INTERNATIONAL STANDARD

ISO 3183-1

Second edition
1996-09-15

Petroleum and natural gas industries — Steel pipe for pipelines — Technical delivery conditions —

Part 1:
Pipes of requirement class A

Industries du pétrole et du gaz naturel — Tubes en acier pour conduites — Conditions techniques de livraison —

Partie 1: Tubes de la classe d'exigences A

Reference number
ISO 3183-1:1996(E)

Contents

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

Printed in Switzerland

Annexes

Foreword

ISO (International Organization for Standardization) is a worldwide federation of national standard 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 3183-1 was prepared by Technical Committee ISO/TC 67 *Materials, equipment and offshore structures for petroleum and natural gas industries,* Subcommittee SC 1, *Line pipe,* on the basis of the American National Standard ANSI/API Spec. 5L [1], structured in accordance with the ISO rules and aligned with ISO 3183, part 2 as far as possible.

It replaces partly ISO 3183:1980 of which it constitutes a technical revision.

ISO 3183 consists of the following parts under the general title

Petroleum and natural gas industries – Steel pipe for pipelines – Technical delivery conditions

- *Part 1: Pipes of requirement class A*
- *Part 2: Pipes of requirement class B*
- *Part 3: Pipes of requirement class C*

Annexes A to G form an integral part of this part of ISO 3183.

Annexes H to K are for information only.

Introduction

In the preparation of this International Standard the competent committee was unanimous in seeking to avoid specifying the quality of line pipe to be used for a particular application. However, the committee recognized that there are several broad quality levels commonly used, and has differentiated between these quality levels as follows:

Firstly, the committee recognized the need to provide a basic quality level which corresponds to that specified in ANSI/API Spec. 5L [1]. This is designated requirement class A and considered in this part of ISO 3183. The main differences between ANSI/API Spec. 5L and ISO 3183-1 are listed in annex J.

Secondly, many purchasers impose requirements different from, or additional to, the basic standard. This approach is common, for example, for transmission pipelines. Such overall enhanced requirements are addressed in requirement class B and considered in Part 2 of ISO 3183.

Thirdly, there are certain particularly demanding applications where very stringent requirements on quality and testing are imposed. Such requirements are reflected in requirement class C and considered in Part 3 of ISO 3183.

The selection of the requirement class depends on many factors. The properties of the fluid to be conveyed, the service conditions, design code and any statutory requirements should all be taken into consideration. Therefore, this International Standard gives no detailed guidelines. It is the ultimate responsibility of the user to select the appropriate requirement class for the intended application.

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Petroleum and natural gas industries – Steel pipe for pipelines – Technical delivery conditions –
Part 1: Pipes of requirement class A

1 Scope

This part of ISO 3183 specifies the technical delivery conditions for seamless and welded pipe of non-alloy and alloy (except stainless) steels with the basic quality and testing requirements (level A), which are intended for the transmission and distribution of combustible and non-combustible fluids (including water) in the petroleum and natural gas industries.

This part of ISO 3183 includes threaded and extra-strong threaded line pipe; and plain-end, regular-mass plain-end, special plain-end, extra-strong plain-end and double-extra-strong plain-end pipe; as well as bell and spigot pipe.

Dimensional requirements on threads and thread gauges, stipulations on gauging practice, gauge specifications and certification, as well as instruments and methods for inspection of threads are given in ISO 10422 and are applicable to products covered by this part of ISO 3183.

Grades covered by this part of ISO 3183 are L175, L210, L245, L290, L320, L360, L390, L415, L450, L485, L555, grades intermediate to the grades L290 and higher, listed in table 2.

For regular-mass and special plain-end pipe (special mass) as shown in tables 8 and 9 and for threaded pipe larger than nominal size 12 (see table 6) the size designations used herein are outside-diameter sizes. For all other pipe, the size designations are nominal pipe sizes. Where pipe size limits (or size ranges) are given, these are outside-diameter sizes except when it is stated that they are nominal. These outside-diameter size limits and ranges apply also to the corresponding nominal sizes (see 7.6).

NOTE 1 Attention is drawn to the definition for seamless pipe in 3.2.2.1.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 3183. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 3183 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 404:1992, *Steel and steel products – General technical delivery requirements.*

ISO 1027:1983, *Radiographic image quality indicators for non-destructive testing – Principles and identification.*

ISO 2566-1:1984, *Steel – Conversion of elongation values – Part 1: Carbon and low alloy steels.*

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

ISO 4948-1:1982, *Steels – Classification – Part 1: Classification of steels into unalloyed and alloy steels based on chemical composition.*

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

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

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

ISO 6929:1987, *Steel products – Definitions and classification.*

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

ISO 8491:1986, *Metallic materials – Tube (in full section) – Bend test.*

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

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

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

API Bull 5A2-1992, *Bulletin on thread compounds for casing, tubing, and line pipe.*

