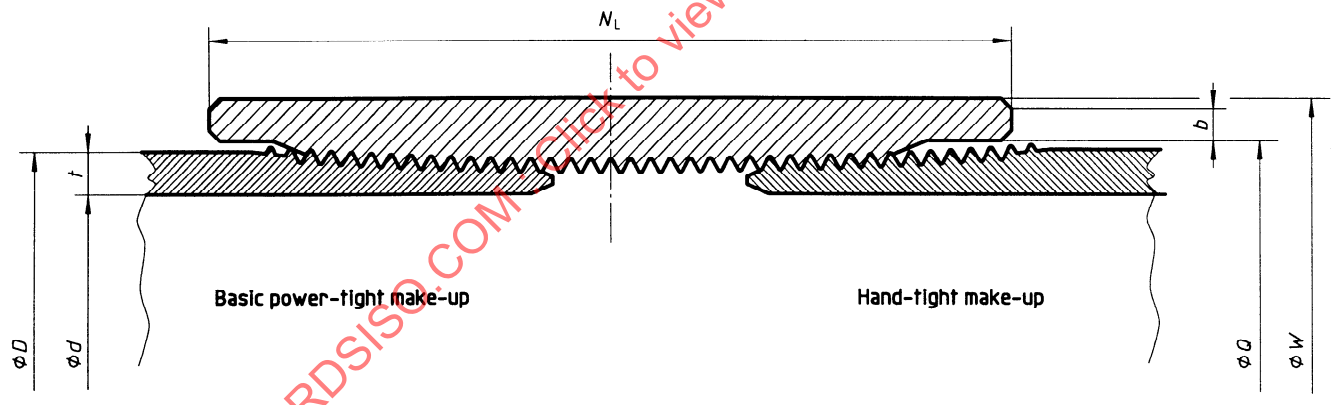
Labels		Outside diameter, D	Nominal[1] mass, upset and threaded	Upset dimensions mm							
				Pin				Box			
1	2			Outside[2] diameter, D_4 + 1,59	Inside[3] diameter, d_{iu} + 0,38	Length, L_{iu} min.	Length of taper, m_{iu} min.	Outside diameter, W_b + 0,13 – 0,64	Length, L_{eu} min.	Length of taper, m_{eu}	Diameter of recess, Q	Width of face, b min.
		mm	kg/m	mm	mm	mm	mm	mm	mm	mm	mm	mm
1,315	1,72	33,40	2,56	—	24,64	34,93	6,35	39,37	44,45	25,40	35,00	0,79
1,660	2,10	42,16	3,13	—	33,05	38,10	6,35	47,75	47,63	25,40	43,76	0,79
1,660	2,33	42,16	3,47	—	33,05	38,10	6,35	47,75	47,63	25,40	43,76	0,79
1,900	2,40	48,26	3,57	—	38,89	41,23	6,35	53,59	50,80	25,40	49,86	0,79
1,900	2,76	48,26	4,11	—	38,89	41,23	6,35	53,59	50,80	25,40	49,86	0,79
2,063	3,25	52,40	4,84	53,19	42,47	42,86	6,35	59,06	53,98	25,40	54,76	0,79

NOTE — See figure 6.

1) Nominal masses, upset and threaded are shown for information only.
2) The minimum outside diameter, D_4, is limited by the minimum length of full crest threads. See ISO 10422.
3) The minimum inside diameter, d_{iu}, is limited by the drift test.



Special bevel coupling

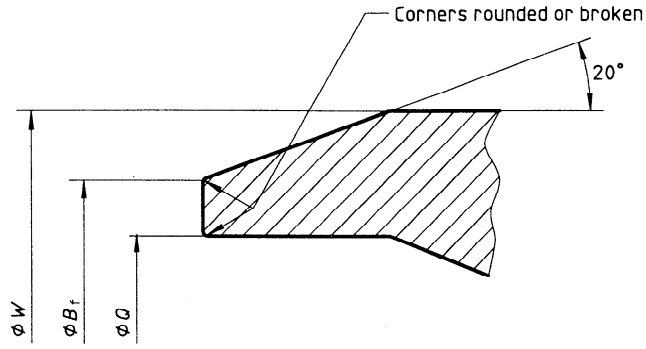


Basic power-tight make-up

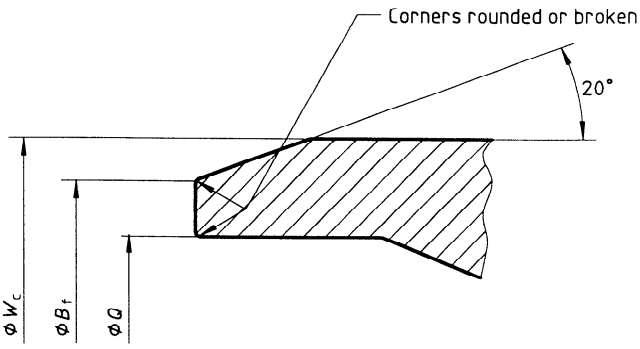
Hand-tight make-up

NOTE — See table 19 for pipe dimensions, table 29 for coupling dimensions and ISO 10422 for thread details.

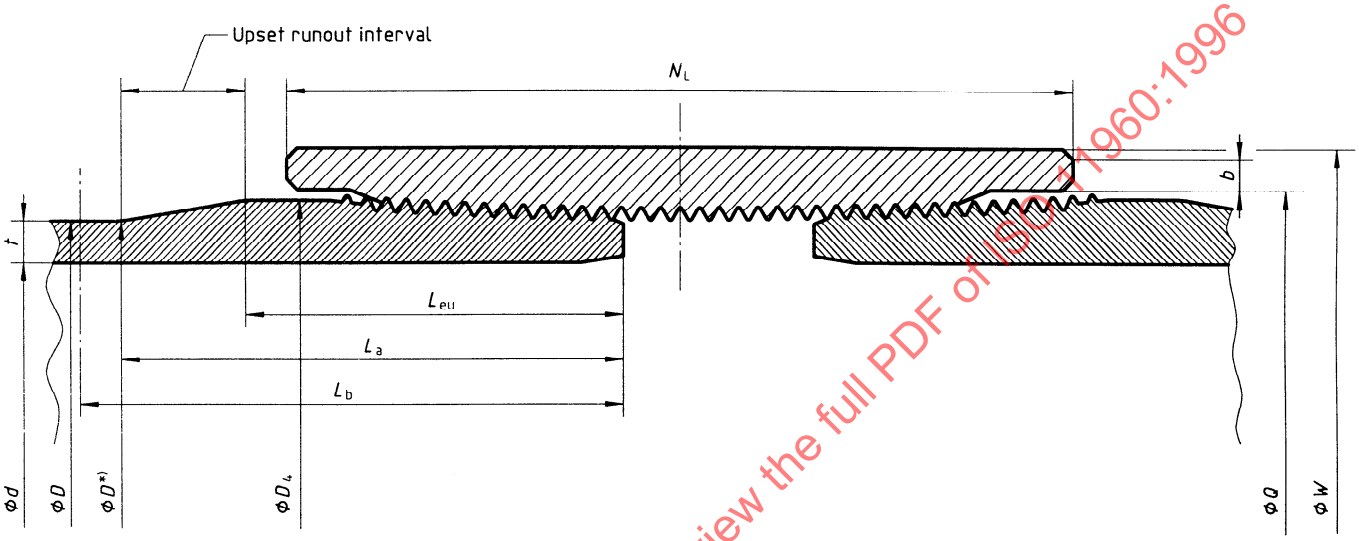
Figure 4 — Non-upset tubing and coupling



Special bevel coupling



Special clearance coupling



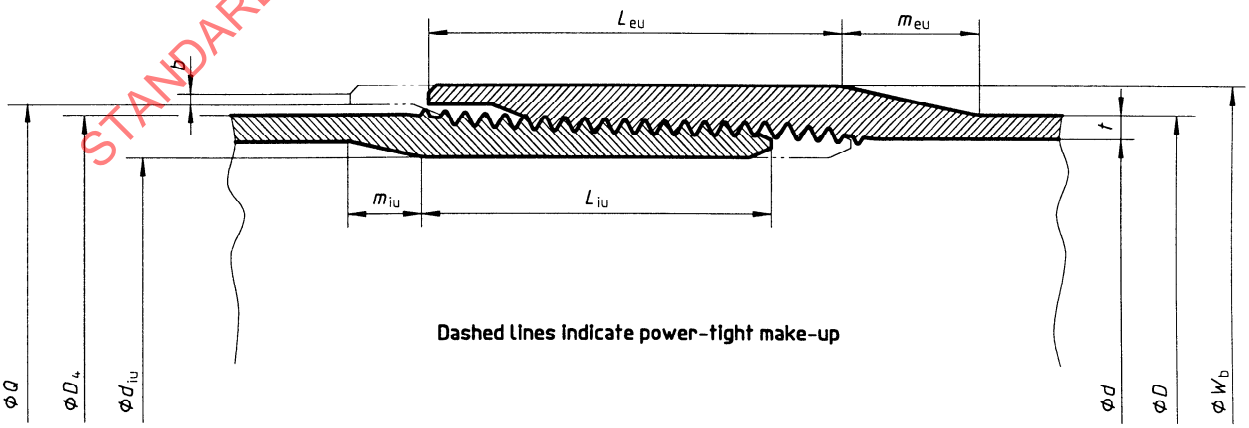
Basic power-tight make-up

Hand-tight make-up

*) See 7.10.1 for tolerance on outside diameter at a distance L_a from end of pipe.

NOTE — See tables 19 and 20 for pipe dimensions, table 30 for coupling dimensions and ISO 10422 for thread details.

Figure 5 — External-upset tubing and coupling

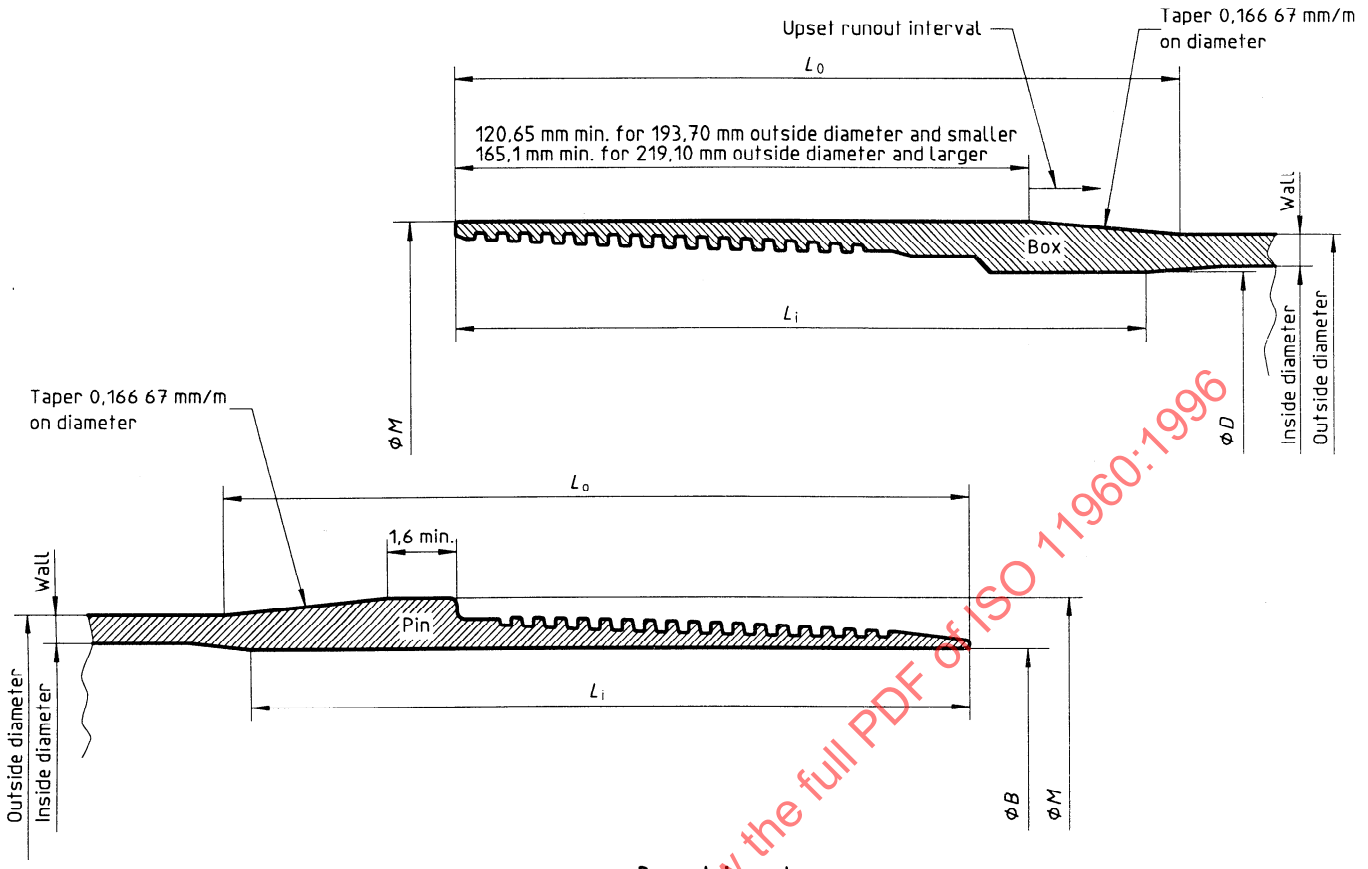


Dashed lines indicate power-tight make-up

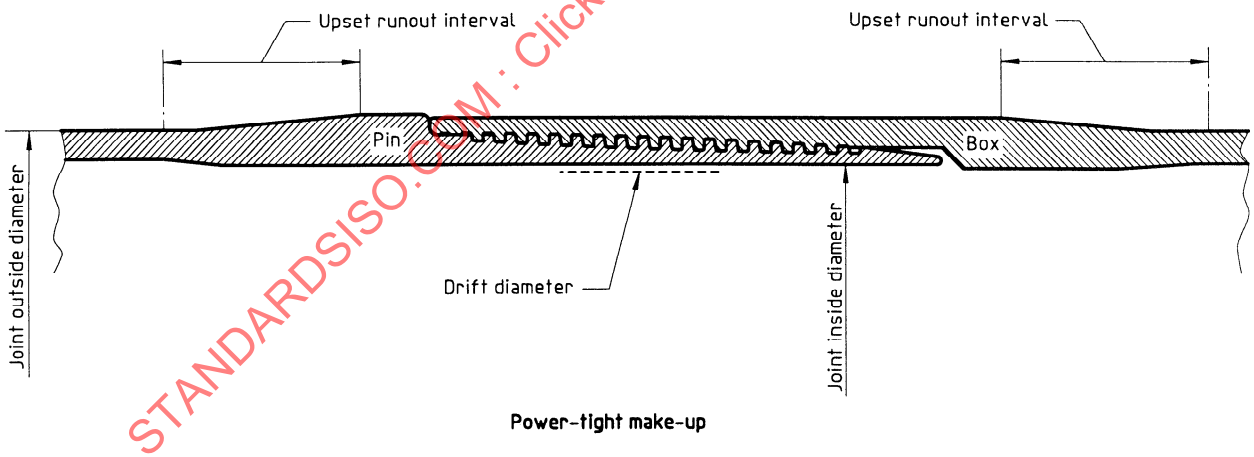
NOTE — See tables 19 and 22 for pipe dimensions and ISO 10422 for thread details.

Figure 6 — Integral-joint tubing

Dimensions in millimetres



Box and pin members



Power-tight make-up

NOTE — Upset runout interval includes both internal and external upset tapers.
L_0 = pin or box maximum length.
L_i = minimum length from end of pipe of the machined diameter B on pin, or machined diameter D plus length of thread on box, to the beginning of the internal upset runout.
For pup-joints only, L_0 may be 127 mm longer than specified for either pin or box.
See tables 18 and 20 for pipe dimensions and ISO 10422 for thread details.

Figure 7 — Extreme-line casing

Table 23 — Plain-end liners — Group 1 (J55 grade only) — Dimensions and masses

Labels		Outside diameter, D	Plain-end mass	Wall thickness, t	Inside diameter, d
1	2	mm	kg/m	mm	mm
3-1/2	9,91	88,90	14,75	7,34	74,22
4	11,34	101,60	6,88	7,26	87,07
4-1/2	13,04	114,30	19,41	7,37	99,57
5	17,93	127,00	26,68	9,19	108,61
5-1/2	19,81	139,70	29,48	9,17	121,36
6-5/8	27,65	168,28	41,15	10,59	147,09

Table 24 — Length ranges

Dimensions in metres

	Range 1	Range 2	Range 3
Casing and liners			
Total length range, inclusive	4,88 to 7,62	7,62 to 10,36	10,36 to 14,63
Length range for 95 % or more of carload[1)]			
Permissible variation, max.	1,83	1,52	1,83
Permissible length, min.	5,49	8,53	10,97
Tubing			
Total length range, inclusive[2)]	6,10 to 7,32	8,53 to 9,75	10,36 to 14,63
Length range for 100 % of carload[1)]			
Permissible variation, max.	0,61	0,61	1,83
Permissible length, min.	6,10	8,53	10,36
Pup-joints			
Lengths — 0,61; 0,91; 1,22; 1,83; 2,44; 3,05 and 3,66[3)]			
Tolerance — ± 0,076			

1) Carload tolerances shall not apply to orders of less than a carload. For any carload of pipe shipped to the final destination without transfer or removal from the car, the tolerance shall apply to each car. For any order consisting of more than a carload and shipped from the manufacturer's facility by rail, but not to the final destination, the carload tolerance shall apply to the total order, but not to the individual carloads.

2) By agreement between interested parties the total length range for range 1 tubing may be 6,1 m to 8,53 m.

3) 0,61 m pup-joints may be furnished up to 0,91 m long by agreement between interested parties, and lengths other than those listed may be furnished by agreement between interested parties.

7.5 Length

Casing, tubing, plain-end liners and pup-joints shall be furnished in lengths conforming to table 24. The length of connectors, except couplings, shall be as agreed between interested parties. The length of each finished pipe shall be determined for conformance to length requirements. Length determination shall be in metres and hundredths of a metre.

7.6 Casing jointers

If specified on the purchase order (for round-thread casing only) jointers (two pieces coupled to make a standard length) may be furnished to a maximum of 5 % of the order; but no length used in making a jointer shall be less than 1,52 m.

7.7 Height and trim of electric weld flash

The outside flash of electric-welded casing and tubing shall be trimmed to an essentially flush condition.

It shall be the aim of the manufacturer to provide an inside surface at the weld of electric-welded casing and tubing that is a) reasonably close to flush after trimming, and b) contains no jagged edges from the original weld flash. It may be desirable for the manufacturer to provide an inside surface at the trimmed weld with a slight groove in order to meet this aim.

