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.