API RP 5L3-1996, *Recommended practice for conducting drop-weight tear tests on line pipe.*

API Std 1104-1994, *Welding of pipelines and related facilities.*

ASTM A 29, *Recommended practice for indicating which places of figures are to be considered significant in specified limiting values.*

ASTM A 370:1989, *Test methods and definitions for mechanical testing of steel products.*

ASTM A 751:1990, *Test methods, practices and terminology for chemical analysis of steel products.*

ASTM E 4:1989, *Practices for load verification of testing machines.*

ASTM E 83:1990, *Method of verification and classification of extensometers.*

ASME, *Boiler and pressure vessel code, Section IX.*

3 Definitions

3.1 General

For the purpose of this part of ISO 3183 the definitions in 3.2 shall apply when additional to or differing from those given in ISO 6929 for steel products.

Moreover, within this part of ISO 3183:

- The term *manufacturer* refers to the firm, company or corporation responsible for marking the product to warrant that the product conforms to the standard. The *manufacturer* may be either a pipe mill, a processor, a maker of couplings or a threader as applicable. The *manufacturer* is responsible for compliance with all of the applicable provisions of the standard.
- The term *pipe mill* refers to the firm, company or corporation that operates pipe making facilities.
- The term *processor* refers to the firm, company or corporation that operates facilities capable of heat treating pipe made by a pipe mill.

3.2 Welding processes, pipes and welds

3.2.1 Welding process

3.2.1.1 Without filler metal

(a) **continuous welding:** Process of forming a seam by heating the strip in a furnace and mechanically pressing the formed edges together, wherein successive coils of strip had been joined together to provide a continuous flow of steel for the welding mill. (This process is a type of butt-welding.)

(b) **electric-welding:** Process of forming a seam by electric-resistance or electric-induction welding 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.

3.2.1.2 With filler metal

(a) **submerged arc-welding:** Welding process that produces coalescence of metals by heating them with an arc or arcs between bare metal consumable electrode or electrodes and the work. The arc and molten metal are shielded by a blanket of granular, fusible material on the work. Pressure is not used, and part or all of the filler metal is obtained from the electrode(s).

(b) **gas metal arc-welding:** Welding process that produces coalescence of metals by heating them with an arc or arcs between a continuous consumable electrode and the work. Shielding is obtained entirely from an externally supplied gas or gas mixture. Pressure is not used, and the filler metal is obtained from the electrode.

3.2.2 Types of pipe

3.2.2.1 seamless pipe: Tubular product without a welded seam, manufactured in a hot forming process which may be followed by cold finishing to obtain the desired shape, dimensions and properties.

NOTE 2 Cast pipes are not covered by ISO 3183.

3.2.2.2 continuous welded pipe: Pipe having one longitudinal seam produced by the continuous welding process defined in 3.2.1.1 (a). (This type of pipe is a type of butt-welded pipe.)

3.2.2.3 electric-welded pipe: Pipe having one longitudinal seam produced by the electric-welding process defined in 3.2.1.1 (b).

3.2.2.4 longitudinal seam submerged arc-welded pipe: Pipe having one longitudinal seam produced by the automatic submerged arc-welding process defined in 3.2.1.2 (a).

3.2.2.5 gas metal arc-welded pipe: Pipe having one longitudinal or helical seam produced by the continuous gas metal arc-welding process defined in 3.2.1.2 (b).

3.2.2.6 combination gas metal arc- and submerged arc-welded pipe: Pipe having one longitudinal or helical seam produced by a combination of the welding processes defined in 3.2.1.2 (a) and 3.2.1.2 (b)

3.2.2.7 double seam submerged-arc welded pipe: Pipe having two longitudinal seams produced by the automatic submerged-arc welding process defined in 3.2.1.2 (a).

3.2.2.8 double seam gas metal arc-welded pipe: Pipe having two longitudinal seams produced by the gas metal arc-welding process defined in 3.2.1.2 (b).

3.2.2.9 double seam combination gas metal arc- and submerged arc-welded pipe: Pipe having two longitudinal seams produced by a combination of the welding processes defined in 3.2.1.2 (a) and 3.2.1.2 (b).

3.2.2.10 helical seam submerged arc-welded pipe: Pipe having one helical seam produced by the automatic submerged arc-welding process defined in 3.2.1.2 (a). (This type of pipe is also known as spiral weld pipe.)

3.2.3 Types of seam welds

3.2.3.1 electric-weld: Longitudinal seam weld produced by the electric-welding process defined in 3.2.1.1 (b).

3.2.3.2 submerged arc-weld: Longitudinal or helical seam weld produced by the submerged arc-welding process defined in 3.2.1.2 (a).