The inside flash of electric-welded casing and tubing shall be trimmed as specified in 7.7.1 and 7.7.2.

7.7.1 Groups 1 and 2

a) The height of the inside weld flash shall not exceed 1,14 mm for casing or 0,38 mm for tubing, measured from the inside surface adjacent to the flash.

b) The depth of groove resulting from removal of the inside flash shall not be greater than the amount listed below for the various wall thicknesses. Depth of groove is defined as the difference between the wall thickness measured approximately 25 mm from the weld line and the remaining wall under the groove.

Wall thickness, t	Maximum depth of trim
3,84 mm $\leqslant t \leqslant$ 7,64 mm	0,38 mm
$\geqslant$ 7,64 mm	0,05t

7.7.2 Groups 3 and 4

No inside flash height shall be permitted. The groove on the inside weld surface shall not exceed a depth of 0,38 mm and shall not contain sharp corners that would interfere with ultrasonic inspection.

Casing or tubing with weld flash exceeding the above limits shall be either rejected or repaired by grinding.

7.8 Straightness

Deviation from straight or chord height shall not exceed either of the following:

a) 0,2 % of the total length of the pipe measured from one end of the pipe to the other end for pipes with specified diameter above 101,60 mm;

b) 3,18 mm maximum drop in the transverse direction in the 1,52 m length at each end.

See figures 13 and 14.

7.9 Drift requirements

Each length of casing and tubing either finished or unfinished shall be drift tested throughout its entire length. Casing and tubing threaded by an entity other than the pipe manufacturer shall also be drift tested for a distance of 0,6 m from the coupled end on casing and 1 m from the coupled end on tubing.

NOTE 7 Unfinished pipe is pipe furnished unthreaded, either upset or non-upset, but in compliance with all requirements of this International Standard for a particular grade, and identified by the UF symbol in addition to the other marking requirements. See clause 10.

Table 25 — Standard drift size

Dimensions in millimetres

Product and size	Standard drift mandrel size, min. Length	Diameter
Casing[1] **and liners**		
219,10 and smaller	152	d – 3,18
244,50 to 339,70	305	d – 3,97
406,40 and larger	305	d – 4,76
Tubing[2]		
73,00 and smaller	1 067	d – 2,38
88,90 and larger	1 067	d – 3,18

1) The minimum diameter of the drift mandrel for extreme-line casing shall be as shown in table 20, thirteenth column.

2) Integral-joint tubing shall be tested before upsetting with a drift mandrel as shown, and shall also be drift tested at the pin end, after upsetting, with a cylindrical drift mandrel 1 067 mm in length and d_{iu} – 0,38 mm in diameter (see table 22, sixth column).

When specified by the purchaser, casing in the following sizes and masses shall be furnished as "alternate drift casing" when tested with the larger drift mandrels as shown in table 26. Pipe which is drifted with the larger drift mandrels shall be marked as described in clause 10.

Table 26 — Alternate drift size

Labels 1	Labels 2	Product size mm	Product mass kg/m	Alternate drift mandrel size, min. Length mm	Diameter mm
7	23	177,80	34,23	152	158,75
7	32	177,80	47,62	152	152,40
7-3/4	46,1	196,90	68,60	152	165,10
8-5/8	32	219,10	47,62	152	200,03
8-5/8	40	219,10	59,53	152	193,68
9-5/8	40	244,50	59,53	305	222,25
9-5/8	53,5	244,50	79,62	305	215,90
9-5/8	58,4	244,50	85,48	305	212,73
10-3/4	45,5	273,10	67,71	305	250,82
10-3/4	55,5	273,10	82,59	305	244,48
11-3/4	42	298,50	62,50	305	279,40
11-3/4	60	298,50	89,29	305	269,88
11-3/4	65	298,50	96,73	305	269,88
13-3/8	72	339,70	107,15	305	311,15

7.10 Tolerances on dimensions and masses

7.10.1 Outside diameter, D

Outside diameter	Tolerance
$\leqslant$ 101,60 mm	± 0,79 mm
$\geqslant$ 114,30 mm	+ 1 % −0,5 %

For upset casing the following tolerances apply to the outside diameter of the pipe body immediately behind the upset for a distance of approximately 127 mm for sizes 139,70 mm and smaller (label 1: 5-1/2 and below), and a distance approximately equal to the outside diameter for sizes larger than 139,70 mm (label 1: beyond 5-1/2). Measurements shall be made with calipers or snap gauges.

Pipe size, D mm	Tolerances behind m_{eu} or L_0	
$26,67 \leqslant D \leqslant 88,90$	+ 2,38 mm	– 0,79 mm
$101,60 \leqslant D \leqslant 127,00$	+ 2,78 mm	– 0,75 % D
$139,70 \leqslant D \leqslant 219,10$	+ 3,18 mm	– 0,75 % D
$\geqslant 244,50$	+ 3,97 mm	– 0,75 % D

For 60,33 mm and larger (label 1: 2-3/8 and beyond) external-upset tubing the following tolerances shall apply to the outside diameter at distance L_a from the end of the pipe.

The measurements shall be made with snap gauges or calipers. Changes in diameter between L_a and L_b shall be smooth and gradual. Pipe body outside diameter tolerances do not apply for a distance of L_b from the end of the pipe.

Pipe size, D mm	Tolerance	
$60,33 \leqslant D \leqslant 88,90$	+ 2,38 mm	– 0,79 mm
101,60	+ 2,78 mm	– 0,79 mm
114,30	+ 2,78 mm	– 0,75 % D

7.10.2 Wall thickness

Tolerance – 12,5 %

7.10.3 Mass

	Tolerance
Single lengths	+ 6,5 % – 3,5 %
Carload lots	– 1,75 %

A carload is considered to be a minimum of 18 144 kg.

7.10.4 Inside diameter

The inside diameter d is governed by the outside diameter and mass tolerances.

7.10.5 Upset dimensions

Tolerances on upset dimensions are given in tables 20, 21 and 22.

7.11 Pipe ends

7.11.1 General

The user should specify on the purchase order the type of connection which is adequate for the intended application. When selecting the type of connection, the user should take into consideration factors such as well fluids, pressure and temperature, operating environment, depth, etc.

7.11.2 Casing

Unless otherwise stated on the purchase order, casing shall be furnished threaded and coupled, 8-round thread. If specified on the purchase order, casing shall be furnished with one of the following end finishes:

— plain end;

— 8-round thread without coupling;

— buttress thread with coupling;

— buttress thread without coupling;

— extreme-line thread;

— other type of connection as specified by the purchaser.

Additionally, seal-ring configuration according to annex B (SR13) may be ordered.

If long-thread grade H40, J55 or K55 casing in accordance with table 18 is desired, the purchaser shall specify this on the purchase order. Otherwise short-thread casing in accordance with table 18 will be furnished. Likewise, if special threads or end finish are desired, agreement shall be reached with the manufacturer and the requirements shall be specified on the purchase order.

7.11.3 Liners

Liners shall be furnished with square-cut plain ends, with all burrs removed from both inside and outside edges.

7.11.4 Tubing

Unless otherwise stated on the purchase order, tubing shall be furnished threaded and coupled. If so specified on the purchase order, tubing shall be furnished with one of the following end finishes:

— plain end;

— threaded ends without coupling;

— integral joint;

— other type of connection as specified on the purchase order.

Additionally, seal-ring configuration according to annex B (SR13) may be ordered.

Ends shall be either upset or non-upset as specified on the purchase order.

7.11.5 Pup-joints and connectors

Pup-joints and connectors shall be furnished with threaded ends without couplings unless specified otherwise.

NOTE 8 Special marking as given in clause 10 is required for pipe furnished with plain ends or end finish not specified in this section, but whose body is manufactured in accordance with the requirements specified in this section.

7.11.6 Threading

Pipe threads, gauging practice, and thread inspection shall conform to the requirements of ISO 10422. Pipe ends shall not be rounded out by hammering to secure conformance with threading requirements. Pipe threaded by an entity other than the pipe manufacturer shall be marked in accordance with 10.8

7.11.7 Workmanship of ends

The inside and outside edges of the ends of all pipes shall be free of burrs. The threads of martensitic chromium alloys have shown a tendency towards adhesive wear, or galling during make-up and breakout. Their galling resistance may be improved by surface preparations which are beyond the scope of this document.

7.12 Coupling make-up and thread protection

7.12.1 Groups 1, 2 and 3

All casing couplings and regular tubing couplings shall be screwed on to the pipe power-tight except when they shall be screwed on handling-tight[1] or shipped separately, if so specified on the purchase order. Special clearance tubing couplings shall be screwed on to the pipe handling-tight, except when they shall be shipped separately if so specified on the purchase order. A thread compound shall be applied to cover the full surface on the engaged thread of either the coupling or pipe before making up the joint. Unless otherwise specified by the purchaser, the thread compound shall be that (or any) which meets the performance objectives set forth in API Bul 5A2. When pipe is furnished threaded and coupled, the field end and the coupling shall be provided with thread protectors. When pipe is furnished threaded, but without couplings attached, each end shall be provided with a thread protector. Thread protectors shall conform to the requirements of 11.2. All exposed threads shall be coated with a high-grade thread compound. A storage compound of distinct colour may be substitued for high-grade thread compound on all exposed threads. Whichever compound is used shall be applied to a surface that is clean and reasonably free of moisture and cutting fluids.

NOTES

9 Martensitic chromium steels are sensitive to galling. Special precautions may be necessary for thread surface treatment and/or lubrication to minimize galling during hydrostatic testing (plug application and removal).

10 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 for thread leakage, because mill-applied couplings made up power-tight, although leakproof at the time of make-up, may not always remain so after transportation, handling and use.

7.12.2 Group 4

All requirements are the same as shown in 7.12.1 except casing couplings shall be shipped separately unless power-tight make-up is specified on the purchase order.

8 Couplings

8.1 Material

Couplings for pipe conforming to this International Standard shall be seamless, be of the same grade and type as the pipe and be given the same heat treatment as the pipe with the following exceptions.

8.1.1 Group 1

When heat treatment is not stipulated on the purchase order, grade H40 pipe may be furnished with either as-rolled, normalized, normalized and tempered or quenched and tempered grade H40, J55 or K55 couplings.

When heat treatment is not stipulated on the purchase order, grade J55 pipe may be furnished with either as-rolled, normalized, normalized and tempered or quenched and tempered grade J55 or K55 couplings.

When heat treatment is not stipulated on the purchase order, grade K55 pipe may be furnished with either as-rolled, normalized, normalized and tempered or quenched and tempered grade K55 couplings.

Grade J55 EUE tubing shall be furnished with L80 special clearance couplings when specified on the purchase order. Grade J55 and K55 buttress casing shall be furnished with L80 couplings when specified on the purchase order.

Normalized grade N80 pipe may be furnished with either normalized, normalized and tempered or quenched and tempered grade N80 couplings. Normalized and tempered grade N80 pipe may be furnished with either normalized and tempered or quenched and tempered grade N80 couplings. Grade N80 EUE tubing shall be furnished with P110 special clearance couplings when specified on the purchase order. Grade N80 buttress casing shall be furnished with P110 couplings when specified on the purchase order.

1) Handling-tight is defined as sufficiently tight that the coupling cannot be removed except by the use of a wrench.

8.1.2 Group 3

Grade P110 buttress casing shall be furnished with Q125 couplings when specified on the purchase order.

8.1.3 Group 4

The couplings shall be of seamless manufacture using the same requirements and quality control provisions as casing manufactured to this International Standard. See clauses 5 and 6. Couplings and coupling blanks shall be cut from coupling stock. For coupling blanks, refer to annex B (SR9).

NOTE 11 When couplings are electroplated, the electroplating process should be controlled to minimize hydrogen absorption.

8.2 Process of manufacture

8.2.1 Groups 1, 2 and 3

8.2.1.1 Seamless pipe and hot forging

Couplings made from seamless pipe as defined in 3.1 or hot forgings shall be heat treated as specified in 5.2.

8.2.1.2 Subcritical forging

Grade J55 and K55 couplings made by subcritical forging shall be stress relieved, or at the discretion of the manufacturer may be normalized or normalized and tempered. Grade N80 couplings shall be normalized and tempered, or at the discretion of the manufacturer may be quenched and tempered. For groups 2 and 3, couplings shall be heat treated as specified in 5.2 for the particular grade and type.

8.2.1.3 Centrifugal casting

Couplings made by centrifugal casting shall be cast in a rotating mould, shall be given a homogenizing heat treatment (as defined in the latest edition of ASTM A919) prior to the final treatment, and shall be fully machined on all surfaces. All grades of centrifugal cast couplings shall be either normalized and tempered or quenched and tempered at the discretion of the manufacturer.

8.2.2 Group 4

Same as seamless pipe.

8.3 Performance properties

Buttress thread casing in the following sizes and masses will not develop the highest minimum joint strengths listed in API Bul 5C2 unless couplings of the next higher grade are specified.

Label 1	Size	Label 2	
		Regular coupling	Special clearance coupling
4-1/2	114,30	—	20,09 and beyond
5	127,00	31,85 and beyond	22,32 and beyond
5-1/2	139,70	34,23	all
6-5/8	168,28	—	all
7	177,80	47,62 and beyond	all
7[1)]	177,80	52,09 and beyond	—
7-5/8	193,70	—	44,20 and beyond
7-5/8[1)]	193,70	63,39 and beyond	—
8-5/8	219,10	—	all
9-5/8	244,50	—	all
10-3/4	273,10	—	all
11-3/4	298,50	—	—
13-3/8	339,70	—	—

1) For grade Q125.

8.4 Mechanical properties

Couplings shall conform to the mechanical requirements specified in clauses 6 and 9 including the frequency of testing, retest provisions, etc. A record of these tests shall be open to inspection by the purchaser.

8.5 Dimensions and tolerances

8.5.1 Groups 1, 2 and 3

Couplings shall conform to the dimensions and tolerances shown in tables 27 to 30. Unless otherwise specified, threaded and coupled casing and tubing shall be furnished with regular couplings.

8.5.2 Group 4

Couplings may be machined on the complete outside surface in addition to the inside surface. Dimensions shall be as specified on the purchase order unless standard ISO couplings are ordered, in which case the dimensions shall be as shown in tables 27 and 28.

NOTE 12 The purchaser should recognize that ISO threaded couplings with the regular outside diameter may not have a leak resistance as high as the internal yield pressure rating of the pipe body due to inadequate bearing pressure between the coupling and pin.

8.6 Regular couplings

Regular couplings have diameters as shown in tables 27 to 30 (W). The inside and outside edges of the bearing face shall be rounded or broken, but shall not materially reduce dimension b so that enough thickness is left to safely support the mass of the pipe on the elevator. The ends of couplings shall be faced true at right angles to the axis.

Table 27 — Round-thread casing coupling dimensions, masses and tolerances — All groups

Label 1	Outside[1] diameter of pipe	Outside[2, 3] diameter, W	Minimum length		Diameter of recess, Q	Width of bearing face, b	Mass	
			short,[4] N_L	long, N_L			short	long
	mm	mm	mm	mm	mm	mm	kg	kg
4-1/2	114,30	127,00	158,75	177,80	116,68	3,97	3,59	4,12
5	127,00	141,30	165,10	196,85	129,38	4,76	4,62	5,70
5-1/2	139,70	153,67	171,45	203,20	142,08	3,18	5,219	6,36
6-5/8	168,28	187,71	184,15	222,25	170,66	6,35	9,04	11,24
7	177,80	194,50	184,20	228,60	180,20	4,76	8,31	10,73
7-5/8	193,70	215,90	190,50	235,00	196,10	6,35	12,19	15,49
8-5/8	219,10	244,50	196,90	254,00	221,50	7,14	16,09	21,47
9-5/8	244,50	269,90	196,90	266,70	246,90	7,14	17,87	25,22
10-3/4	273,10	298,50	203,20	—	275,40	7,14	20,59	—
11-3/4	298,50	323,90	203,20	—	300,80	7,14	22,44	—
13-3/8	339,70	365,10	203,20	—	342,10	7,94	25,43	—
16	406,40	431,80	228,60	—	408,80	7,94	34,60	—
18-5/8	473,10	508,00	228,60	—	475,50	7,94	53,53	—
20	508,00	533,40	228,60	292,10	510,40	7,94	43,03	57,04

NOTE — See figures 1 and 2.

1) The size of the coupling is the same as the corresponding pipe size.
2) Tolerance on outside diameter W shall be ± 1 % but not greater than ± 3,18 mm for groups 1, 2 and 3.
3) Tolerance on outside diameter W shall be ± 1 % but not greater than + 3,18 mm – 1,59 mm for group 4.
4) Short or long couplings available on group 1 pipe, up to 273,10 mm. For 273,10 mm and larger use only short couplings on all groups.

Table 28 — Buttress-thread casing coupling dimensions, masses and tolerances — All groups

Label 1	Outside[1] diameter of pipe	Outside diameter[2, 3]		Minimum length, N_L	Diameter of counterbore, Q	Width of bearing face, b	Mass	
		regular, W	special clearance, W_c				regular	special clearance
	mm	mm	mm	mm	mm	mm	kg	kg
4-1/2	114,30	127,00	123,83	225,40	117,86	3,18	4,55	3,45
5	127,00	141,30	136,53	231,80	130,56	3,97	5,85	3,96
5-1/2	139,70	153,67	149,23	235,00	143,26	3,97	6,36	4,43
6-5/8	168,28	187,71	177,80	244,50	171,83	6,35	11,01	5,60
7	177,80	194,50	187,30	254,00	181,40	5,56	10,45	6,22
7-5/8	193,70	215,90	206,40	263,50	197,20	7,94	15,68	9,20
8-5/8	219,10	244,50	231,80	269,90	222,60	9,53	20,67	10,70
9-5/8	244,50	269,90	257,20	269,90	248,00	9,53	22,95	11,91
10-3/4	273,10	298,50	285,80	269,90	276,00	9,53	25,51	13,28
11-3/4	298,50	323,90	—	269,90	302,00	9,53	28,00	—
13-3/8	339,70	365,10	—	269,90	343,30	9,53	31,48	—
16[4]	406,40	431,80	—	269,90	410,30	9,53	39,93	—
18-5/8[4]	473,10	508,00	—	269,90	477,00	9,53	62,12	—
20[4]	508,00	533,40	—	269,90	511,90	9,53	49,66	—

NOTE — See figure 3.

1) The size of the coupling is the same as the corresponding pipe size.
2) Tolerance on outside diameter W shall be ± 1 % but not greater than ± 3,18 mm for groups 1, 2 and 3.
3) Tolerance on outside diameter W shall be ± 1 % but not greater than + 3,18 mm – 1,59 mm for group 4.
4) Available on group 1 only.

Table 29 — Non-upset tubing coupling dimensions, masses and tolerances — Groups 1, 2 and 3

Group	Label 1	Outside[1] diameter of pipe	Outside[2] diameter, W	Minimum length, N_L	Diameter of recess, Q	Width of bearing face, b	Maximum bearing face diameter special bevel, B_f	Mass
		mm	mm	mm	mm	mm	mm	kg
1, 2	1,050	26,67	33,35	80,96	28,27	1,59	30,00	0,23
1, 2	1,315	33,40	42,16	82,55	35,00	2,38	37,79	0,38
1, 2	1,660	42,16	52,30	88,90	43,76	3,18	47,17	0,59
1, 2	1,900	48,26	55,88	95,25	49,86	1,59	52,07	0,56
1, 2, 3	2-3/8	60,33	73,03	107,95	61,93	4,76	66,68	1,28
1, 2, 3	2-7/8	73,03	88,90	130,18	74,63	4,76	80,98	2,34
1, 2, 3	3-1/2	88,90	107,95	142,88	90,50	4,76	98,43	3,71
1, 2	4	101,60	120,65	146,05	103,20	4,76	111,13	4,34
1, 2	4-1/2	114,30	132,08	155,58	115,90	4,76	123,19	4,88

NOTE — See figure 4.

1) The size of the coupling is the same as the corresponding pipe size.
2) Tolerance on outside diameter W shall be ± 1 %.

Table 30 — External-upset tubing coupling dimensions, masses and tolerances — Groups 1, 2 and 3

Group	Label 1	Outside[1] diameter of pipe	Outside diameter[2, 3] regular and special bevel, W	Outside diameter[2, 3] special clearance, W_c	Minimum length, N_L	Diameter of recess, Q	Width of bearing face, regular	Maximum bearing face diameter special bevel	Maximum bearing face diameter special clearance	Mass regular	Mass special clearance
		mm	mm	mm	mm	mm	mm	mm	mm	kg	kg
1, 2	1,050	26,67	42,16	—	82,55	35,00	2,38	37,79	—	0,38	—
1, 2	1,315	33,40	48,26	—	88,90	38,89	2,38	42,77	—	0,57	—
1, 2	1,660	42,16	55,88	—	95,25	47,63	3,18	50,95	—	0,68	—
1, 2	1,900	48,26	63,50	—	98,43	54,76	3,18	58,34	—	0,84	—
1, 2, 3	2-3/8	60,33	77,80	73,91	123,83	67,46	3,97	71,83	69,90	1,55	1,04
1, 2, 3	2-7/8	73,03	93,17	87,88	133,35	80,16	5,56	85,87	83,26	2,40	1,51
1, 2, 3	3-1/2	88,90	114,30	106,17	146,05	96,85	6,35	104,78	100,71	4,09	2,30
1, 2	4	101,60	127,00	—	152,40	109,55	6,35	117,48	—	4,82	—
1, 2	4-1/2	114,30	141,30	—	158,75	122,25	6,35	130,96	—	6,04	—

NOTE — See figure 5.

1) The size of the coupling is the same as the corresponding pipe size.
2) Tolerance on outside diameter W shall be ± 1 %.
3) Tolerance on outside diameter W_c shall be ± 0,38 mm.

8.7 Special clearance couplings — Groups 1, 2 and 3

Special clearance (reduced outside diameter W_c) couplings for buttress casing and external-upset tubing shall be furnished when specified in the purchase order. Special clearance couplings shall conform to the dimensions (except b) and tolerances given in tables 28 and 30. See clause 10 for marking and colour identification. Unless otherwise specified, special clearance tubing couplings shall be bevelled at both ends.

8.8 Combination couplings

Combination couplings with different types of thread of the same specified size shall be furnished when specified on the purchase order. The minimum length and minimum outside diameter of combination couplings shall be sufficient to accommodate the specified size and type of threads.

8.9 Reducing couplings

8.9.1 Groups 1, 2 and 3

Reducing couplings are used to connect two pipes of different D sizes with the same or different types of thread on the two ends, and shall be furnished when specified on the purchase order. The minimum length and minimum D of reducing couplings shall be sufficient to accommodate the specified size and type of threads.

8.9.2 Group 4

Reducing couplings are not allowed.

8.10 Seal-ring couplings

Seal-ring couplings conforming to the requirements of annex B (SR13) shall be furnished when specified on the purchase order.

8.11 Special bevel couplings — Groups 1, 2 and 3

Special bevel couplings conforming to the requirements of tables 29 and 30 shall be furnished for non-upset and external-upset tubing when specified on the purchase order. Unless otherwise specified, special bevel couplings shall be bevelled 20° on both ends.

8.12 Threading

Coupling threads, gauging practice and thread inspection shall conform to the requirements of ISO 10422. Couplings shall not be expanded to provide the required taper for threads.

8.13 Surface inspection

8.13.1 General requirements — All groups

a) Couplings shall be inspected after finish machining and before any inside or outside surface plating. Inspection shall be by the wet fluorescent magnetic particle method, or by other non-destructive method of equal sensitivity as demonstrated to the purchaser. The inspection shall exclude the dry magnetic method. The inspection shall encompass both inside and outside surfaces with a circumferentially oriented magnetic field. The threaded surfaces shall be visually inspected after plating or coating.

b) Finished couplings shall be free of all seams, cracks, porosity and imperfections[2] on the inside which break the continuity of the thread. Indications of non-metallic inclusions shall not be considered defects[3] unless they are demonstrated to have a depth in excess of 0,89 mm; longitudinal discontinuities which do not exceed 12,7 mm in length need not be probed by the manufacturer.

c) Finished couplings with grip marks, pits, round or sharp bottom gouges and similar imperfections are not cause for rejection, unless the depth of the imperfections exceeds those listed in table 31.

Table 31 — Permissible depth of external imperfections of couplings

Dimensions in millimetres

Coupling for pipe sizes	Permissible depth of external imperfections		
	Group 1, Group 2 (except C90 and T95) and Group 3		Group 2 (C90 and T95) and Group 4
	Pits and round bottom gouges	Grip marks and sharp bottom gouges	All
Tubing			
⩾ 73,03	0,76	0,64	—
88,90 ⩽ D ⩽ 139,70	0,89	0,76	—
177,80	1,14	1,02	—
Casing			
⩾ 139,70	0,89	0,76	0,76
168,28 ⩽ D ⩽ 193,70	1,14	1,02	0,89
⩽ 219,10	1,52	1,02	0,89

8.13.2 By agreement between interested parties, non-destructive testing inspection of group 1, grades H40, J55 and K55, couplings may be waived. In this case, the couplings shall be free of all visible seams, cracks and porosity.

8.14 Measurement of imperfection

The depth of imperfection shall be measured from the normal surface or contour of the coupling extended over the imperfection. The outside diameter of the finished coupling shall be measured across the finished surface or contour of the coupling (i.e., initial surface or grind contour resulting from the removal of an imperfection or defect). The outside diameter shall not be measured at the base of an acceptable pit.

2) An imperfection is a discontinuity or irregularity in the product detected by methods outlined in this International Standard.

3) A defect is an imperfection of sufficient magnitude to warrant rejection of the product based on the stipulations of this International Standard.

8.15 Repair and removal of imperfections and defects

Repair welding is not permitted. All seams, cracks or pits may be removed, and all other imperfections and defects may be removed or reduced to acceptable limits by machining or grinding on the outer surface, provided the outside diameter of the finished coupling is within the tolerances when measured at the point where the defect was removed. The machining or grinding shall be approximately faired into the outer contour of the coupling.

8.16 Thread plating — Group 4

Thread plating shall be as specified on the purchase order.

8.17 Couplings and coupling blank protection — Group 4

All loose couplings and all coupling blanks that have been machined to their final outside diameter shall be boxed to prevent contact with one another during shipment. All other coupling blanks shall be boxed to prevent nicks and gouges that will not be removed by subsequent machining. Boxes shall be manufactured from wood and designed to be easily handled by fork-lift. Boxes shall be limited to 1,22 m in width to facilitate truck transport.

9 Inspection and testing

9.1 General

9.1.1 Mill control tests

9.1.1.1 Groups 1, 2 and 3

One tensile test shall be made as a control on each heat of steel used by the manufacturer for the production of pipe according to this International Standard. For electric welded pipe, these tensile tests shall be made on either the skelp or the finished pipe, at the discretion of the manufacturer.

9.1.1.2 Group 4 (grade L80)

Each control tensile specimen shall be hardness tested to verify conformance to hardness requirements.

9.1.2. Testing or measuring devices

If testing or measuring equipment, whose calibration or verification is required under the provisions of this International Standard, is subjected to unusual or severe conditions such as would make its accuracy questionable, recalibration or reverification shall be performed before further use of the equipment.

9.1.3 Imperfections and defects

An imperfection is a discontinuity or irregularity in the product, detected by methods outlined in this International Standard. An imperfection is considered a defect when it is of sufficient magnitude to warrant rejection of the product based on the stipulations of this International Standard. All pipe shall be free from defects as specified below.

9.1.3.1 Surface-breaking pipe body and weld seam defects

Any imperfection on the outside or inside surface, of any orientation, shall be considered a defect if

— it is linear and deeper than 12,5 % of the specified wall thickness in the radial direction for grades H40, J55, K55, L80, C95, N80 and P110 manufactured to SR16; or is linear and deeper than 5 % of the specified wall thickness in the radial direction for grades C90, T95, P110 without SR16 and Q125; or

— it is linear[4] or non-linear[5] and results in a wall thickness above or below the imperfection with a value less than 87,5 % of the specified wall thickness.

9.1.3.2 Surface-breaking pipe upset defects

Any imperfection on the outside or inside surface, of any orientation, that is deeper than that given in table 32 shall be considered a defect. The internal upset configuration on all upset products shall exhibit no sharp corners or drastic changes of section that would cause a 90° hook-type tool to hang up.

9.1.3.3 Quench cracks

Quench cracks detected by methods outlined in this International Standard shall be considered defects.

NOTE 13 Quench cracks in steel result from stresses produced during the austenite-to-martensite transformation, which is accompanied by an increase in volume.

9.1.3.4 Non-surface-breaking weld seam defects

Any weld seam imperfection within 1,59 mm of either side of the weld line, not on the inside or outside surface, which is proven to reduce the net effective wall thickness below 87,5 % of the specified wall thickness shall be considered a defect.

4) Linear imperfections include, but are not limited to, cracks, seams, laps, plug scores, cuts and gouges.

5) Non-linear imperfections include, but are not limited to, pits and round-bottom die stamping.

Table 32 — Upset products — Maximum permissible depth of imperfections

Surface	Depth	Measurement notes
A. Extreme-line casing integral-joint and external-upset tubing		
1 All surfaces of upset and upset runout interval, except as stated below.	12,5 %	Percent of specified pipe body wall thickness; for non-linear imperfections; for all groups of pipe.
	12,5 %	Percent of specified pipe body wall thickness; for linear imperfections; for groups 1 and 2 (except C90 and T95) pipe.
	5 %	Percent of specified pipe body wall thickness; for linear imperfections; for groups 3 and 4 and grades C90, T95 pipe.
2 The minimum wall thickness in the upset runout interval, and the maximum combined effect of coincident internal and external imperfections in all areas, shall not result in less than 87,5 % of the specified wall thickness.		
B. Extreme-line casing		
1 Box-end external surface	0,25 mm	For Label 1: 7-5/8 and below. From end of pipe to a plane 120,6 mm from the end.
	0,25 mm	For Label 1: Beyond 7-5/8. From end of pipe to a plane 165,1 mm from the end.
2 Pin-end internal surface	0,38 mm	From end of pipe to plane of external shoulder.
3 All machined surfaces of the box shall be free of seams, laps and cracks. The pin and box shall be free of any imperfections which break the continuity of the threads or seals.		
C. Integral-joint tubing		
1 Box-end external surface	0,25 mm	From end of pipe to a plane at a distance equal to the specified minimum dimension L_{eu} (figure 6) from end of pipe.
2 Pin-end internal surface	0,38 mm	From end of pipe to a plane at a distance equal to the specified minimum dimension L_{iu} (figure 6) from end of pipe.
		For grades C90 and T95, the maximum permissible depth for linear imperfections shall be 5 % of the specified pipe body wall thickness.
3 Upset underfills in the upset runout intervals shall not be considered a defect unless the remaining wall thickness (at the upset underfill) is less than 87,5 % of the specified pipe body wall thickness.		

9.2 Testing of chemical composition

9.2.1 Heat analyses

9.2.1.1 Groups 1, 2 and 3

When requested by the purchaser, the manufacturer shall furnish a report giving the heat analysis of each heat of steel used in the manufacture of pipe and couplings furnished on the purchase order. In addition, the purchaser, upon request, shall be furnished with the results of quantitative analyses of other elements normally used by the manufacturer to control mechanical properties.

9.2.1.2 Group 4

The manufacturer shall furnish a report giving the heat analysis of each heat of steel used in the manufacture of pipe and couplings furnished on the purchase order. The report shall include quantitative analyses of other elements normally used by the manufacturer to control mechanical properties.

9.2.2 Product analyses — All groups[6)]

Two tubular products from each heat used shall be analysed for product analyses.

6) For couplings, pup-joints and connectors, the analyses required in 9.2.1 and 9.2.2 may be furnished by the steel manufacturer.

Product analyses shall be made by the manufacturer on the finished tubular product.

Product analyses shall include the results of quantitative determinations of all elements listed in table 2 plus any other elements used by the manufacturer to control mechanical properties.

For groups 1, 2 and 3, the product analyses shall be available to the purchaser on request.

For group 4, the product analyses shall be provided to the purchaser.

9.3 Testing of mechanical and technological properties

9.3.1 Lot definition

9.3.1.1 Pipe (except coupling blanks, pup-joints or connectors heat treated after cutting to blank or individual length)

9.3.1.1.1 Groups 1, 2 (grade L80, type 1 and C95), and 3

A lot is defined as all those lengths of pipe with the same specified dimension and grade which are either as-rolled or heat treated as part of the continuous operation (or batch), and are from a single heat of steel; or from different heats that are grouped according to a documented procedure which will ensure that the appropriate requirements of this International Standard are met.

9.3.1.1.2 Groups 2 (grades L80 9Cr, L80 13Cr, C90 and T95) and 4

A lot is defined as all those lengths of pipe with the same specified dimensions and grade from the same heat of steel which are heat treated as part of a continuous operation (or batch).

9.3.1.2 Coupling blanks, pup-joints or connectors heat treated after cutting to blank or individual length

9.3.1.2.1 All groups

A lot of coupling blanks, pup-joints or connectors heat treated after cutting to blank or individual lengths is defined as that group of pieces with the same specified dimensions and grade from the same heat of steel

a) batch heat treated concurrently in the same heat treating furnace unit,

b) heat treated in sequential loads to the same cycle without interruption in an integral quench furnace unit equipped with a recording controller to provide documentation of heat treating control through the run; or

c) individually heat treated on a unit in a continuous process run within 8 h or less of continuous operation.

9.3.1.2.2 Additional requirements for groups 2 (grades C90 and T95) and 4

A lot shall not exceed 30 couplings, pup-joints or connectors for 244,50 mm and larger casing, or 50 couplings, pup-joints or connectors for smaller sizes of individually heat-treated pieces.

9.3.2 Frequency of testing

9.3.2.1 Tensile tests

9.3.2.1.1 Casing and tubing

The frequency of testing for casing and tubing of all groups is given in table 33.

The joints for testing shall be selected at random, provided the selection procedure provides samples representing the start and end of the heat treatment cycle and alternate ends of the tubes.

9.3.2.1.2 Couplings, pup-joints and connectors

The frequency of testing for couplings is given in table 34 and for pup-joints and connectors in table 35.

For group 1, group 2 (except grades C90 and T95) and group 3, the test specimens from bar stock shall be taken from a location corresponding to the midwall of the finished products for connectors.

For group 2 (grades C90 and T95) and group 4, tensile test specimens for coupling, pup-joint or connector material heat treated in tube length shall be removed from locations as shown in figure 9.

Table 33 — Frequency of tensile tests — Casing and tubing

Group		Maximum number of pieces in a lot	Number of tests per lot
1	⩽ 139,70 mm	400	1
	⩾ 139,70 mm	200	1
2	Tubing	200	1
	Casing	100	1
3	⩽ 139,70 mm	200	1
	⩾ 139,70 mm	100	1
4	All sizes	—	3

NOTE — For multiple-length seamless pipe, a length shall be considered as all of the sections cut from a particular multiple length.

Table 34 — Frequency of tensile tests — Couplings

Group	Source of coupling	Maximum number of pieces in a lot	Number of tests
1 2[1] 3	Seamless pipe tubing casing Forged, or centrifugal cast, or heat treated in blank	200 tubes 100 tubes Heat treatment lot or 400 couplings, whichever is less	1 per heat plus 1 per lot
2[2] and 4	Seamless pipe, all sizes Heat treated in blank	1 tube Heat treatment lot	1 per lot

1) Except C90 and T95.
2) C90 and T95 only.

Table 35 — Frequency of tensile tests — Pup-joints and connectors

Group	Source of pup-joint or connector	Maximum number of pieces in a lot	Number of tests
1 2[1] 3	From casing or tubing: if batch heat treated if continuously heat treated From thick wall tube or bar stock: tubing casing No subsequent heat treatment	100 pup-joints or 400 connectors Heat treatment lot (see 9.3.1.2.2) 200 tubes or bars 100 tubes or bar stock	1 per heat plus 1 per lot No test
2[2] 4	Seamless pipe, all sizes Heat treated in individual lengths No subsequent heat treatment	1 tube Heat treatment lot (see 9.3.1.2.2)	1 per lot No test

1) Except C90 and T95.
2) C90 and T95 only.

9.3.2.2 Flattening tests

See table 36.

Flattening tests shall be made for all welded pipe with D/t ratios as shown in table 17.

9.3.2.3 Hardness tests

9.3.2.3.1 Group 2 — Grades C90 and T95

a) **Non-upset pipe**

A test ring shall be cut from one end of each pipe. Approximately 50 % of these test rings shall be cut from the front end and approximately 50 % from the back ends of the pipe. HRC impressions shall be made in one quadrant of each ring as shown in figure 10.

b) **Upset pipe**

The pipe body of each length tensile tested as specified in 9.3.2.1 shall also be hardness tested in all four quadrants to verify conformance to the requirements. The test frequency of the upset shall be one in every 20 lengths within each lot.

One ring shall be cut from the section of the upset with the maximum wall thickness. Hardness impressions shall be taken on each ring in accordance with figure 10 to provide three hardness values per quadrant in each of four quadrants.

In addition to the through-wall (transverse) hardness tests, an external-surface Brinell or HRC test shall be made on the pipe body and the upset of each length. If the Brinell or HRC reading does not exceed 255 or 25,4 respectively, the length is acceptable. If any of the readings is over 255 HBS (or HBW) or 25,4 HRC, two additional tests may be made in the immediate area. If either of the second tests exceeds 255 HBS (or HBW) or 25,4 HRC, the length shall be rejected.