3.2.3.3 gas metal arc-weld: Longitudinal seam weld produced in whole or in part by the continuous gas metal arc-welding process defined in 3.2.1.2 (b).

3.2.3.4 strip/skelp end weld: Seam weld that joins plate or strip ends together.

3.2.3.5 jointer weld: Circumferential seam weld that joins two pieces of pipe together.

3.2.3.6 tack weld: Seam weld used to align the abutting edges until the final seam welds are produced.

3.2.4 Imperfections and defects

3.2.4.1 An "imperfection" is a discontinuity or irregularity in the product detected by methods outlined in this part of ISO 3183.

3.2.4.2 A "defect" is an imperfection of sufficient magnitude to preclude acceptance of the product in accordance with this part of ISO 3183.

4 Designation

The steels specified in this part of ISO 3183 are designated as shown in table 2 differing from ISO/TR 4949.

NOTE 3 In annex H a comparison of these steel designations with those specified in ANSI/API Spec 5L [1] is given.

5 Information to be supplied by the purchaser

In placing orders for line pipe to be manufactured in accordance with this part of ISO 3183 the purchaser should specify the following on the purchase order:

Specification	ISO 3183-1
Quantity	
Grade or class	tables 2 and 3
Type of pipe	3.2.2
Size	
Nominal size	
Threaded pipe	table 6
Extra-strong threaded pipe	table 7
Plain-end pipe	table 8
Extra-strong plain-end pipe	table 8
Double-extra-strong plain-end pipe	table 8
Outside diameter	
Regular-mass plain-end pipe	table 8
Special plain-end pipe	table 8
Mass per metre or wall thickness	7.6.1, 7.6.3
Nominal length	7.6.5
End finish	7.6.9
Delivery date and shipping instructions	

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

Document of compliance	8.1.1
Chemical analysis test reports	8.1.2
Acceptance and maximum allowable length requirements on jointers	7.6.7
Jointers for threaded pipe	7.6.7
Threaded ends, extra-strong pipe	7.6.9.1
Alternative bevel, plain-end pipe with outside diameter ≥ 60,3 mm	7.6.9.3
Special coupling pipe ends	7.6.9.5
Power-tight make-up	7.6.9.2
Special non-destructive inspection for laminations	G.3.9
Defect repair procedures	G.6, G.7, G.8
Bare pipe - special coatings	10
Method of welding jointers	annex A
Purchaser inspection	annex F

Attention is called to the following stipulations which are subject to agreement between the interested parties:

Strip end welds	6.5
Chemical composition	7.2.1
Intermediate grades	1, 7.2.1, 7.3.2, table B.1
Flattening test orientation	8.5.2.2, figure 3
Intermediate diameters	7.6.2
Intermediate wall thickness	7.6.3
Supplementary requirements	annex D

NDT electric welds	8.9, SR7
NDT seamless pipe	8.9, SR2
Supplementary hydrostatic test	8.10.9.4
Hydrostatic test pressure	8.10.9.3
Lengths applied to carloads	7.6.8.6, table 11
Nonstandard length and length tolerances	7.6.5
Welded couplings	C.1
Thread protectors	7.6.9
Repair of welds of electric-welded pipe	8.10.11.3.4, G.5 b)
Marking requirements	9.2, 9.3, 9.7

This information should preferably be given in the way indicated in the following example.

EXAMPLE

Delivery of 1 500 m regular-mass plain-end pipe of grade L290 with an outside diameter of 457,0 mm, a wall thickness of 10,3 mm and a nominal length of 12 m (see table 11), with document of compliance.

Designation in the order:

1 500 m pipe **ISO 3183-1-L290-457,0x10,3x12**-with document of compliance.

6 Manufacturing

6.1 Pipe manufacturing

Pipe complying with this part of ISO 3183 shall be subject to the limitations specified in table 1.

6.1.1 Electric-welded pipe in grades higher than L290, the weld seam and the entire heat affected zone shall be heat treated so as to simulate a normalizing heat treatment (see note 4), except that, by agreement between the interested parties, alternative heat treatments or combinations of heat treatment and chemical composition may be substituted. Where such substitutions are made, the manufacturer shall demonstrate the effectiveness of the method selected using a mutually agreed upon procedure, which may include, but is not necessarily limited to, hardness-testing, microstructural evaluation, or mechanical testing. For grades L290 and lower, the weld seam shall be similarly heat treated, or the pipe shall be processed in such a manner that no untempered martensite remains.

NOTE 4 During the manufacture of electric-welded pipe, the product is in motion through the surrounding air. Normalizing is usually defined as "cooling in still air", hence, the phrase "to stimulate a normalizing heat treatment" is used.

6.1.2 Longitudinal seam submerged arc-welded pipe, at least one pass shall be on the inside and at least one pass shall be on the outside.

6.1.3 Combination gas metal arc- and submerged arc-welded pipe, the gas metal arc-welding process shall be continuous and first, and followed by the automatic submerged arc-welding process with, at least, one pass on the inside and one pass on the outside.

6.1.4 Double seam submerged arc-welded pipe, the seams shall be approximately 180° apart. For each seam, at least one pass shall be on the inside and at least one pass shall be on the outside.

6.1.5 Double seam gas metal arc-welded pipe, the seams shall be approximately 180° apart. For each seam, at least one pass shall be on the inside and at least one pass shall be on the outside.

6.1.6 Double seam combination gas metal arc- and submerged arc-welded pipe, the seams shall be approximately 180° apart. For each seam, the gas metal arc-welding shall be continuous and first, and followed by the automatic submerged arc-welding process with at least one pass on the inside and one pass on the outside.

6.1.7 Tack welds shall be made by manual or semi-automatic submerged arc-welding; electric-welding; gas metal arc-welding; flux cored arc-welding; or shielded metal arc-welding using low hydrogen electrodes. Tack welds shall be removed by machining or remelted during subsequent welding of the seam.

6.1.8 Helical seam submerged arc-welded pipe, at least one pass shall be on the inside and at least one pass shall be on the outside.

6.2 Cold expansion

Pipe complying with this part of ISO 3183, except continuous welded, shall be either non-expanded or cold expanded at the option of the manufacturer unless otherwise specified on the purchase order. Suitable provision shall be incorporated to protect the weld from contact with the internal expander during mechanical expansion.

6.3 Material

The width of plate or strip used to manufacture helical seam pipe shall be not less than 0,8 or more than 3 times the pipe outside diameter.

6.4 Heat treatment

The heat treating process shall be performed in accordance with a documented procedure. Pipe complying with this part of ISO 3183 may be as rolled, normalized, normalized and tempered, subcritically stress-relieved, or subcritically age-hardened; and grades L290 and higher may be quenched and tempered. (See clause 9 for applicable marking requirements.)

6.5 Strip end welds - helical seam pipe

Junctions of strip end welds and helical seam welds in finished pipe shall be permitted only at distances greater than 304,8 mm from the pipe ends. By agreement between the interested parties, strip end welds shall be permitted at the pipe ends, provided there is a circumferential separation of at least 152,4 mm between the strip end weld and the helical seam weld at the applicable pipe ends. Strip end welds in finished pipe shall be properly prepared for welding and shall be made by automatic submerged arc-welding, automatic gas metal arc-welding, or a combination of such welding procedures.

6.6 Traceability

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

Table 1 – Process of manufacture

Type of pipe	Grade	
	L175	L210 to L555
Seamless	X	X
Continuous welded	X	
Electric-welded	X	X
Longitudinal seam submerged arc-welded		X
Gas metal arc-welded		X
Combination gas metal arc- and submerged arc-welded		X
Double seam submerged arc-welded[1)]		X
Double seam gas metal arc-welded[1)]		X
Double seam combination gas metal arc- and submerged arc-welded[1)]		X
Helical seam submerged arc-welded[2)]		X

1) Double seam pipe is limited to outside diameter ≥ 914,0 mm.
2) Helical seam pipe is limited to outside diameter ≥ 114,3 mm.

7 Requirements

7.1 General

The requirements specified in this part of ISO 3183 apply under the conditions that the relevant specifications for sampling, test piece preparation and test methods given in 8.5.2 and 8.10 are complied with.

Pipe manufactured as grade L415 or higher shall not be substituted for pipe ordered for grade L360 or lower without purchaser's approval.

7.2 Chemical composition

7.2.1 The composition of pipe complying with this part of ISO 3183, as determined by cast analysis for pipe other than grade L555, shall conform to the chemical requirements specified in table 2, except that, by agreement between the purchaser and the manufacturer, carbon contents higher than those specified may be used. The composition of intermediate grades (higher than L290) shall conform to chemical requirements agreed upon between the interested parties, and such requirements shall be consistent with the requirements specified in table 2 for the applicable type of pipe. For grades L290 and higher, by agreement between the purchaser and the manufacturer, elements other than niobium, vanadium, and titanium may be used; however, caution should be exercised in the determination of the quantity that may be present for any particular size and thickness of pipe, because the addition of such otherwise desirable elements may alter the weldability of the pipe.

NOTE 5 Class II steel is rephosphorized and probably has better threading properties than Class I but may be somewhat more difficult to bend.