By agreement between interested parties, hardness test frequencies other than given above may be specified.

By agreement between interested parties, the maximum hardness values may be altered from those stated above based on sulfide stress corrosion cracking tests specified in 6.2.13.

Table 36 — Frequency of flattening tests

A. Casing and tubing			
Group	**Type of heat treatment**		**Number of tests**
1	Non-full body		1 per standard range length
2	Full body casing tubing		1/20 lengths 1/100 lengths
3 4	All		1/length of pipe
B. Pup-joints and connectors			
Group	**Source of pup-joint or connector**		**Maximum number of pieces in a lot**	**Number of tests**
1 2	Treated separately from casing	If batch heat treated	100 pup-joints or 400 connectors	1 per heat plus 1 per lot
		If continuously heat treated	—	
	Manufactured from welded pipes	casing	100 lengths	
		tubing	200 lengths	
3 4	All			1 per length of pipe

c) **Couplings**

Two test rings, one from each end, shall be taken from each tube used for couplings. Hardness tests shall be taken on each ring in accordance with figure 10 and shall include three locations in each of four quadrants.

9.3.2.3.2 Group 2 — Grade L80, type 1, L80 9Cr and L80 13Cr

a) **Pipe**

Each tensile specimen in accordance with 9.3.3.1 shall be tested for hardness to comply with the requirements given in table 3. By agreement between interested parties additional hardness tests may be specified as a supplementary requirement. The laboratory Rockwell C hardness test shall be used as a referee method in cases of disagreement.

b) **Couplings**

Each tensile specimen required shall be tested for hardness.

9.3.2.3.3 Group 4

Hardness test specimens for casing and coupling, pup-joint or connector material heat treated in tube length shall be removed from the locations shown in figure 9 at the frequencies specified in a), b) and c) below.

No test is required for pup-joints or connectors manufactured from a length of Q125 casing or coupling stock previously tested, provided there be no subsequent heat treatment.

a) **Casing**

The hardness test specimens shall be taken at a frequency of three lengths per lot. The lengths for testing shall be selected at random provided the selection procedure provides samples representing the start and end of the heat treatment cycle and alternate ends of the tubes.

b) **Coupling, pup-joint or connector material heat treated in tube length**

One end of each tube of material shall be tested to verify conformance to hardness requirements (approximately 50 % each end).

c) **Couplings, pup-joints or connectors heat treated in coupling blank or individual length**

One piece from each lot shall be tested to verify conformance to hardness requirements. The test specimen shall be removed from the piece as illustrated in figure 9.

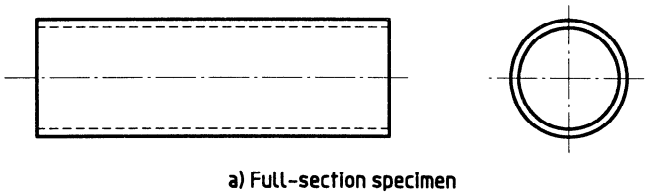
9.3.2.4 Hardenability test — Group 2 (grades C90 and T95)

The sample ring shall be tested with nine Rockwell C impressions in each of four quadrants as shown in figure 10. The minimum frequency of this test shall be one per production run or heat treatment practice. Samples shall be taken at the beginning of each order and thereafter whenever a size change occurs or the austenitization and quenching process conditions change significantly. The average of three readings on an arc constitute a hardness value.

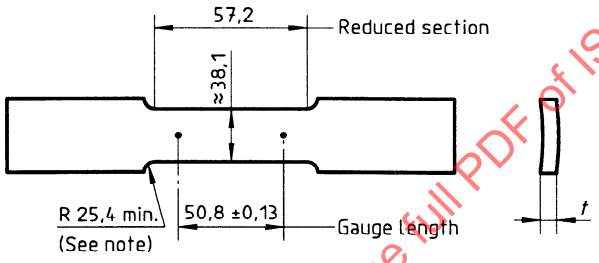
9.3.2.5 Grain size determination — Group 2 (grades C90 and T95)

The frequency of testing for grain size shall be a minimum of once per heat treatment run. The grain size determination shall be made on the as-quenched hardenability test sample.

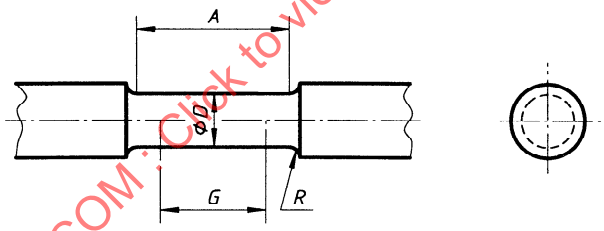
Dimensions in millimetres



a) Full-section specimen

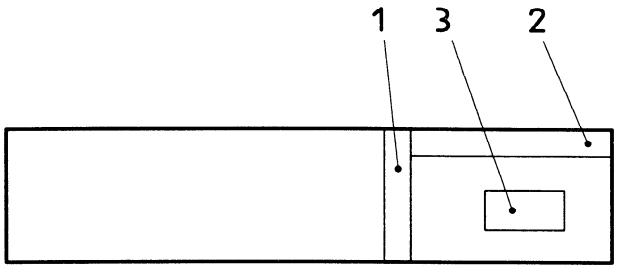


b) Strip specimen



c) Round bar specimen

Figure 8 — Tensile test specimens



Location of test samples:

1 hardness test ring (see figure 10 for details)

2 tensile test specimen

3 impact test samples (see figure 11 for details)

NOTE — Hardness test ring shall be removed from mid-length position of individual heat treated coupling blank.

Figure 9 — Typical location of tests as samples removed from casing, tubing, coupling stock, pup-joint and connector material

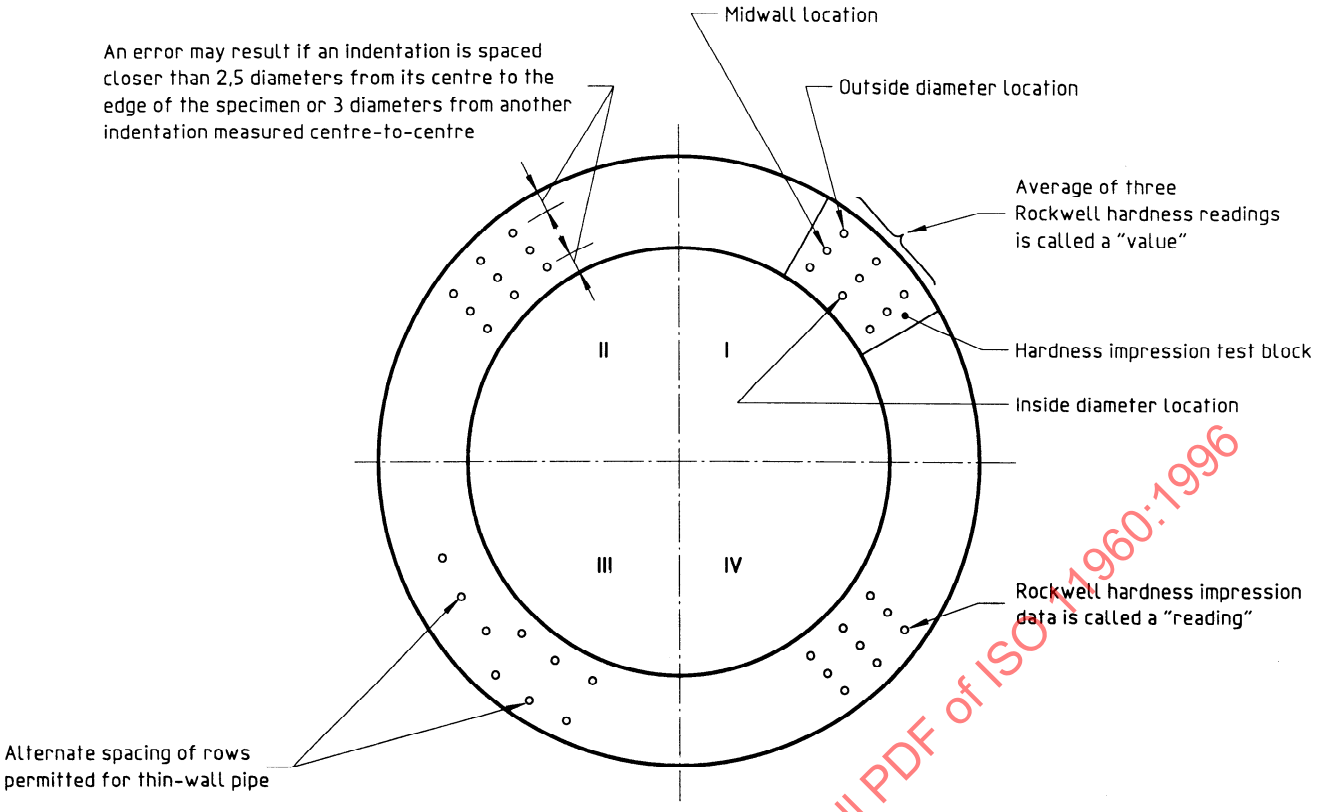
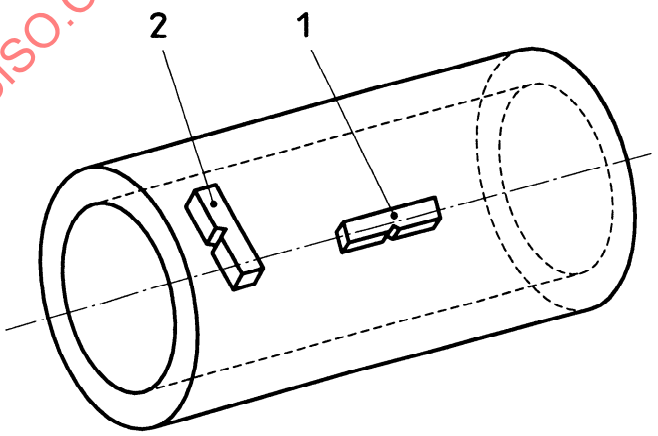


Figure 10 — Through-wall hardness test



All impact samples shall be 10 mm × 10 mm if possible.

1 longitudinal samples

2 transverse samples — notch oriented perpendicular to the axis of the tube (normal to the tube surface)

Figure 11 — Impact test sample orientation

9.3.2.6 Impact test

9.3.2.6.1 Groups 1, 2 and 3

One test shall be taken from each lot.

9.3.2.6.2 Group 4

a) **Casing**

Three lengths per lot shall be tested. The lengths for testing shall be selected at random provided the selection procedures provides samples representing the start and end of the heat treatment cycle and alternate ends, as processed, of the casing.

b) **Couplings, pup-joint or connector material heat treated in tube length**

Alternate ends, as processed, shall be tested on an approximately 50 % basis.

c) **Couplings, pup-joints or connectors heat treated in coupling blank or individual length**

One length from each lot shall be tested.

Supplementary requirements — EW group 4

See annex B (SR11.3) for mandatory requirements for welded casing.

9.3.2.7 Metallographic evaluation — EW group 3

A metallographic evaluation shall be performed at the beginning of the welding process for each size of tubular section, at least every 4 h during the welding and after any substantial interruption of the welding process. The samples shall be obtained prior to heat treatment.

The manufacturer shall have objective criteria at his disposal in order to evaluate the acceptability of the electric welded zone.

9.3.3 Test specimens

9.3.3.1 Tensile test

9.3.3.1.1 General — All groups

Pipe body tensile test specimens shall be either full-section specimens, strip specimens or round bar specimens, as shown in figure 8, at the discretion of the manufacturer. Strip specimens from seamless pipe may be taken from any location about the pipe circumference at the discretion of the manufacturer. Round bar specimens shall be taken from the mid-wall. Strip specimens and round bar specimens from welded pipe shall be taken approximately 90° from the weld or, at the discretion of the manufacturer, from the skelp parallel to the direction of rolling and approximately midway between the edge and the centre. Tensile test specimens for heat-treated pipe shall be removed from pipe subsequent to final heat treatment on the production line.

All strip specimens shall be approximately 38 mm wide in the gauge length if suitable curved-face testing grips are used, or if the ends of the specimen are machined or cold flattened to reduce the curvature in the grip area. Otherwise they shall be approximately 19 mm wide for pipe up to 88,90 mm, approximately 25 mm wide for pipe 101,60 mm to 193,70 mm, and approximately 38 mm wide for pipe from 219,10 mm. All pipe body tensile specimens shall represent the full-wall thickness of the pipe from which the specimen was cut, except for round bar tensile specimens, and shall be tested without flattening. When round bar specimens are used, the 12,7 mm diameter round bar specimens shall be used when the pipe size allows, and the 8,9 mm diameter round bar specimen shall be used for other sizes. For pipe sizes too small to allow an 8,9 mm specimen, round bar tensile specimens are not permitted.

9.3.3.1.2 Additional — Casing and tubing

a) **Group 2 (grade T95 only)**

Test specimens shall be removed from material that has been processed on the production line only.

b) **Group 3**

For welded casing, see requirements in annex B (SR11).

c) **Group 4**

For upset casing, see requirements in annex B (SR10.2). For welded casing, see requirements in annex B (SR11).

9.3.3.1.3 Couplings, pup-joints and connectors — Group 4

In addition to the requirements in 9.3.3.1.2, longitudinal tensile test specimens shall be removed from coupling, pup-joint or connector material and individually heat-treated coupling blanks, pup-joints or connectors subsequent to final heat treatment. Tensile test specimens shall be either strip specimens or, if the wall thickness of the tubular section is over 19,1 mm, a round specimen 12,7 mm in diameter may be used as shown in figure 8.

Round specimens may be used for coupling stock at the discretion of the manufacturer. Tensile test specimens for coupling, pup-joint or connector material heat treated in coupling blank or individual lengths shall be removed from the piece as illustrated in figure 8. Reduced-section strip specimens may be used following agreement between interested parties.

9.3.3.2 Flattening test

Test specimens shall be rings or crop ends not less than 63,5 mm long cut from each end of each length of pipe.

On pipe cut from multiple lengths of a coil, the test on one end of one piece shall represent a test on the adjacent end of the next piece of pipe. If the pipe is to be upset, the test specimen shall be taken from the tube prior to upsetting.

The test specimens may be cut before heat treating and given the same type of heat treatment as the pipe represented. If lot testing is used, precaution shall be taken to ensure that the test specimens can be identified with respect to the length of pipe from which they are cut. Each heat in each lot shall be subjected to a flattening test.

9.3.3.3 Hardness test

a) Hardness test specimens (blocks or rings) shall be taken as shown in figure 9 and tested as shown in figure 10. The three hardness readings taken at each position [outside diameter (OD), midwall and inside diameter (ID)] shall be averaged to give one hardness value for each position.

b) The test ring shall be 12,7 mm to 25,4 mm long.

c) Hardness test surfaces shall be ground parallel and smooth.

d) OD and ID readings shall be made on a band from 2,54 mm to 3,81 mm from the surface.

e) Hardness readings shall be taken on the Rockwell C scale (HRC).

f) All hardness impressions shall be at least three diameters apart.

g) The first impression on each hardness block (or ring quadrant) may be disregarded in order to reduce the probability of errors.

h) For hardenability test (group 2, grades C90 and T95), the sample ring shall be tested with nine Rockwell C impressions in each of four quadrants as shown in figure 10.

9.3.3.4 Impact test

Three samples shall be removed with the notch oriented as shown in figure 11. Full size 10 mm × 10 mm specimens shall be used whenever possible. A test shall consist of three samples (see 6.2.3).

Impact test specimens shall not be machined from flattened tubular sections.

The surface of the finish machined transverse test specimen may contain the OD curvature of the original tubular product provided that the requirements of figure 12 be met. These specimens shall be used only to permit the use of a transverse specimen of maximum thickness.

9.4 Hydrostatic test

9.4.1 Hydrostatic test procedures

Test each length of casing, tubing, liners and pup-joints full length subsequent to upsetting and subsequent to final heat treatment (as applicable) to at least the hydrostatic pressure specified in 9.4.2, without leakage. Hold the test for not less than 5 s at full pressure. For electric weld pipe, inspect the pipe seam for leaks and sweats while under full test pressure. The entity performing the threading shall hydrostatically test (or arrange for such a test) the full length of casing, tubing, liners and pup-joints unless previously tested full length to at least the pressure required for the final end condition. The test may be performed under one of the following conditions:

— plain-end non-upset provided no upsetting or further heat treatment is to be performed;

— plain-end non-upset after heat treatment;

— plain-end after upsetting provided no further heat treatment is to be performed; if such pipe has been tested full length to the threaded and coupled test pressure in the plain-end condition prior to upsetting, the test of the upset portion may be made after upsetting through the use of an end tester which seals behind the portion of the pipe which was heated for upsetting;

— plain-end upset after heat treatment;

— threaded without couplings applied;

— threaded and coupled with couplings applied power-tight.

Test pup-joints, after finish machining and any heat treatment, either plain end or threaded.

Dimensions in millimetres

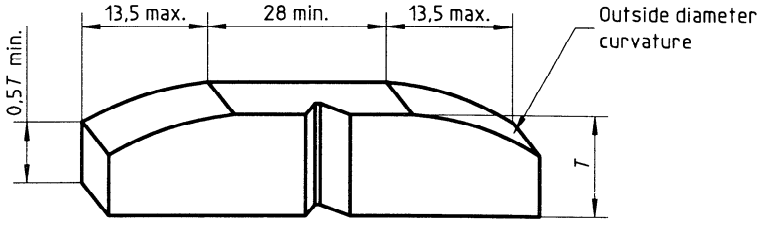


Figure 12 — Charpy specimen dimensions

For material requiring heat treatment, carry out the test after the final heat treatment. The test pressure shall be at least the threaded and coupled test pressure for all material sold with threaded ends. Pipe furnished with extreme-line end finish shall have been hydrotested to at least the extreme-line test pressure in one of the above conditions.

The tester shall be equipped with devices for assuring that the specified test pressure and time interval requirements are met. Calibrate the test pressure measuring device by means of a deadweight tester, or equivalent, within 4 months prior to each use. Calibration and verification records retention shall be as given in 12.4.

NOTES

14 Martensitic chromium steels are sensitive to galling. Special precautions may be necessary for thread surface treatment and/or lubrication to minimize galling during hydrostatic testing (plug application and removal).

15 There are various types of hydrotest systems available. The entity performing the hydrotest is responsible for establishing a test procedure which minimizes the potential damage to the pipe and threads of both the pipe and coupling.

9.4.2 Hydrostatic test requirements

Pipe shall comply with the test requirements for every size, grade and end finish.