Table 2 – Chemical requirements for cast analysis[9], % by mass

Type of pipe	Grade and class	Carbon max.[1]	Manganese min.	Manganese max.	Phosphorus min.	Phosphorus max.	Sulfur max.
Seamless							
Non-expanded or cold expanded	L175, Cl I	0,21	0,30	0,60	-	0,030	0,030
Non-expanded or cold expanded	L175, Cl II[2]	0,21	0,30	0,60	0,045	0,080	0,030
Non-expanded or cold expanded	L210	0,22	-	0,90	-	0,030	0,030
Non-expanded or cold expanded	L245[3]	0,27	-	1,15	-	0,030	0,030
Non-expanded	L290[5]	0,29	-	1,25	-	0,030	0,030
Non-expanded	L320[5], L360[5]	0,31	-	1,35	-	0,030	0,030
Cold expanded	L290[5], L320[5], L360[5]	0,29[4]	-	1,25	-	0,030	0,030
Non-expanded or cold expanded	L390[5] [6], L415[5] [6]	0,26	-	1,35	-	0,030	0,030
Non-expanded or cold expanded	L450, L485, L555	(By agreement between the interested parties.)					
Welded							
Electric-welded or continous welded only	L175, Cl I	0,21	0,30	0,60	-	0,030	0,030
Electric-welded or continous welded only	L175, Cl II[2]	0,21	0,30	0,60	0,045	0,080	0,030
Non-expanded or cold expanded	L210	0,21	-	0,90	-	0,030	0,030
Non-expanded or cold expanded	L245[3]	0,26	-	1,15	-	0,030	0,030
Non-expanded or cold expanded	L290[5]	0,28	-	1,25	-	0,030	0,030
Non-expanded	L320[5], L360[5]	0,30	-	1,25	-	0,030	0,030
Cold expanded	L320[5], L360[5]	0,28	-	1,25	-	0,030	0,030
Non-expanded or cold expanded	L390[5] [6], L415[5] [6]	0,26	-	1,35	-	0,030	0,030
Non-expanded or cold expanded	L450[5] [7]	0,26	-	1,40	-	0,030	0,030[2]
Non-expanded or cold expanded	L485[6]	0,23[8]	-	1,60[8]	-	0,030	0,030
Non-expanded or cold expanded	L555[9]	0,18[8] [9]	-	1,80[8] [9]	-	0,030[9]	0,030[9]

1) For grades L290 to L450 for each reduction of 0,01 % below the specified maximum carbon content, an increase of 0,05 % above the specified maximum manganese content is permissible, up to a maximum of 1,45 % for L360 and lower and up to a maximum of 1,60 % for grades higher than L360.

2) Class II steel is rephosphorized. (See 7.2.1 for note on bending and threading properties.)

3) Niobium, vanadium, titanium, or combinations thereof, may be used by agreement between the interested parties.

4) For cold expanded seamless pipe with ≥ 508 mm outside diameter, the maximum carbon content shall be 0,28 %.

5) Niobium, vanadium, titanium, or combinations thereof, may be used at the discretion of the manufacturer.

6) Other chemical compositions may be furnished by agreement between the interested parties.

7) For grade L450 welded pipe with ≥ 406,4 mm outside diameter with a wall thickness of 12,7 mm or less, the chemical composition shall be as shown or as agreed upon between the interested parties; for all other outside diameters and wall thicknesses of such pipe, the chemical composition shall be as agreed upon between the interested parties.

8) For each reduction of 0,01 % below the specified maximum carbon content, an increase of 0,05 % above the specified maximum manganese content is permissible, up to a maximum of 2,00 %.

9) For grade L555, limits are for product analysis only, thereby eliminating the need for product analysis tolerances in 7.2.2.

7.2.2 The product analysis shall conform to the chemical requirements shown in table 2, within the following permissible variations for product analysis, except for grade L555 pipe where the requirements in table 2 are for product analysis:

Carbon, %:

Seamless pipe	
All non-expanded and cold expanded outside diameter < 508 mm	+ 0,03
Cold expanded 508 mm outside diameter and larger in grades L290 and higher	+ 0,04
Welded pipe	+ 0,04

Manganese, %:

All grades up to L240	+ 0,05
Where minimum is specified	– 0,05
Grade L290 and higher	+ 0,10
Phosphorus, %:	+ 0,01
Where minimum is specified	– 0,01
Sulfur, %:	+ 0,01

7.3 Mechanical properties

7.3.1 Acceptance criteria

These shall be in conformity with the requirements of

- tensile test in 8.10.2;
- flattening test in 8.10.3;
- bend test in 8.10.4;
- guided-bend test in 8.10.5;
- weld ductility test in 8.10.6;
- fracture toughness test in 8.10.7;
- hydrostatic test in 8.10.9.