9.4.2.1 Casing and tubing

The production hydrostatic test pressures for threaded pipe shall be standard pressures calculated as described below, or a higher pressure as agreed upon between the purchaser and the entity performing the threading. The hydrostatic test pressures for plain-end pipe shall be the pressures calculated as described below, or a higher pressure as agreed upon between interested parties. It is recognized that the maximum hydrostatic test pressures of 68,9 MPa is imposed due to limitations of test equipment. This does not preclude the conducting of subsequent hydrostatic tests at a fibre stress not exceeding 80 % of specified minimum yield strength in accordance with the formula given in 9.4.2.3. Failure to pass this hydrostatic test without leakage is basis for rejection.

9.4.2.2 Connectors and pup-joints

Testing is not required on connectors and group 4 pup-joints except by special agreement between interested parties.

NOTES

16 The user should be aware that ISO couplings with special clearance or standard outside diameters may leak at a pressure less than the ISO alternative test pressure for the plain-end or threaded and coupled tube due to inadequate bearing pressure between the coupling and pin.

17 The hydrostatic test pressures specified herein are inspection test pressures, not intended as a basis for design, and do not necessarily have any direct relationship to working pressures.

9.4.2.3 Test pressure calculation

The hydrostatic test pressures shall be calculated using the following formula, rounded to the nearest 0,5 MPa and limited to a maximum of 68,9 MPa:

$$P = (2 \times f \times Y_n \times t)/D$$

where

P is the hydrostatic test pressure, in megapascals;

f is a factor of 0,6 or 0,8 as applicable;

Y_n is the specified yield strength for the pipe body, in newtons per square millimetre.

Grade	f		
	Standard test pressures		Alternate test pressures (all sizes)
	Sizes ≤ 244,50	Sizes > 244,50	
H40	0,8	0,6	0,8
J55, K55	0,8	0,6	0,8
L80, N80	0,8	0,8	—
C90	0,8	0,8	—
C95, T95	0,8	0,8	—
P110	0,8	0,8	—
Q125	0,8	0,8	—

The hydrostatic test pressures for threaded and coupled pipe are calculated from the above formula, except where a lower pressure is required to avoid leakage due to insufficient coupling strength or interface pressure between pipe and coupling threads. The lower pressures shall be calculated as follows.

9.4.2.3.1 Internal yield pressure for couplings

The internal yield pressure for the coupling is calculated using the following formula, rounded to the nearest 0,5 MPa:

$$P = 0{,}8 \times Y_c \times \frac{W - d_1}{W}$$

where

P is the internal leak pressure resistance, in megapascals;

Y_c is the specified minimum yield strength of coupling, in newtons per square millimetre;

W is the specified outside diameter of the coupling, in millimetres;

d_1 is the diameter at the root of the coupling thread at the end of the pipe in the power-tight position, rounded to the nearest 0,01 mm.

For round-thread casing and tubing:

$$d_1 = E_1 - (L_1 + A) \times T + H - 2s_{rn}$$

where

E_1 is the pitch diameter at hand-tight plane, in millimetres;

L_1 is the length from the end of the pipe to hand-tight plane, in millimetres;

A is the hand-tight standoff, in millimetres;

T is the thread taper on diameter, in millimetres per metre.

For H, s_{rn}, see ISO 10422, figure 2.4.

TPI	H mm	s_{rn} mm
8	2,75	0,43
10	2,20	0,36

For buttress-thread casing:

$$d_1 = E_7 - (L_7 + I) \times T + 1{,}57$$

where

E_7 is the pitch diameter, in millimetres;

L_7 is the length of perfect threads, in millimetres;

I is the value in the following table, in millimetres.

	Diameter mm		
	114,30	127,00 to 339,70	Over 339,70
I	10,16	12,70	9,53
T	0,062 5	0,062 5	0,083 3

9.4.2.3.2 Internal pressure leak resistance at E_1 or E_7 plane

The internal pressure leak resistance at the E_1 or E_7 plane is calculated from the following formula, rounded to the nearest 0,5 MPa:

$$P = E \times T \times N \times P_r \left(2E_s \times W^2\right) \times \left(W^2 - E_s{}^2\right)$$

where

E is the modulus of elasticity (205×10^3 N/mm^2);

T is the thread taper on diameter (0,062 5 m/m for round-thread casing and buttress-thread casing 339,70 mm and smaller, or 0,083 3 m/m for buttress-thread casing larger than 339,70 mm);

N is the number of thread turns make-up, i.e.:

— A, for round-thread casing (see ISO 10422);

— A + 1,5, for buttress-thread casing 339,7 mm and smaller;

— A + 1, for buttress-thread casing larger than 339,70 mm;

P_r is the thread pitch, in millimetres (3,18 mm for round-thread casing or 5,08 mm for buttress-thread casing);

E_s is the pitch diameter at plane of seal, in millimetres (E_1 for round-thread casing or E_7 for buttress-thread casing).

9.5 Dimensional testing

9.5.1 General

The accuracy of all measuring instruments except ring and plug thread gauges, used for acceptance/rejection shall be verified at least once every operating shift. Accuracy, verification of rules, length measuring tapes and other non-adjustable measuring devices shall be defined as a visual check of legibility of markings and the general wear of fixed reference points. The verification procedure of these working gauges shall be documented. The adjustable and non-adjustable designation utilized by the manufacturer shall be documented.

9.5.2 Wall thickness

Each length of pipe shall be measured for conformance to wall thickness requirements.

Wall thickness measurements shall be made with a mechanical caliper or with a properly calibrated non-destructive testing device of appropriate accuracy. In case of dispute, the measurement determined by use of the mechanical caliper shall govern. The mechanical caliper shall be fitted with contact pins having circular cross-sections of 6,35 mm diameter. The end of the pin contacting the inside surface of the pipe shall be rounded to a maximum radius of 38,10 mm for pipe 168,28 mm and larger, and a maximum radius of $d/4$ for pipe less than 168,28 mm with a minimum radius of 3,18 mm. The end of the pin contacting the outside surface of the pipe shall be either flat or rounded to a radius of not less than 38,10 mm.

9.5.3 Drift test

All drift testing shall be performed with a drift mandrel containing a cylindrical portion conforming to the requirements shown in table 25. The ends of the drift mandrel extending beyond the specified cylindrical portion shall be shaped to permit easy entry into the pipe. The drift mandrel shall pass freely through the pipe by the use of a manual or power drift procedure. In case of dispute, the manual drift procedure shall be used. Pipe shall not be rejected until it has been drift tested when it is free of all foreign matter and properly supported to prevent sagging.

9.5.4 Length

When pipe is furnished with threads and couplings, the length shall be measured to the outer face of the coupling or, if measured without couplings, proper allowances shall be made to include the length of the coupling.

For extreme-line casing and integral-joint tubing, the length shall be measured to the outer face of the box end. For pup-joints and connectors, the length shall be measured from end to end.

The accuracy of length measuring devices for lengths of pipe less than 30 m shall be ± 0,03 m.

9.5.5 Mass determination

Each length of casing and each length of tubing in sizes 42,16 mm and larger shall be weighed separately. Lengths of tubing in sizes 26,67 mm and 33,40 mm shall be weighed either individually or in convenient bundles.

The pipe manufacturer applying the markings to the pipe body shall be responsible for weighing the pipe to determine conformance with mass tolerance. The pipe may be weighed plain-end, upset, non-upset, threaded, or threaded and coupled. Threaded-and-coupled pipe may be weighed with the couplings screwed on or without couplings, provided proper allowance is made for the mass of the coupling. Threaded-and-coupled pipe, integral-joint pipe and pipe shipped without couplings shall be weighed with or without protectors if proper allowances are made for the mass of the thread protectors. Weighing of a pipe by a threader is not mandatory.

NOTE 18 The densities of martensitic chromium steels (L80, types 9Cr and 13Cr) are different from carbon steels. The masses shown are therefore not accurate for martensitic chromium steels. A mass correction factor of 0,989 may be used.

9.5.6 Straightness

All pipe shall be visually examined. The straightness of excessively bent pipes or crooked extremities shall be measured

— using a straight edge or taut string (wire) from one end of the pipe to the other end;

— using a minimum 1,83 m straight edge shouldered on the pipe surface beyond the extent of the hooked extremity.

The chord and straight edge shall be positioned to highlight the maximum deviation.

Deviation from straight, or chord height, shall not exceed the requirements given in 7.8. See figures 13 and 14.

Measurement of the deviation shall not be made in the plane of the upset, the upset fade-away or the coupling.

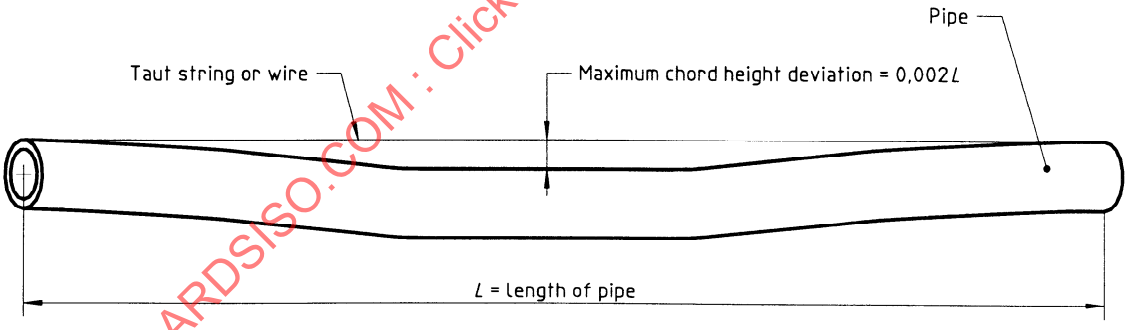


Figure 13 — Measuring full-length straightness

Dimensions in metres

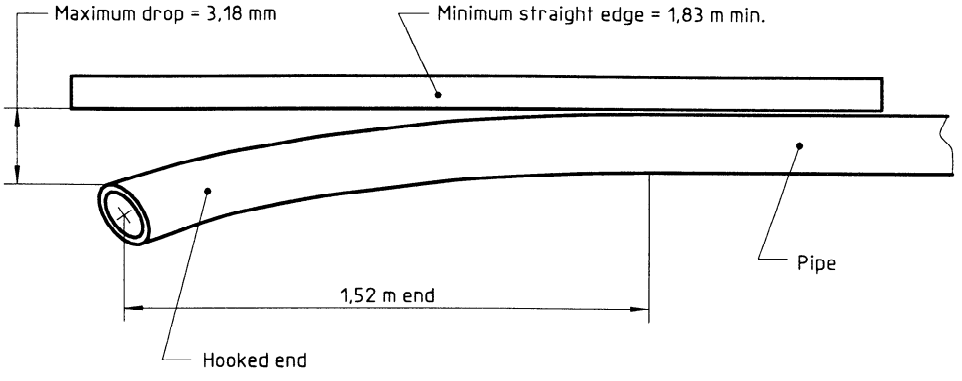


Figure 14 — Measuring end straightness

9.6 Visual inspection

Each pipe, including upsets, shall be visually inspected for defects on the entire outside surface, except when either ultrasonic testing or electromagnetic inspection is applied. Ends, including upsets, of all pipe shall be visually inspected

— on the outside surface for a minimum distance of 457 mm for casing and for a minimum distance of 305 mm for tubing;

— on the inside surface of casing and tubing, the minimum distance shall be $2D$ with a maximum value of 457 mm;

— unless another inspection method is applied with demonstrated capability of detecting defects as defined in 9.1.3.

If defects are found on the end and cropping is performed in accordance with 9.7.12.2, the inside surface shall be thus visually inspected again.

Pipes of grades L80 9Cr and L80 13Cr shall be free of internal scale after final heat treatment.

9.7 Non-destructive inspection

9.7.1 General

9.7.1.1 Introduction

This section establishes requirements for the non-destructive inspection and disposition of pipe covered in this International Standard.

Unless otherwise specified, the provisions of annex C shall apply to the initial purchaser and to the subsequent purchasers that apply the product(s) in field service.

9.7.2 Pipe body inspection

The manufacturer shall inspect the pipe body using the methods given in table 37 in accordance with 9.7.6, or by other inspection methods that have demonstrated the capability of detecting defects as defined in 9.1.3. The location of the equipment shall be at the discretion of the manufacturer. However, non-destructive inspection shall take place after all heat treating and rotary straightening operations. When more than one non-destructive inspection method is required, one of these may take place before heat treating and/or rotary straightening operations. When one of these methods is ultrasonic inspection, the ultrasonic inspection shall be performed after all heat treating and rotary straightening.

For pup-joints made from full-length casing or tubing, the required inspection for inside and outside surface defects shall take place either before or after cutting into final lengths, provided there be no subsequent upsetting or heat treatment. For machined pup-joints, the required inspection shall take place either before or after machining to final product dimensions; however, the outside surface shall be visually inspected subsequent to being machined to final product dimensions.

Table 37 — Pipe body inspection methods

Grade	Electro-magnetic inspection	Ultrasonic testing	Magnetic particle inspection (circular field)
H40, J55, K55 N80 (N, N and T)	N	N	N
N80 type Q, L80, C95	A	A	A
P110	A	A	not applicable
C90, T95, Q125	C	B	C

A — One method or any combination of methods shall be used
B — Ultrasonic testing shall be used to inspect the inside and outside surface
C — At least one method shall be used in addition to ultrasonic testing to inspect the outside surface
N — Not required

9.7.3 Pipe inspection coverage

9.7.3.1 Pipe body

All pipe requiring non-destructive inspection shall be inspected full length (end to end) for outside and inside surface defects.

9.7.3.2 End areas

When an automatic ultrasonic or electromagnetic inspection system (combined equipment, operating procedures, and personnel) is applied to meet the requirements of 9.7.2, end areas that are not covered by the automated inspection system shall be inspected for defects by the magnetic particle method or another inspection method with demonstrated capability of detecting defects as defined in 9.1.3. Such end area inspection shall be performed after final heat treatment and any rotary straightening; however, it need only be performed once. The combination of the inspection methods shall inspect 100 % of the outside and inside surfaces.

9.7.3.3 Pipe upsets

Forged upsets (including the upset runout interval) on all grades except H40, J55 and K55 shall be inspected for transverse, outside and inside surface defects by any of the inspection methods listed in 9.7.6 (excluding ASTM E273) and shall take place after all heat treatment.

9.7.4 Pipe body wall thickness verification

All seamless casing, tubing, liners and pup-joints requiring electromagnetic or ultrasonic inspection, as given in table 37, shall have the wall thickness verified in a helical or longitudinal path over the length of the pipe, excluding end areas not covered by automated systems. The location and procedure of this verification process shall be at the discretion of the manufacturer.

9.7.5 Inspection of weld seam

The weld seam of all welded pipe furnished to this International Standard shall be inspected for defects either electromagnetically or ultrasonically, except that P110 and Q125 grade pipe shall have its weld seam ultrasonically inspected in accordance with annex B (SR11).

The weld seam inspection shall take place after final heat treating and subsequent rotary straightening operations on all pipe receiving a quench and temper heat treatment. On all pipe not receiving a quench and temper heat treatment, the location of the weld seam inspection equipment shall be at the discretion of the manufacturer.

Inspection equipment shall be capable of inspecting the entire wall thickness 1,6 mm on both sides of the weld line.

9.7.6 Standard practices for inspection

For other than wall thickness verification and visual inspection, the inspections shall be performed, as a minimum, in accordance with the applicable ASTM standards (or equivalent standards) listed below:

1 — Electromagnetic (flux leakage)	ASTM E570
2 — Electromagnetic (eddy current)	ASTM E309
3 — Ultrasonic	ASTM E213
4 — Ultrasonic (weld seam)	ASTM E273
5 — Magnetic particle	ASTM E709
6 — Liquid penetrant	ASTM E165

9.7.7 Reference standards

Ultrasonic and electromagnetic inspection systems for other than wall thickness verification shall use reference standards containing notches or holes as shown in table 38 to verify equipment response from artificial reference indicators. This response establishes a reject threshold.

The manufacturer may use any documented procedure to establish the reject threshold for ultrasonic or electromagnetic inspection, provided the artificial reference indicators described in table 38 can be detected dynamically under normal operating conditions. Such detection capability shall be demonstrated dynamically. At the discretion of the manufacturer, this may be performed either on-line or off-line.

Table 38 lists the reference indicators for manufacturers to use in establishing thresholds for sorting pipe that may contain defects as specified in 9.1.3. The reference indicators, used during automated ultrasonic or electromagnetic inspection, are not to be construed as being the defects sizes specified in 9.1.3, or be used by those other than the manufacturer as the only basis for rejection.

9.7.8 Automated inspection system signal evaluation

All indications that are equal to or greater than the reject threshold shall be considered defects, unless it can be demonstrated that the imperfection causing the indication is not a defect as described in 9.1.3. Pipe with defects shall be given a disposition in accordance with 9.7.12.

9.7.9 Records verifying system capability

Inspection system records shall be maintained to verify the system capabilities in detecting reference indicators as stated in 9.7.7. These records shall include calibration and operating procedures, equipment description, personnel qualifications, and dynamic test data demonstrating the system capabilities for detecting the reference indicators.

9.7.10 Certification and qualification of personnel

As a minimum, ASNT Recommended Practice ASNT-TC-1A or equivalent shall be the basis of certification for non-destructive testing (NDT) personnel. Inspections shall be conducted by level I, II or III certified inspectors.

9.7.11 Evaluation of indications (prove-up)

The manufacturer has the option of evaluating an indication, which is equal to or greater than the reject threshold, in accordance with this subclause or disposing of the indication as a defect in accordance with 9.7.12. Evaluation of indications shall be performed by level I certified inspectors under the supervision of level II or III certified inspectors or by level II or III certified inspectors. Evaluation of indications shall be performed in accordance with written procedures. For the evaluation of an indicated imperfection, the depth shall be measured to determine if it is a defect in accordance with 9.1.3. This measurement shall be performed as follows.

9.7.11.1 The depth of imperfection may be measured using a mechanical measuring device (e.g. pit gauge, calipers, etc.). Removal of material by grinding or other means to facilitate measurement shall not reduce the remaining wall below 87,5 % of the specified wall thickness. Abrupt changes in wall thickness caused by probe grinding shall be removed.

Table 38 — Artificial reference indicators

Grade	Notch location		Notch orientation[1]		Notch dimensions (maximum at full depth)			Radially drilled hole[2]
	outside diameter	inside diameter	longitudinal	transversal	depth[3] %	length mm	width mm	diameter
Pipe body								
N80, type Q, L80, C95	X	X	X	—	12,5	50	1	3,2
C90, P110, Q125, T95	X	X	X	X	5,0	50	1	1,6
P110 to SR16	X	X	X	X	12,5	50	1	3,2
Weld seam								
Q125, P110	X	X	X	—	5,0	50	1	1,6
All other grades	X	X	X	—	10,0	50	1	3,2

NOTE — The reference indicators defined above are convenient for verification of non-destructive testing equipment response. The dimensions of the notches or holes should not be construed as the minimum size imperfections detectable by such equipment. The inspections performed in accordance with 9.7.2 with the equipment calibrated to the reference indicators in this table should not be construed as assuring that the material requirements in 9.1.3 have been met.

1) Notches shall be rectangular or U-shaped according to ASTM E213, figure 2, "common notch shapes". For seamless pipe, at the discretion of the manufacturer, notches may be oriented at such an angle as to optimize detection of anticipated defects.

2) Drilled hole diameter (through the pipe wall) shall be based on drill bit size. When calibrating EMI equipment using drilled holes, the inspection system shall be capable or producing signals from both O.D and I.D notches that are equal to or greater than the reject threshold established using the drilled hole. This system capability shall be recorded according to 9.7.9.

3) Depth as a percent of specified wall thickness. The depth tolerance shall be ± 15 % of the calculated notch depth with a minimum notch depth of 0,3 mm ± 0,05 mm.

9.7.11.2 The depth of imperfection may be measured by an ultrasonic technique (time and/or amplitude based, or other capable technique). Verification of the ultrasonic technique(s) shall be documented, and shall show capability to differentiate imperfection sizes larger and smaller than the appropriate defect size stated in 9.1.3.

9.7.11.3 If the purchaser and manufacturer do not agree on the evaluation test results, either party may require destructive evaluation of the material; after which, accountability shall be as described in annex C, C.4.

9.7.11.4 Imperfections that have been evaluated and found to be defects shall be given a disposition in accordance with 9.7.12.

9.7.12 Disposition

Imperfections that satisfy the material requirements and are less than the defect size stated in 9.1.3 are allowed to remain in the pipe. Repair welding is not permitted. Pipe containing defects shall be given one of the following dispositions.

9.7.12.1 Grinding or machining

Defects shall be completely removed by grinding or machining, provided the remaining wall thickness is within specified limits. Generous radii shall be used to preclude abrupt changes in wall thickness. Where the depth of the grind exceeds 10 % of the specified wall thickness, the remaining wall thickness shall be verified in accordance with 9.5.2. After removal of the defect, the affected area shall be reinspected by one or more of the non-destructive inspection methods specified in 9.7.6 to verify complete removal of the defect. The manufacturer's documented prove-up procedures shall address the possibility that there may be other coincident defects in the affected area.

9.7.12.2 Cut-off

The section of pipe containing the defect shall be cut off within the limits of requirements on length of the intended product.

9.7.12.3 Rejection

The pipe shall be rejected.

9.8 Test methods and results

9.8.1 Chemical analysis

Chemical analysis shall be determined by any of the procedures commonly used for determining chemical compositions, such as emission spectroscopy, X-ray emission, atomic absorption, combustion techniques or wet analytical procedures. The calibration methods used shall be traceable to established standards. All chemical analyses shall be made in accordance with ISO/TR 9769.

9.8.2 Tensile tests

9.8.2.1 Procedures

Determine tensile properties by testing longitudinal specimens conforming to the requirements of 9.3.3.1 and ISO 6892. Carry out the tensile tests at room temperature. The strain rate during tensile testing shall be in accordance with the requirements of ISO 6892.

9.8.2.2 Equipment

Tensile test machines shall have been calibrated within 15 months preceding any test in accordance with the procedures of ISO 7500-1. Extensometers shall be calibrated within 15 months preceding any test in accordance with the procedures of ASTM E83. Records retention shall be as stated in clause 12.

9.8.3 Flattening test

9.8.3.1 Groups 1 and 2

For electric-welded pipe, the test specimen shall be flattened between parallel plates with the weld at the point of maximum bending. At the discretion of the inspector, separate flattening tests shall also be made with the weld located 90° from the point of maximum bending. Test specimens shall be flattened until opposite walls of the pipe meet. No cracks or breaks shall occur anywhere in the specimen until the distance between the plates is less than that specified in table 17; nor shall evidence of poor texture, incomplete fusion in the weld, laminations, burnt metal or extruded metal develop during the entire flattening process.

9.8.3.2 Groups 3 and 4

See annex B (SR11) for mandatory requirements.

9.8.4 Hardness test

Hardness tests shall be made in accordance with ISO 6508 and ISO 6506 as appropriate.

Conversions shall be made in accordance with ASTM A370. The use of the HRB scale is permissible at hardness levels below HRC 20. Although hardness readings below HRC 20 may not be precise, they may be used for the calculation of hardness values. Care should be exercised when evaluating those hardness readings and values below HRC 20. The laboratory Rockwell C hardness test shall be used as a reference method in case of disagreement.

Calibration shall be checked at the beginning and end of a continuous run, and at such times during the run as required to assure the operator and the purchaser or his representative that the testing machine is in calibration. In any case, calibration shall be checked at least once per 8-hour shift.

Calibration shall be made on a certified test block over a range of 25 HRC to 35 HRC for group 4, and a range of 20 HRC to 25 HRC for group 2 products. Hardness test surfaces shall be ground parallel and smooth to ensure reliable data. Rockwell hardness readings and values shall be reported to the nearest tenth to minimize conflict as to the hardness and acceptance or rejection of the material.

9.8.5 Grain size determination

Grain size shall be determined by metallurgical evaluation such as the McQuaid-Ehn test or other methods as specified in ISO 643. The method used to determine the grain size shall be reported.

9.8.6 Sulfide stress cracking test

NACE Test Method, TM-01-77 shall be used to determine the sulfide stress cracking resistance of grade C90 and T95 products. The level of resistance to sulfide stress cracking is measured by the threshold stress. Threshold stress (for a 6,35 mm diameter test specimen in accordance with the latest edition of NACE TM-01-77) is defined as the maximum stress at or below which no specimen fails the sulfide stress cracking test for a period of 720 h.

9.8.7 Impact test

9.8.7.1 General procedures

Charpy V notch impact tests shall be conducted as specified in ASTM A370 and ASTM E23.

9.8.7.2 Test temperature

The test temperature shall be 0 °C for all groups except group 1, grades J55 and K55. Grades J55 and K55 shall be tested at 21 °C. A lower alternative test temperature may be specified on the purchase order or selected by the manufacturer for any grade. The tolerance on the test temperature shall be ± 3 °C.

9.8.7.3 Subsize test temperature reduction — Group 1, grades J55 and K55

A test temperature reduction may be required when subsize specimens are used. The test temperature reduction depends on the critical thickness of the connection and the size of the impact test specimen. The test temperature reduction specified in table 7 shall be used when applicable.

9.8.7.4 Rounding-off procedures

For purposes of determining conformance with these requirements, an observed value shall be rounded-off to the nearest whole number in accordance with the rounding-off method of ISO 31-0. Further, limiting values as specified or calculated shall be expressed as whole numbers, rounded-off if necessary.

9.9 Invalidation of tests

9.9.1 Tensile test

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

9.9.2 Hardness test

If any hardness specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

9.9.3 Impact test

Any test specimen that shows defective preparation or material imperfections unrelated to the intent of the test, whether observed before or after testing, may be discarded and be replaced by another specimen from the same length of product. Specimens shall not be judged defective simply because they failed to exhibit the minimum absorbed energy requirement (see 9.10.5).

9.10 Retests

9.10.1 Chemical composition — Recheck product analyses — All groups[7)]

If the product analyses of both lengths of tubular product representing the heat fail to conform to the specified requirements, at the manufacturer's discretion either the heat shall stand rejected or all the remaining lengths in the heat shall be tested individually for conformance to the specified requirements. If only one of two samples fails, at the manufacturer's discretion either the heat shall stand rejected or two recheck product analyses shall be made on two additional lengths from the same heat. If both recheck product analyses conform to the requirements, the heat shall be accepted except for the length represented by the initial analysis which failed. If one or both of the recheck product analyses fail, at the manufacturer's discretion the entire heat shall be rejected or each of the remaining lengths shall be tested individually. In the individual testing of the remaining lengths in any heat, analyses for only the rejected element or elements need be determined. Samples for recheck product analyses shall be taken in the same manner as specified for product analysis samples. The results of all recheck product analyses shall be provided to the purchaser when specified on the purchase order.

9.10.2 Tensile retests

9.10.2.1 All groups

If a tensile test specimen representing a lot of pipe fails to conform to the specified requirements, the manufacturer may elect to make retests on three additional lengths from the same lot.

If all of the retest specimens conform to the requirements, all the lengths in the lot shall be accepted except the length from which the initial specimen was taken.

If more than one of the original test specimens fail or one or more of the retest specimens fail to conform to the specified requirements, the manufacturer may elect to individually test the remaining lengths in the lot, in which case determinations are required only for the particular requirements with which the specimens failed to comply in the preceding tests. Specimens for retests shall be taken in the same manner as specified in 9.3.3.1. Casing and coupling, pup-joint or connector material from the same heat of steel which has been rejected by one or more of the above criteria may be re-heat treated and retested since by definition they are then a new lot of pipe.

9.10.2.2 Group 2 (grades C90 and T95) and group 4

a) **Couplings, pup-joints or connector materials treated in tube lengths**

If a tensile specimen fails to conform to the specified requirements, the manufacturer shall either make tests on both ends of the pipe in question to verify the property in question or reject the material. No additional testing will be allowed to qualify a piece of coupling, pup-joint or connector material.

b) **Couplings, pup-joints and connectors heat treated in coupling blank or individual lengths**

If a tensile specimen fails to conform to the specified requirements, the manufacturer shall either re-heat treat the lot in question or make three additional tests from the lot in question. If one or more of them fail, the lot shall be rejected. The manufacturer may elect to re-heat treat and retest the lot.

7) For couplings, pup-joints and connectors, the analyses required in 9.2.1 and 9.2.2 may be furnished by the steel manufacturer.

9.10.3 Flattening retests

If either test specimen representing a single length of pipe fails to meet the requirements specified, the manufacturer may elect to make additional tests on specimens cut from the same end of the same length of pipe, until the requirements are met, except that the finished pipe shall not be shorter than 80 % of its length after the initial cropping. If any test specimen from a length of pipe representing a lot fails to conform to the requirements specified, the manufacturer may elect to repeat the tests on specimens cut from two additional lengths of pipe from the same lot. If such specimens conform to the specified requirements, all the lengths in the lot shall be accepted except the length initially selected for the test. If any of the retest specimens fails to pass the specified requirements, the manufacturer may elect to test specimens cut from the individual lengths remaining in the lot. Specimens for retests shall be taken in the same manner as specified in 9.3.3.2. At the option of the manufacturer, any lot of pipe may be re-heat treated and retested.

9.10.4 Hardness retests

9.10.4.1 Group 2 (grade L80)

Retest in accordance with 9.3.3.3.

9.10.4.2 Group 2 (grades C90 and T95)

If any hardness value falls between 25,4 HRC and 27 HRC inclusive, one more hardness value shall be taken in the immediate area (three readings required). If the new hardness value does not exceed 25,4 HRC, the new hardness value shall be accepted. If the new hardness value exceeds 25,4 HRC, the piece shall be rejected.

9.10.4.3 Group 4

If the maximum hardness variation as specified in table 3 is exceeded on a specimen, the surface in that quadrant may (at the discretion of the manufacturer) be reground below the initial hardness impressions and retested. Only one regrind and retest is allowed for each specimen. Pipe and coupling blanks that fail to comply with table 3 shall be rejected.

a) **Casings**

If more than one of the initial three lengths required to qualify a lot of casing is rejected, then the manufacturer may elect to test each of the remaining lengths in the lot as specified in 9.3.2.3 or reprocess the lot. Retests of these lengths shall only be allowed as specified in 9.3.2.3.

If only one of the initial three lengths required to qualify a lot of casing is rejected as specified, then an additional three lengths may be tested as specified in 9.3.2.3 to attempt to qualify the lot of casing. Retests of the additional lengths shall only be allowed as specified in 9.3.2.3. If any of the additional three lengths required to qualify a lot of casing is rejected, then the manufacturer may elect to test each of the remaining lengths in the lot or reprocess the lot (i.e., 5 of the 6 lengths tested shall meet the requirements of 6.2.7 and table 3 to qualify the casing on a lot basis).

b) **Couplings, pup-joints and connectors**

In the case of couplings, pup-joints or connectors heat treated in coupling blank or individual lengths, if the maximum hardness variation as specified in 6.2.7 and table 3 is exceeded, at the discretion of the manufacturer three more lengths from the lot in question may be sampled or the lot re-heat treated. If a specimen from any one of the three lengths fails to meet the maximum hardness variations, the lot shall be rejected. The manufacturer may elect to re-heat treat and retest the lot.

9.10.5 Impact retest

9.10.5.1 Retest of a length — All groups

If more than one specimen is below the specified minimum absorbed energy requirement or if one value is below two thirds of the minimum specified absorbed energy requirement, a retest of three additional specimens shall be made from the same length. The impact energy of each of the retest specimens shall equal or exceed the specified minimum absorbed energy requirement or the length is rejected.

9.10.5.2 Replacement of a reject length — All groups

If the results of a test do not meet the requirements of 6.2.4 or 6.2.5 and do not qualify for retest in accordance with 9.10.5.1, then an additional three test specimens shall be removed from each of three additional lengths from the lot. If all the additional lengths tested conform to the requirements, then the lot shall be qualified except for the length that was initially rejected. If one or more of the additional lengths tested fail to conform to the specified requirements, the manufacturer may elect to individually test the remaining lengths in the lot or re-heat treat and retest the lot.

9.10.5.3 Multiple length rejection — All groups

If more than one of the initial three lengths required to qualify a lot of casing is rejected, retesting to qualify the lot is not permitted. The manufacturer may elect to test each of the remaining pieces in the lot, or to re-heat treat and retest the lot.

10 Marking

10.1 General

Products manufactured in conformance with this International Standard shall be marked by the manufacturer as specified in this clause. Unless otherwise agreed, such markings shall be die stamped or paint

stencilled, or both, as stipulated. The location, size, and sequence of markings shall be as specified in 10.4, 10.5 and 10.6, except that, at the discretion of the manufacturer, hot-rolled or hot-stamped markings on pipe and couplings may be substituted for die-stamped markings and are permitted at intervals along the length. Additional markings as desired by the manufacturer or as requested by the purchaser are not prohibited. Markings for compatible national specifications adjacent to the ISO mark are permissible within the body of the product marking. Markings shall not overlap and shall be applied in such a manner as not to damage the pipe.

In circumstances where it is necessary to remark pipe with the original marking information, the accuracy and traceability of the transferred markings shall be the responsibility of the operative remarking that pipe. The transferred marks shall be include the words "transferred by".

10.2 Couplings and connectors

Markings for couplings and connectors and methods of application shall be as follows.

10.2.1 Groups 1 and 3

The manufacturer's name or mark, "ISO 11960" and the symbol for the grade (10.3) shall be die stamped unless otherwise agreed upon between interested parties, in which case they shall be paint stencilled. Quenched and tempered N80 couplings shall be paint stencilled with the letter "Q". Tin-plated couplings shall be paint stencilled with the letter "T".

10.2.2 Groups 2 and 4

The manufacturer's name or mark, "ISO 11960" and the symbol for the grade (10.3) shall be paint stencilled. Tin-plated couplings shall be paint stencilled with the letter "T". Coupling blanks for C90, T95 and Q125 shall be identified with regard to the coupling stock length identification number from which it was obtained so that test data may be related to individual joints.

Couplings which are visually inspected only shall be paint stencilled with the letter "V".

10.3 Pipe and pup-joints

Markings for pipe and pup-joints and methods of application shall be as follows.

10.3.1 Groups 1 and 3

10.3.1.1 Manufacturer's name or mark

The manufacturer's name or mark shall be die stamped unless otherwise agreed upon between interested parties, in which case it shall be paint stencilled.

10.3.1.2 Additional markings

Additional markings (e.g. "API" or "Spec 5CT") should be, whenever necessary, applied immediately following the manufacturer's marking and immediately before the standard reference marking.

10.3.1.3 Standard reference

"ISO 11960" shall be die stamped unless otherwise agreed upon between interested parties, in which case it shall be paint stencilled. The "ISO 11960" identity shall be applied only as specified and only by manufacturers who meet all requirements of this International Standard.

10.3.1.4 Unfinished pipe

Casing and tubing furnished with plain ends or end finish not detailed in this section but having the body of the pipe manufactured in accordance with the requirements specified in this section, shall be die stamped with the symbol "UF" immediately following the reference standard marking and immediately before the size marking.

10.3.1.5 Label 1

Label 1 (tables 18 to 23) shall be paint stencilled, except when the value of label 1 is 1,05 or 1,315, then the label 1 marking shall be die stamped.

10.3.1.6 Label 2

Label 2 (tables 18 to 23) shall be die stamped and paint stencilled, except when the value of label 1 is either 1,050 or 1,315, then the label 2 marking shall not be paint stencilled.

10.3.1.7 Grade

The grade markings shall be die stamped and paint stencilled, using the following symbols, except that when the value of label 1 is either 1,050 or 1,315 the grade marking shall not be paint stencilled.

Grade	Marking
H40	H
J55	J
K55	K
N80 and N80Q	N
P110	P

When reduced alternative impact test temperatures are specified or selected by the manufacturer for grades J55, K55 or other grades, the product shall have the specified test temperature (i.e. not including the test temperature reduction that may be applicable for grades J55 and K55) and sign paint stencilled after the grade marking.

EXAMPLE

(Grade) - 10

10.3.1.8 Process of manufacture

The process of manufacture shall be stamped and paint stencilled on casing, liners and tubing, using the following symbols, except that when the value of label 1 is either 1,050 or 1,315, the process-of-manufacture marking shall not be paint stencilled.

Seamless	S
Electric welded	E

10.3.1.9 Supplementary requirements

See annex B for special marking for supplementary requirements.

10.3.1.10 Test pressure

For tubing with a value of label 1 equal to 2-3/8 and beyond, when the specified hydrostatic test pressure is higher than the tabulated standard pressure, the test pressure in megapascals, preceded by the word TESTED, shall be paint stencilled.

10.3.1.11 Type of thread (casing only)

Casing shall be paint stencilled to identify the type of thread as follows:

ROUND THREAD
BUTTRESS THREAD
EXTREME-LINE

or, at the manufacturer's, processor's or threader's discretion, the abbreviations given in 10.8 may be used.

10.3.1.12 Heat treatment — Group 1 only

J55 tubing that has been full-length normalized or quenched and tempered after upsetting shall be paint stencilled with the word "NORM" or "Q", as applicable. N80 type Q casing and tubing shall be paint stencilled with the letter "Q" when furnished: (1) plain-end, (2) threaded without couplings, or (3) threaded and coupled with quenched and tempered couplings.