7.3.2 Requirements for tensile strength

Grades L175, L210, L245, L290, L320, L360, L390, L415, L 450, L485 and L555 shall conform to the tensile requirements specified in table 3. Other grades intermediate to the listed grades between L290 and L555 shall conform to tensile requirements agreed upon between the interested parties, which requirements shall be consistent with those specified in table 3. For cold expanded pipe, the ratio of body yield strength and body ultimate tensile strength shall not exceed 0,93. The yield strength shall be the tensile stress required to produce a total elongation of 0,5 % of the gauge length as determined by an extensometer.

Table 3 – Tensile requirements

Grade	Yield strength for 0,5% total elongation $R_{t0,5}$ min. N/mm²	Ultimate tensile strength R_m min. N/mm²	Ultimate tensile strength R_m max. N/mm²	Elongation[1] A $L_0 = 5{,}65\sqrt{S_0}$ min. %
L175	175	315		27
L210	210	335		25
L245	245	415		21
L290	290	415		21
L320	320	435		20
L360	360	460		19
L390	390	490		18
L415	415	520		17
L450	450	535		17
L485	485	570		16
L555	555	625	825	15

1) These values apply to transverse specimens taken from the pipe body. When longitudinal specimens are tested (see figure 4) the values of elongation shall be 2 units higher.

7.3.3 Requirements for fracture toughness

For grade L555, the following fracture toughness requirements are mandatory for all diameters.

Table 4 – SR3 mandatory toughness requirements

Minimum impact energy at 0 °C J		Minimum shear area at 0 °C %	
Average of 3 specimens		Average of 3 specimens	
all cast averages	from one cast	all cast averages	from one cast
68	27	70	40

Table 5 – Optional SR3B and SR4 mandatory toughness requirements based on Charpy and drop weight tear tests

Minimum impact energy at 0 °C J		Minimum DWTT shear area at 0 °C %	
Average of 3 specimens		Average of 2 specimens	
all cast averages	from one cast	all cast averages	from one cast
68	27	60	40

For grades lower than L555 optional tests can be specified by the purchaser in accordance with annex D, SR3 or SR4 or any combination of these.

7.4 Metallurgical requirement

For grades higher than L290, full body normalized pipe excluded, compliance with the requirement of 6.1.1 that the entire heat affected zone be heat treated shall be demonstrated by metallographic examinations of a weld cross-section.

7.5 Appearance, imperfections and defects

7.5.1 For workmanship, visual inspection and repair of defects annex G applies.

7.5.2 For the acceptance limits for non-destructive inspection 8.10.11 applies.

7.6 Dimensions, masses and tolerances

7.6.1 General – Dimensions and masses: Line pipe shall be made in the outside diameters, wall thicknesses, and masses provided in tables 6, 7, 8 and 9 and in 7.6.2 and 7.6.3, respectively or in the relevant dimensions and masses given in ISO 4200, as specified on the purchase order.

The plain-end mass M shall be calculated using the following formula:

$$M = (D - T) \times T \times 0{,}024\ 661\ 5$$

where

M is the mass per unit length, in kilograms per metre, rounded to the nearest 0,01 kg/m;
D is the outside diameter, in millimetres, rounded to the nearest 0,1 mm for sizes < 457,0 mm, and 1 mm for sizes ≥ 457,0 mm;
T is the specified wall thickness, in millimetres, rounded to the nearest 0,1 mm.

The coefficient takes into account a density equal to 7,85 kg/dm^3.

7.6.2 Diameter

The outside diameter shall be within the tolerances specified in 7.6.8.1 (inside diameters are governed by the outside diameter and mass tolerances). Pipe in grades L290 and higher with outside diameters intermediate to those listed in table 9 is available in outside diameters ≥ 508,0 mm by agreement between the interested parties. Such pipe shall be consistent with all requirements of this part of ISO 3183 and shall be marked with the specified outside diameter. For threaded pipe, the outside diameter at the threaded ends shall be such that the thread length L4 and the number of full-crest threads in that length are within the dimensions and tolerances specified in ISO 10422 (inside diameters are governed by the outside diameter and mass tolerances).

7.6.3 Wall thickness

The wall thickness at any place shall be within the tolerances specified in 7.6.8.4 except that the weld area shall not be limited by the plus tolerance.

Pipe with wall thicknesses intermediate to those listed in tables 8 and 9 is available by agreement between the interested parties. Such pipe shall be consistent with all requirements of this part of ISO 3183 and shall be marked in accordance with clause 9 using the specified wall thickness to calculate M.

7.6.4 Mass

The masses determined as described in 8.10.10.3 shall conform to the specified masses or calculated masses for plain-end pipe, or to the specified calculated masses (or adjusted calculated masses) for threaded-and-coupled pipe, within the tolerances specified in 7.6.8.5.