10.3.2 Groups 2 and 4

Each length of pipe and pup-joint shall be marked by paint stencilling as specified in 10.6, except that if so desired in lieu of paint stencilling, bundled tubing with a value of label 1 either 1,050 or 1,315 shall be marked by die stamping on a metal tag affixed to each bundle.

10.3.2.1 Manufacturer's name or mark

10.3.2.2 Additional markings

10.3.2.3 Standard reference

10.3.2.4 Unfinished pipe

Casing and tubing furnished with plain ends or end finish not detailed in this section but having the body of the pipe manufactured in accordance with the requirements specified in this section, shall be marked with the symbol "UF" immediately following the reference standard marking and immediately before the size marking.

10.3.2.5 Label 1

See tables 18 to 23.

10.3.2.6 Label 2

See tables 18 to 23.

10.3.2.7 Grade

The grade markings shall be paint stencilled as follows:

Grade	Marking
L80, type 1	L80
L80, type 9CR	L80-9Cr
L80, type 13Cr	L80-13Cr
C90, type 1	C90-1
C90, type 2	C90-2
C95	C95
T95, type 1	T95-1
T95, type 2	T95-2
Q125, type 1	Q-1
Q125, type 2	Q-2
Q125, type 3	Q-3
Q125, type 4	Q-4

When reduced alternative impact test temperatures are specified or elected by the manufacturer, the product shall have the test temperature paint stencilled after the grade marking.

10.3.2.8 Process of manufacture

Seamless	S
Electric welded	E

10.3.2.9 Supplementary requirements

See annex B for special marking for supplementary requirements.

10.3.2.10 Test pressure

For tubing with a value of label 1 equal to 2-3/8 and beyond, when the specified hydrostatic test pressure is higher than the tabulated standard pressure, the test pressure in megapascals, preceded by the word TESTED, shall be paint stencilled.

10.3.2.11 Type of thread (casing only)

Casing shall be paint stencilled to identify the type of thread as follows:

ROUND THREAD
BUTTRESS THREAD
EXTREME-LINE

or, at the manufacturer's, processor's or threader's discretion, the abbreviations given in 10.8 may be used.

10.3.2.12 Serialization of grades C90, T95 and Q125 products

Each length of casing and coupling stock shall be numbered in sequence so that test data may be related to individual joints.

EXAMPLES

a) Labels 7 - 26 - grade C90, type 1, seamless casing - joint serial number 0001, optional additional marking "Spec 5 CT", should be paint stencilled as follows:

AB CO Spec 5 CT ISO 11960 7 26 C90-1 S-0001 (type thread)

b) Labels 7 - 38 - grade Q125, type 1, plain end seamless steel casing from lot XYZ joint 28, optional additional marking "Spec 5 CT", should be paint stencilled as follows:

AB CO Spec 5 CT ISO 11960 UF 7 38 Q-1 S XYZ 28

10.4 Die-stamp marking requirements

10.4.1 Groups 1 and 3

For casing, liners and tubing, die-stamped markings shall be placed on the outside surface of each length of pipe within 305 mm from the coupling or box, or externally threaded end, or either end of plain-end pipe, except that for tubing with a value of label 1 either 1,050 or 1,315, die-stamped markings shall be applied to a metal tag affixed to the tubing.

10.4.2 Group 2

Unless otherwise specified, pipe, couplings, connectors and pup-joints may be die stamped by one or more of the following methods at the manufacturer's discretion:

— hot die stamped;

— cold die stamped and subsequently heat treated in compliance with 5.2;

— low-stress markings using interrupted dot or round "V" cold die stamp or vibratory method.

C90 and T95 products, if not paint stencilled, shall be die stamped with the serial number before heat treatment and limited to low-stress markings as described above. Marking shall be at a location such that it will not be removed by further processing.

Cold-die-stamped marking of pipe or couplings without subsequent heat treatment is prohibited, except for the make-up triangle on buttress-thread casing which may be cold die stamped with rounded or blunt dies. When additional marking is desired, hot-rolled marking or hot-stamped markings may be used. For bundled tubing with a value of label 1 either 1,050 or 1,315, when paint stencilled marks are omitted, die-stamped markings shall be applied to a metal tag affixed to each bundle.

10.4.3 Group 4

Unless otherwise specified on the purchase order, die stamping may be applied hot or cold but shall be applied prior to heat treatment. Die-stamped markings for in-process identification may be placed on the outside of each length of pipe prior to heat treatment. All cold-die-stamped marking of pipe or couplings is prohibited, except for the make-up triangle, which may be cold die stamped with rounded or blunt dies on buttress-thread casing and round-thread casing. No die stamping except the triangle on buttress-thread casing and round-thread casing shall be applied after heat treatment unless such markings are located where they will be removed by subsequent machining operations. Unless otherwise specified on the purchase order, the triangle mark in buttress casing may be replaced with a transverse 10 mm wide white band, approx. 75 mm long, around the pipe. An approx. 25 mm wide, approx. 300 mm long white paint stripe shall be oriented longitudinally on the tube, adjacent to the above band to assist in locating the band.

10.5 Die-stamp marking placement

Die-stamped markings shall be placed on the outside surface of each length of pipe within 305 mm from the coupling or box, or externally threaded end, or either end of plain-end pipe. The size of die-stamped markings shall be as follows:

Label 1		Size of markings mm
Pipe	≤ 4	4,8
	≥ 4-1/2	6,4
Coupling	≤ 4	6,4
	4-1/2 to 7 inclusive	9,5
	≥ 7-5/8	12,7

The sequence of die-stamped markings shall be as follows:

Manufacturer's name or mark	(10.3)
Additional markings	(10.3)
Reference to this International Standard (Φ 11960)	(10.3)
Symbol UF	(10.3)
Label 2	(10.3)

Grade of pipe	(10.3)
Process of manufacture	(10.3)

EXAMPLES

a) Labels 7 - 26 - grade P110 casing, seamless, optional additional marking "Spec 5 CT" should be die stamped as follows:

AB CO Spec 5 CT Φ 11960 26 P

b) Labels 2-3/8 - 6,4 - grade P110, plain-end tubing, seamless, optional additional markings "Spec 5 CT" should be die stamped as follows:

AB CO Spec 5 CT Φ 11960 UF 6,4 P S

10.6 Paint-stencil marking

10.6.1 Groups 1, 2 and 3

Paint-stencilled markings shall be placed on the outside surface of each length of pipe starting not less than 0,61 m from the coupling or box, or externally threaded end, or either end of plain-end pipe. For connectors and short length pup-joints, the required paint stencil markings may be placed on a decalcomania attached to the outside surface within 0,3 m from the end. These markings shall be separated by a dash or shall be adequately spaced. The sequence of paint-stencilled markings shall be as follows, except that the type of thread marking shall be paint stencilled on the pipe at a location convenient to the manufacturer.

Label 1	(10.3)
Label 2	(10.3)
Grade of pipe	(10.3)
Process of manufacture	(10.3)
Hydrostatic test pressure	(10.3)

10.6.2 Group 4

In addition to the placement required as above for the other groups, the following paint-stencilled markings are required in the following sequence:

Manufacturer's name or mark	(10.3)
Additional markings	(10.3)
Reference to this International Standard (ISO 11960)	(10.3)
Symbol UF	(10.3)
Label 1	(10.3)
Label 2	(10.3)
Grade of pipe	(10.3)
Hydrostatic test pressure	(10.3)

10.7 Colour code identification — All groups

10.7.1 In addition to the required markings as specified above, each length of casing and tubing shall be colour coded as follows.

a) A paint band shall encircle the pipe at a distance not greater than 0,61 m from the coupling or box.

b) The entire outside surface of the coupling shall be painted.

c) For pup-joints shorter than 1,83 m in length, the entire surface except the threads shall be painted.

The colour and number of bands shall be as follows:

	Coupling		Pipe
Grade	Entire surface	Bands	Band(s) encircling the pipe
H40	none or black	—	no colour marking or black, at the manufacturer's discretion
J55	green	—	one bright green
K55	green	—	two bright green
N80	red	—	one red
L80	red	one brown	one red and one brown
L80 9Cr	red	one brown + two yellow	one red, one brown and two yellow
L80 13Cr	red	one brown + one yellow	one red, one brown and one yellow
C90	purple	—	one purple
C95	brown	—	one brown
T95	silver	—	one silver
P110	white	—	one white
Q125	orange	—	one orange

10.7.2 For special clearance couplings, in addition to the described marking, a black band shall be painted around the centre of the coupling.

10.8 Thread marking — All groups

Casing (short, round-thread)	CSG
Casing (long, round-thread)	LCSG
Casing (buttress-thread)	BCSG
Casing (extreme-line)	XCSG
Tubing (non-upset)	TBG
Tubing (external-upset)	UP TBG
Tubing (integral-joint)	IJ TBG

Pipe threaded by a threader other than the original pipe manufacturer shall be identified by die stamp or paint stencil consistent with 10.1 and 10.4 adjacent to the threads with the threader's name or mark, and the size and type of thread.

EXAMPLE

Label 1: 7 casing threaded with 8 round long threads by a threader shall be marked:

AB CO ISO 11960 7 LCSG

The threader shall also mark on the body of the pipe the hydrostatic test pressure if higher than the standard test pressure (see 10.3). No other markings shall be applied to the body of the pipe by the threader. The markings applied to the body of the pipe by the original pipe manufacturer shall not be removed or altered. Additional markings adjacent to the threads requested by the purchaser or desired by the threader are not prohibited.

NOTE 19 Use of the characters ISO 10422 to identify or certify that threads on tubular goods comply with ISO 10422 is not permitted.

10.9 Triangle make-up marking

For casing delivered threaded and coupled, the following is applicable:

— buttress shall be marked with a make-up triangle or paint band as referenced in figure 3 and as specified in ISO 10422;

— round thread in grades H40, J55 and K55 in sizes 406,40 mm and larger shall be marked with a make-up triangle as referenced in figure 1 and as specified in ISO 10422.

10.10 Pipe processor markings — All groups

Pipe heat treated by a processor other than the original pipe manufacturer shall be marked as stipulated in 10.1 to 10.7. The processor shall remove any identity which is not indicative of the new condition of the product as a result of heat treating (i.e. prior grade identity, original pipe manufacturer's name or logo).

10.11 Alternate drift casing markings — All groups

Casing which has been drift tested utilizing the alternate drift mandrels described in 7.9 shall be paint stencilled with the following:

ALTERNATE DRIFT TESTED

11 Coating and protection

11.1 Coatings — All groups

11.1.1 Unless otherwise specified, pipe and couplings shall be given an external coating for protection from rust while in transit and during a storage period of at least three months. An attempt should be made to make these coatings smooth, hard to the touch, and with minimum sags.

NOTES

20 If bare pipe or specially coated pipe is desired, the purchase order should so state. For special coatings, the purchase order should state further whether the coating is to be applied to the full length or whether a certain specific distance from the end is to be left uncoated. Unless otherwise specified, such bare ends are commonly given a coating with oil for protection in transit.

21 13 % Cr tubular sections have shown a tendency towards localized pitting corrosion when stored in moist environments. Special precautions during coating, shipping and storage are worthwhile.

11.1.2 By agreement between interested parties, protective coatings, internal and external, may be required for pipe long-term storage to protect against corrosion, especially when stored in a marine environment.

The coating shall be applied at the manufacturer's premises — or in the vicinity of the manufacturer's premises — as soon as is physically possible after manufacture of the tubular goods.

The following points shall be adhered to.

a) The protection shall be effective against corrosion in a marine environment during the long-term storage period defined by the interested parties; minor surface discoloration shall be acceptable.

b) There shall be no need for removal of the protective coating before the running of the tubular sections.

c) Correct application of the coating is essential and the following parameters shall be assessed:

— dryness of the pipe;

— cleanliness of the pipe;

— temperature at application;

— thickness of the coating film.

11.2 Thread protectors

11.2.1 General

The operative performing the threading shall apply external and internal thread protectors of such design, material and mechanical strength to protect the thread and end of the pipe from damage under normal handling and transportation. External thread protectors shall cover the full length of the thread on the pipe and internal thread protectors shall cover the equivalent total pipe thread length of the internal thread. Thread protectors shall be of such design and material to inhibit infiltration of dust and water to the threads during transportation and normal storage period. Normal storage period shall be considered as approximately one year. The thread forms in protectors shall be such that the product threads are not damaged by the protectors. Thread protectors are not required for pup-joints and connectors provided they be packaged in a manner that protects the threads.

11.2.2 Material

Protector material shall contain no compounds capable of causing corrosion or promoting adherence of the protectors to the threads and shall be suitable for service temperatures from – 46 °C to + 66 °C.

11.2.3 Special group 2 (grade L80, types 9Cr and 13Cr)

Bare steel thread protectors shall not be used on grade L80, types 9Cr and 13Cr tubular goods.

11.2.4 Driftable thread protectors

By agreement between interested parties, open-ended, driftable protectors may be supplied. The thread compound shall cover the entire thread and seal surfaces of the connection.

12 Documents

12.1 Certification

The manufacturer shall, upon request by the purchaser, furnish to the purchaser a certificate of compliance stating that the material has been manufactured, sampled, tested and inspected in accordance with this International Standard and has been found to meet the requirements.

Where additional information is required, including the results of mechanical testing, SR15 shall be specified in the purchase order.

12.2 Certification requirements — Group 4

A certification shall be provided by the manufacturer for all pipe shipped meeting group 4 requirements. This shall include the results of all the tests required in this International Standard for group 4 and any other special provisions as required by the purchaser on the purchase order.

12.3 Groups 1, 2 and 3

A record of mill control tests shall be made available to the purchaser.

12.4 Retention of records

Tests and inspections requiring retention of records in this International Standard are shown in table 39. Such records shall be retained by the manufacturer and shall be available to the purchaser on request for a period of three years after the date of purchase from the manufacturer.

Table 39 — Retention of records

Requirement	Reference
Chemical properties	
heat analysis	9.2.1
product analysis	9.2.2
Mechanical properties	
tensile tests	6.2.1 and 9.8.2
control tests	9.1.1
impact tests	6.2.3.4, 9.3.3.4
couplings	8,4
hardness tests	6.2.7, 6.2.8, 6.2.9, 9.3.3.3
hardenability test (group 2 — C90 and T95)	6.2.10, 9.3.2.4
Hydrostatic tests	
tester recorder charts	9.4.1
testing	9.4.1
Manufacturer certification	
results of all required tests (group 4)	12.2
sulfide stress cracking test (group 2 — C90 and T95)	6.2.13, 9.8.6
calibration	various

Annex A
(normative)

Dimensions and end finish

Tables A.1 to A.3 give, for pipes covered by this International Standard, the possible sizes, masses, wall thicknesses, grades and applicable end finishes.

Table A.1 — ISO casing list — Size, mass, wall thickness, grade and applicable end finish

Labels		Outside diameter, D	Nominal[1, 2] mass of threads and couplings	Wall thickness, t	Type of end finish[3]						
					Grade						
1	2	mm	kg/m	mm	H40	J55 K55	L80 C95	N80	C90[4] T95[4]	P110	Q125[4]
4-1/2	9,5	114,30	14,14	5,21	PS	PS	—	—	—	—	—
4-1/2	10,5	114,30	15,63	5,69	—	PS B	—	—	—	—	—
4-1/2	11,6	114,30	17,26	6,35	—	PSLB	P LB	P LB	P LB	P LB	—
4-1/2	13,5	114,30	20,09	7,37	—	—	P LB	P LB	P LB	P LB	—
4-1/2	15,1	114,30	22,47	8,56	—	—	—	—	—	P LB	P LB
5	11,5	127,00	17,11	5,59	—	PS	—	—	—	—	—
5	13	127,00	19,35	6,43	—	PSLB	—	—	—	—	—
5	15	127,00	22,32	7,52	—	PSLBE	P LBE	P LBE	P LBE	P LBE	—
5	18	127,00	26,79	9,19	—	—	P LBE	P LBE	P LBE	P LBE	P LBE
5	21,4	127,00	31,85	11,10	—	—	P LB	P LB	P LB	P LB	P LB
5	23,2	127,00	34,53	12,14	—	—	P LB	P LB	P LB	P LB	P LB
5	24,1	127,00	35,86	12,70	—	—	P LB	P LB	P LB	P LB	P LB
5-1/2	14	139,70	20,83	6,20	PS	PS	—	—	—	—	—
5-1/2	15,5	139,70	23,07	6,98	—	PSLBE	—	—	—	—	—
5-1/2	17	139,70	25,30	7,72	—	PSLBE	P LBE	P LBE	P LBE	P LBE	—
5-1/2	20	139,70	29,76	9,17	—	—	P LBE	P LBE	P LBE	P LBE	—
5-1/2	23	139,70	34,23	10,54	—	—	P LBE	P LBE	P LBE	P LBE	P LBE
5-1/2	26,8	139,70	39,88	12,70	—	—	—	—	P	—	—
5-1/2	29,7	139,70	44,20	14,27	—	—	—	—	P	—	—
5-1/2	32,6	139,70	48,51	15,86	—	—	—	—	P	—	—
5-1/2	35,3	139,70	52,53	17,45	—	—	—	—	P	—	—
5-1/2	38	139,70	56,55	19,05	—	—	—	—	P	—	—
5-1/2	40,5	139,70	60,27	20,62	—	—	—	—	P	—	—
5-1/2	43,1	139,70	64,14	22,23	—	—	—	—	P	—	—
6-5/8	20	168,28	29,76	7,32	PS	PSLB	—	—	—	—	—
6-5/8	24	168,28	35,72	8,94	—	PSLBE	P LBE	P LBE	P LBE	P LBE	—
6-5/8	28	168,28	41,67	10,59	—	—	P LBE	P LBE	P LBE	P LBE	—
6-5/8	32	168,28	47,62	12,06	—	—	P LBE	P LBE	P LBE	P LBE	P LBE
7	17	177,80	25,30	5,87	PS	—	—	—	—	—	—
7	20	177,80	29,76	6,91	PS	PS	—	—	—	—	—
7	23	177,80	34,23	8,05	—	PSLBE	P LBE	P LBE	P LBE	—	—
7	26	177,80	38,69	9,19	—	PSLBE	P LBE	P LBE	P LBE	P LBE	—
7	29	177,80	43,16	10,36	—	—	P LBE	P LBE	P LBE	P LBE	—

Table A.1 *(continued)*

Labels 1	Labels 2	Outside diameter, D mm	Nominal[1, 2] mass of threads and couplings kg/m	Wall thickness, t mm	Type of end finish[3] Grade H40	J55 K55	L80 C95	N80	C90[4] T95[4]	P110	Q125[4]
7	32	177,80	47,62	11,51	—	—	P LBE	P LBE	P LBE	P LBE	—
7	35	177,80	52,09	12,65	—	—	P LBE	P LBE	P LBE	P LBE	P LBE
7	38	177,80	56,55	13,72	—	—	P LBE	P LBE	P LBE	P LBE	P LBE
7	42,7	177,80	63,54	15,86	—	—	—	—	P	—	—
7	46,4	177,80	69,05	17,45	—	—	—	—	P	—	—
7	50,1	177,80	74,56	19,05	—	—	—	—	P	—	—
7	53,6	177,80	79,77	20,62	—	—	—	—	P	—	—
7	57,1	177,80	84,97	22,23	—	—	—	—	P	—	—
7-5/8	24	193,70	35,72	7,62	PS	—	—	—	—	—	—
7-5/8	26,4	193,70	39,29	8,33	—	PSLBE	P LBE	P LBE	P LBE	—	—
7-5/8	29,7	193,70	44,20	9,52	—	—	P LBE	P LBE	P LBE	P LBE	—
7-5/8	33,7	193,70	50,15	10,92	—	—	P LBE	P LBE	P LBE	P LBE	—
7-5/8	39	193,70	58,04	12,70	—	—	P LBE	P LBE	P LBE	P LBE	P LBE
7-5/8	42,8	193,70	63,69	14,27	—	—	P LB	P LB	P LB	P LB	P LB
7-5/8	45,3	193,70	67,41	15,11	—	—	P LB	P LB	P LB	P LB	P LB
7-5/8	47,1	193,70	70,09	15,86	—	—	P LB	P LB	P LB	P LB	P LB
7-5/8	51,2	193,70	76,19	17,45	—	—	—	—	P	—	—
7-5/8	55,3	193,70	82,30	19,05	—	—	—	—	P	—	—
7-3/4	46,1	196,90	68,60	15,11	—	—	P	P	P	P	P
8-5/8	24	219,10	35,72	6,71	—	PS	—	—	—	—	—
8-5/8	28	219,10	41,67	7,72	PS	—	—	—	—	—	—
8-5/8	32	219,10	47,62	8,94	PS	PSLBE	—	—	—	—	—
8-5/8	36	219,10	53,57	10,16	—	PSLBE	P LBE	P LBE	P LBE	—	—
8-5/8	40	219,10	59,53	11,43	—	—	P LBE	P LBE	P LBE	P LBE	—
8-5/8	44	219,10	65,48	12,70	—	—	P LBE	P LBE	P LBE	P LBE	—
8-5/8	49	219,10	72,92	14,15	—	—	P LBE	P LBE	P LBE	P LBE	P LBE
9-5/8	32,3	244,50	48,07	7,92	PS	—	—	—	—	—	—
9-5/8	36	244,50	53,57	8,94	PS	PSLB	—	—	—	—	—
9-5/8	40	244,50	59,53	10,03	—	PSLBE	P LBE	P LBE	P LBE	—	—
9-5/8	43,5	244,50	64,74	11,05	—	—	P LBE	P LBE	P LBE	P LBE	—
9-5/8	47	244,50	69,94	11,99	—	—	P LBE	P LBE	P LBE	P LBE	P LBE
9-5/8	53,5	244,50	79,62	13,84	—	—	P LBE	P LBE	P LBE	P LBE	P LBE
9-5/8	58,4	244,50	86,91	15,11	—	—	P LB	P LB	P LB	P LB	P LB
9-5/8	59,4	244,50	88,40	15,47	—	—	—	—	P	—	—
9-5/8	64,9	244,50	96,58	17,07	—	—	—	—	P	—	—
9-5/8	70,3	244,50	104,62	18,64	—	—	—	—	P	—	—
9-5/8	75,6	244,50	112,51	20,24	—	—	—	—	P	—	—
10-3/4	32,75	273,10	48,74	7,09	PS	—	—	—	—	—	—
10-3/4	40,5	273,10	60,27	8,89	PS	PS B	—	—	—	—	—
10-3/4	45,5	273,10	67,71	10,16	—	PS BE	—	—	—	—	—
10-3/4	51	273,10	75,90	11,43	—	PS BE	PS BE	PS BE	PS BE	PS BE	—

Table A.1 *(concluded)*

Labels 1	Labels 2	Outside diameter, D mm	Nominal[1, 2] mass of threads and couplings kg/m	Wall thickness, t mm	Type of end finish[3] Grade H40	J55 K55	L80 C95	N80	C90[4] T95[4]	P110	Q125[4]
10-3/4	55,5	273,10	82,59	12,57	—	—	PS BE	PS BE	PS BE	PS BE	—
10-3/4	60,7	273,10	90,33	13,84	—	—	—	—	PS BE	PS BE	PS BE
10-3/4	65,7	273,10	97,77	15,11	—	—	—	—	PS B	PS B	PS B
10-3/4	73,2	273,10	108,93	17,07	—	—	—	—	P	—	—
10-3/4	79,2	273,10	117,86	18,64	—	—	—	—	P	—	—
10-3/4	85,3	273,10	126,94	20,24	—	—	—	—	P	—	—
11-3/4	42	298,50	62,50	8,46	PS	—	—	—	—	—	—
11-3/4	47	298,50	69,94	9,52	—	PS B	—	—	—	—	—
11-3/4	54	298,50	80,36	11,05	—	PS B	—	—	—	—	—
11-3/4	60	298,50	89,29	12,42	—	PS B	PS B	PS B	PS B	PS B	PS B
11-3/4	65	298,50	96,73	13,56	—	—	P	P	P	P	P
11-3/4	71	298,50	105,66	14,78	—	—	P	P	P	P	P
13-3/8	48	339,70	71,43	8,38	PS	—	—	—	—	—	—
13-3/8	54,5	339,70	81,10	9,65	—	PS B	—	—	—	—	—
13-3/8	61	339,70	90,78	10,92	—	PS B	—	—	—	—	—
13-3/8	68	339,70	101,20	12,19	—	PS B	PS B	PS B	PS B	PS B	—
13-3/8	72	339,70	107,15	13,06	—	—	PS B	PS B	PS B	PS B	PS B
16	65	406,40	96,73	9,52	PS	—	—	—	—	—	—
16	75	406,40	111,61	11,13	—	PS B	—	—	—	—	—
16	84	406,40	125,01	12,57	—	PS B	—	—	—	—	—
16	109	406,40	162,21	16,66	—	P	P	P	P	P	P
18-5/8	87,5	473,00	130,21	11,05	PS	PS B	—	—	—	—	—
20	94	508,00	139,89	11,13	PSL	PSLB	—	—	—	—	—
20	106,5	508,00	158,49	12,70	—	PSLB	—	—	—	—	—
20	133	508,00	197,93	16,13	—	PSLB	—	—	—	—	—

1) Nominal masses of threads and couplings are shown for information only.

2) The densities of martensitic chromium steels (L80 types 9Cr and 13Cr) are different from carbon steels. The masses shown are therefore not accurate for martensitic chromium steels. A mass correction factor of 0,989 may be used.

3) P = plain-end, S = short, round-thread, L = long, round-thread, B = buttress-thread, E = extreme-line.

4) Grade C90, T95 and Q125 casing shall be furnished in sizes, masses and wall thicknesses listed above or as shown on the purchase order.

Table A.2 — ISO plain-end casing liner list

Labels 1	Labels 2	Outside diameter mm	Plain-end mass kg/m	Grade	Wall thickness mm
3-1/2	9,91	88,90	14,76	J	7,34
4	11,34	101,60	16,89	J	7,26
4-1/2	13,04	114,30	19,42	J	7,37
5	17,93	127,00	26,71	J	9,19
5-1/2	19,81	139,70	29,51	J	9,17
6-5/8	27,65	168,28	41,18	J	10,59

Table A.3 — ISO tubing list — Size, mass, wall thickness, grade and applicable end finish

Labels[1]				Nominal masses[2, 3]					Type of end finish[4]						
1	2a	2b	2c	Outside diameter, D	Non-upset threads and couplings	External-upset threads and couplings	Integral joint	Wall thickness, t	Grade						
				mm	kg/m	kg/m	kg/m	mm	H40	J55	L80	N80	C90[5]	T95[5]	P110
1,050	1,14	1,2	—	26,67	1,70	1,79	—	2,87	PNU	PNU	PNU	PNU	PNU	PNU	—
1,050	1,48	1,54	—	26,67	2,20	2,29	—	3,91	P U	P U	P U	P U	P U	P U	P U
1,315	1,7	1,8	1,72	33,40	2,53	2,68	2,56	3,38	PNUI	PNUI	PNUI	PNUI	PNUI	PNUI	—
1,315	2,19	2,24	—	33,40	3,26	3,33	—	4,55	P U	P U	P U	P U	P U	P U	P U
1,660	—	—	2,1	42,16	—	—	3,13	3,18	P I	P I	—	—	—	—	—
1,660	2,3	2,4	2,33	42,16	3,42	3,57	3,47	3,56	PNUI	PNUI	PNUI	PNUI	PNUI	PNUI	—
1,660	3,03	3,07	—	42,16	4,51	4,57	—	4,85	P U	P U	P U	P U	P U	P U	P U
1,900	—	—	2,4	48,26	—	—	3,57	3,18	P I	P I	—	—	—	—	—
1,900	2,75	2,9	2,76	48,26	4,09	4,32	4,11	3,68	PNUI	PNUI	PNUI	PNUI	PNUI	PNUI	—
1,900	3,65	3,73	—	48,26	5,43	5,55	—	5,08	P U	P U	P U	P U	P U	P U	P U
1,900	4,42	—	—	48,26	6,58	—	—	6,35	—	—	P	—	P	P	—
1,900	5,15	—	—	48,26	7,66	—	—	7,62	—	—	P	—	P	P	—
2,063	—	—	3,25	52,40	—	—	4,84	3,96	P I	P I	P I	P I	P I	P I	—
2,063	—	—	—	52,40	—	—	—	5,72	P	P	P	P	P	P	P
2-3/8	4	—	—	60,33	5,95	—	—	4,24	PN	PN	PN	PN	PN	PN	—
2-3/8	4,6	4,7	—	60,33	6,85	6,99	—	4,83	PNU	PNU	PNU	PNU	PNU	PNU	PNU
2-3/8	5,8	5,95	—	60,33	8,63	8,85	—	6,45	—	—	PNU	PNU	PNU	PNU	PNU
2-3/8	6,6	—	—	60,33	9,82	—	—	7,49	—	—	P	—	P	P	—
2-3/8	7,35	7,45	—	60,33	10,94	11,09	—	8,53	—	—	P U	—	P U	P U	—
2-7/8	6,4	6,5	—	73,03	9,52	9,67	—	5,49	PNU	PNU	PNU	PNU	PNU	PNU	PNU
2-7/8	7,8	7,9	—	73,03	11,61	11,76	—	7,01	—	—	PNU	PNU	PNU	PNU	PNU
2-7/8	8,6	8,7	—	73,03	12,80	12,95	—	7,82	—	—	PNU	PNU	PNU	PNU	PNU
2-7/8	9,35	9,45	—	73,03	13,91	14,06	—	8,64	—	—	P U	—	P U	P U	—
2-7/8	10,5	—	—	73,03	15,63	—	—	9,96	—	—	P	—	P	P	—
2-7/8	11,5	—	—	73,03	17,11	—	—	11,18	—	—	P	—	P	P	—
3-1/2	7,7	—	—	88,90	11,46	—	—	5,49	PN	PN	PN	PN	PN	PN	—
3-1/2	9,2	9,3	—	88,90	13,69	13,84	—	6,45	PNU	PNU	PNU	PNU	PNU	PNU	PNU
3-1/2	10,2	—	—	88,90	15,18	—	—	7,34	PN	PN	PN	PN	PN	PN	—
3-1/2	12,7	12,95	—	88,90	18,90	19,27	—	9,53	—	—	PNU	PNU	PNU	PNU	PNU
3-1/2	14,3	—	—	88,90	21,28	—	—	10,92	—	—	P	—	P	P	—
3-1/2	15,5	—	—	88,90	23,07	—	—	12,09	—	—	P	—	P	P	—
3-1/2	17	—	—	88,90	25,30	—	—	13,46	—	—	P	—	P	P	—
4	9,5	—	—	101,60	14,14	—	—	5,74	PN	PN	PN	PN	PN	PN	—
4	—	11	—	101,60	—	16,37	—	6,65	P U	P U	P U	P U	P U	P U	—
4	13,2	—	—	101,60	19,64	—	—	8,38	—	—	P	—	P	P	—
4	16,1	—	—	101,60	23,96	—	—	10,54	—	—	P	—	P	P	—
4	18,9	—	—	101,60	28,13	—	—	12,70	—	—	P	—	P	P	—
4	22,2	—	—	101,60	33,04	—	—	15,49	—	—	P	—	P	P	—

Table A.3 *(concluded)*

Labels[1]				Nominal masses[2, 3]					Type of end finish[4]						
1	2a	2b	2c	Outside diameter, D	Non-upset threads and couplings	External-upset threads and couplings	Integral joint	Wall thickness, t	Grade						
				mm	kg/m	kg/m	kg/m	mm	H40	J55	L80	N80	C90[5]	T95[5]	P110
4-1/2	12,6	12,75	—	114,30	18,75	18,97	—	6,88	PNU	PNU	PNU	PNU	PNU	PNU	—
4-1/2	15,2	—	—	114,30	22,62	—	—	8,56	—	—	P	—	P	PN	—
4-1/2	17	—	—	114,30	25,30	—	—	9,65	—	—	P	—	P	P	—
4-1/2	18,9	—	—	114,30	28,13	—	—	10,92	—	—	P	—	P	P	—
4-1/2	21,5	—	—	114,30	32,00	—	—	12,70	—	—	P	—	P	P	—
4-1/2	23,7	—	—	114,30	35,27	—	—	14,22	—	—	P	—	P	P	—
4-1/2	26,1	—	—	114,30	38,84	—	—	16,00	—	—	P	—	P	P	—
5	15	—	—	127,00	22,32	—	—	7,52	PN	PN	PN	PN	PN	PN	PN
5	18	—	—	127,00	26,79	—	—	9,19	PN	PN	PN	PN	PN	PN	PN
5	21,4	—	—	127,00	31,85	—	—	11,10	PN	PN	PN	PN	PN	PN	PN
5	23,2	—	—	127,00	34,53	—	—	12,14	PN	PN	PN	PN	PN	PN	PN
5	24,1	—	—	127,00	35,86	—	—	12,70	PN	PN	PN	PN	PN	PN	PN
5-1/2	15,5	—	—	139,70	23,07	—	—	6,99	PN	PN	PN	PN	PN	PN	PN
5-1/2	17	—	—	139,70	25,30	—	—	7,72	PN	PN	PN	PN	PN	PN	PN
5-1/2	20	—	—	139,70	29,76	—	—	9,17	PN	PN	PN	PN	PN	PN	PN
5-1/2	23	—	—	139,70	34,23	—	—	10,54	PN	PN	PN	PN	PN	PN	PN
7	23	—	—	177,80	34,23	—	—	8,05	PN	PN	PN	PN	PN	PN	PN
7	26	—	—	177,80	38,69	—	—	9,19	PN	PN	PN	PN	PN	PN	PN
7	29	—	—	177,80	43,16	—	—	10,36	PN	PN	PN	PN	PN	PN	PN
7	32	—	—	177,80	47,62	—	—	11,51	PN	PN	PN	PN	PN	PN	PN
7	35	—	—	177,80	52,09	—	—	12,65	PN	PN	PN	PN	PN	PN	PN
7	38	—	—	177,80	56,55	—	—	13,72	PN	PN	PN	PN	PN	PN	PN

1) Labels: 2a = non-upset threaded and coupled;
2b = external-upset threaded and coupled;
2c = integral joint.

2) Nominal masses of threads and couplings are shown for information only.

3) The densities of martensitic chromium steels (L80 types 9Cr and 13Cr) are different from carbon steels. The masses shown are therefore not accurate for martensitic chromium steels. A mass correction factor of 0,989 may be used.

4) P = plain end, N = non-upset threads and couplings, U = external-upset threads and couplings, I = integral joint. Non-upset tubing is available with regular couplings or special bevel couplings. External-upset tubing is available with regular, special bevel or special clearance couplings.

5) Grade C90 and T95 tubing shall be furnished in sizes, masses and wall thicknesses as listed above or as shown on the purchase order.

Annex B
(normative)

Supplementary requirements

This annex describes supplementary requirements that may be agreed between interested parties. These requirements apply only when stated on the purchase order.

B.1 SR1: Supplementary non-destructive inspection for grades H40, J55, K55 and N80 (N, N and T)

The specified casing and tubing shall be inspected for imperfections that are greater than 12,5 % of the specified wall thickness or which reduce the net effective wall thickness below 87,5 % of the specified wall thickness.

These imperfections shall be considered defects and shall be given a disposition in accordance with 9.7.12. The inspection(s) including forged upsets shall be performed to the minimum requirements stated in 9.7 for grades N80, type Q, L80 and C95.

B.2 SR2: Supplementary non-destructive inspection for grades H40, J55, K55, N80, L80 and C95

The specified casing and tubing shall be inspected for imperfections that are greater than 5 % of the specified wall thickness or which reduce the net effective wall thickness below 87,5 % of the specified wall thickness. These imperfections shall be considered defects and shall be given a disposition in accordance with 9.7.12. The inspection(s), including forged upsets, shall be performed to the minimum requirements stated in 9.7 for grade P110.

B.3 SR9: Coupling blanks — Group 4 only

SR9.1 Definition

Coupling blanks are coupling material produced to the requirements of this International Standard and provided to the purchaser in an unthreaded condition.

SR9.2 Coupling blank size

Coupling blank dimensions shall be adequate to yield a fully machined cylinder with uniform wall thickness with an outside diameter and inside diameter and length as specified on the purchase order. The coupling blanks shall be provided fully machined by the manufacturer only when specified on the purchase order.

SR9.3 Dimensional limitation

For fully machined coupling blanks, the tolerance on the outside diameter shall be $^{+2,38}_{0}$ mm, and the tolerance on the inside diameter shall be $^{0}_{-2,38}$ mm, unless otherwise agreed upon between interested parties.

Coupling blanks ordered with as-rolled outside diameter surface shall have an outside diameter tolerance of ± 1 %, but not greater than $^{+3,18}_{-1,59}$ mm.

SR9.4 Imperfections

Coupling blanks that will not be fully machined by either the manufacturer or the purchaser shall be inspected and meet the same requirements as finished couplings. Coupling blanks that will be fully machined by either the manufacturer or the purchaser may have imperfections on the as-rolled surface; however, the machined surface shall meet the surface inspection criteria of 8.13 and be to the specified dimensions.

SR9.5 Marking

All coupling blanks meeting the requirements of SR9 shall be marked "Q125-SR9".

B.4 SR10: Upset casing — Group 4 only

SR10.1 Dimensions

Q125 grade casing shall be provided with upset end(s). Dimensions of the upset, if other than extreme-line (including tolerances), shall be specified on the purchase order.