Calculated masses shall be determined in accordance with the following formula:

$$M_L = (M \times L) + e_M$$

where

M_L is the calculated mass of a pipe of length L, in kilograms;
M is the plain-end mass per unit length, in kilograms per metre;
L is the length of pipe, including end finish, as defined in 7.6.5 and 8.10.10.4, in metres;
e_M is the mass gain or loss due to end finishing, in kilograms.

For plain-end pipe, e_M equals zero.

7.6.5 Length

Unless otherwise agreed upon between the interested parties, pipe shall be made in the nominal lengths and within the length tolerances shown in table 11, as specified on the purchase order.

7.6.6 Straightness

Pipe in grades L175, L210 and L245 of an outside diameter less than 114,3 mm shall be reasonably straight. For all other pipe the deviation from a straight line shall not exceed 0,2 percent of the length.

7.6.7 Jointers

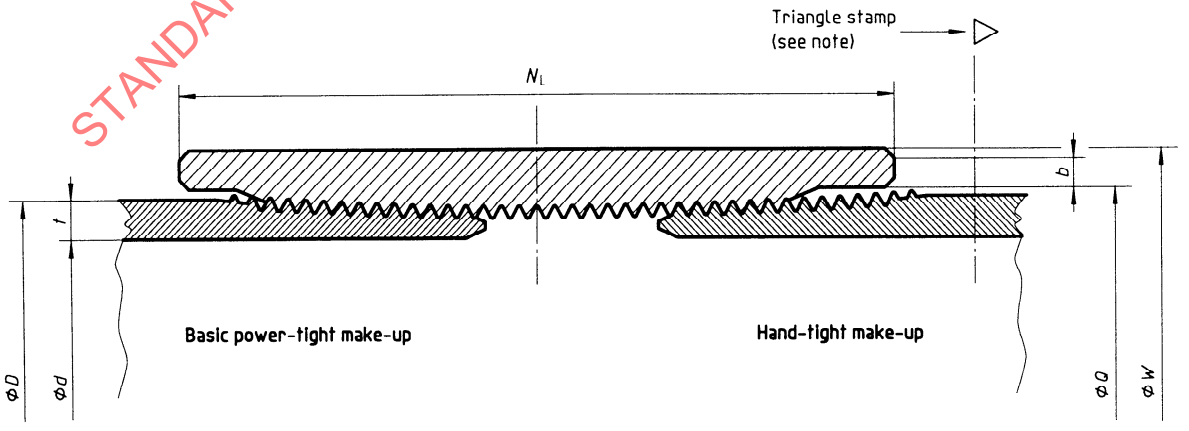
When specified on the purchase order, jointers (two lengths of pipe coupled together by the manufacturer, or two lengths of pipe welded together by the manufacturer in accordance with the requirements of annex A or other equivalent method as agreed between the interested parties), may be provided; however, no length used in making a jointer shall be shorter than 1 520 mm.

Double joints are not within the purview of this part of ISO 3183. Double joints are defined as two or more lengths of pipe welded together by parties other than the manufacturer, or two or more lengths welded together by the manufacturer in accordance with requirements other than those of annex A.

Table 6 – Threaded line pipe dimensions, masses and test pressures

Nominal size designation	Nominal mass designation, threads and coupling[1]	Outside diameter	Wall thickness	Inside diameter	Calculated mass		Minimum test pressure[3]		
					Plain-end	Threads and coupling[2]	Grade		
		D	T	d	M	e_M	L175	L210	L245
		mm	mm	mm	kg/m	kg	100 kPa[4]		
1/8	0,25	10,3	1,7	6,9	0,36	0,09	48	48	48
1/4	0,43	13,7	2,2	9,3	0,62	0,09	48	48	48
3/8	0,57	17,1	2,3	12,5	0,84	0,09	48	48	48
1/2	0,86	21,3	2,8	15,7	1,28	0,09	48	48	48
3/4	1,14	26,7	2,9	20,9	1,70	0,09	48	48	48
1	1,70	33,4	3,4	26,6	2,52	0,09	48	48	48
1 1/4	2,30	42,2	3,6	35,0	3,43	0,18	69	69	76
1 1/2	2,75	48,3	3,7	40,9	4,07	0,27	69	69	76
2	3,75	60,3	3,9	52,5	5,42	0,54	69	69	76
2 1/2	5,90	73,0	5,2	62,6	8,69	0,82	69	69	76
3	7,70	88,9	5,5	77,9	11,31	0,82	69	69	76
3 1/2	9,25	101,6	5,7	90,2	13,48	1,45	83	83	90
4	11,00	114,3	6,0	102,3	16,02	2,00	83	83	90
5	15,00	141,3	6,6	128,1	21,92	2,54	83	83	90
6	19,45	168,3	7,1	154,1	28,22	3,27	-	83	90
8	25,55	219,1	7,0	205,1	36,61	6,72	-	81	94
8	29,35	219,1	8,2	202,7	42,65	6,36	-	94	110
10	32,75	273,0	7,1	258,9	46,57	9,08	-	66	76
10	35,75	273,0	7,8	257,5	51,03	8,72	-	72	84
10	41,85	273,0	9,3	254,5	60,50	7,90	-	86	100
12	45,45	323,8	8,4	307,1	65,35	14,80	-	65	76
12	51,15	323,8	9,5	304,9	73,65	13,98	-	74	86
14D	57,00	355,6	9,5	336,6	81,08	11,17	-	67	79
16D	65,30	406,4	9,5	387,4	92,98	13,62	-	59	69
18D	73,00	457,0	9,5	438,0	104,84	16,16	-	52	61
20D	81,00	508,0	9,5	489,0	116,78	19,07	-	47	55

1) Nominal masses, threads and coupling are shown for the purpose of identification in ordering.
2) Mass gain due to end finishing. See 7.6.4.
3) The test pressures have been calculated on the basis of the formula in 8.10.9.3 for standard test pressure except those for grades L175 (all values) and L210/L245 (up to nominal size 2) which were established arbitrarily.
4) 100 kPa = 1 bar.



(See table 6 for pipe dimensions, table C.1 for coupling dimensions and ISO 10422 for thread details.)

Figure 1 – Line pipe and coupling

Table 7 – Extra-strong threaded line pipe dimensions, masses and test pressures

Nominal size designation	Nominal mass designation, threads and coupling[1]	Outside diameter	Wall thickness	Minimum test pressure[2]		
				Grade		
		D	T	L175	L210	L245
		mm	mm	100 kPa[3]		
1/8	0,31	10,3	2,4	59	59	59
1/4	0,54	13,7	3,0	59	59	59
3/8	0,74	17,1	3,2	59	59	59
1/2	1,09	21,3	3,7	59	59	59
3/4	1,48	26,7	3,9	59	59	59
1	2,18	33,4	4,5	59	59	59
1 1/4	3,02	42,2	4,9	90	103	110
1 1/2	3,66	48,3	5,1	90	103	110
2	5,07	60,3	5,5	90	172	172
2 1/2	7,73	73,0	7,0	90	193	172
3	10,33	88,9	7,6	90	193	172
3 1/2	12,63	101,6	8,1	117	193	193
4	15,17	114,3	8,6	117	190	193
5	21,09	141,3	9,5	117	169	193
6	28,89	168,3	11,0	-	165	192
8	43,90	219,1	12,7	-	146	170
10	55,82	273,0	12,7	-	117	137
12	66,71	323,8	12,7	-	97	114

1) Nominal masses, threads and coupling are shown for the purpose of identification in ordering.
2) Test pressures established arbitrarily. For grades L210 and L245 (nominal size ≥ 2½) the values have been calculated on the basis of the formula in 8.10.9.3 for standard test pressure.
3) 100 kPa = 1 bar.

Table 8 – Plain-end line pipe dimensions[1], masses and test pressures[2]

Nominal size designation	Wall designation	Nominal mass, designation	Outside diameter	Wall thickness	Inside diameter	Minimum test pressure[3]		
						Grade		
		M	D	T	d	L175	L210	L245
			mm	mm	mm	100 kPa[4]		
1/8		0,24	10,3	1,7	6,9	48		
1/8	XS	0,31	10,3	2,4	5,5	59		
1/4		0,42	13,7	2,2	9,3	48		
1/4	XS	0,54	13,7	3,0	7,7	59		
3/8		0,57	17,1	2,3	12,5	48		
3/8	XS	0,74	17,1	3,2	10,7	59		
1/2		0,85	21,3	2,8	15,7	48		
1/2	XS	1,09	21,3	3,7	13,9	59		
1/2	XXS	1,71	21,3	7,5	6,3	69		
3/4		1,13	26,7	2,9	20,9	48		
3/4	XS	1,47	26,7	3,9	18,9	59		
3/4	XXS	2,44	26,7	7,8	11,1	69		
1		1,68	33,4	3,4	26,6	48		
1	XS	2,17	33,4	4,5	24,4	59		
1	XXS	3,66	33,4	9,1	15,2	69		
1 1/4		2,27	42,2	3,6	35,0	69	83	90
1 1/4	XS	3,00	42,2	4,9	32,4	90	124	131
1 1/4	XXS	5,21	42,2	9,7	22,8	96	152	158
1 1/2		2,72	48,3	3,7	40,9	69	83	90
1 1/2	XS	3,63	48,3	5,1	38,1	90	124	131
1 1/2	XXS	6,41	48,3	10,2	27,9	96	152	158

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) Test pressures established arbitrarily.
4) 100 kPa = 1 bar.

Table 9 – Plain-end line pipe dimensions[1], masses and test pressures[2] (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]										
					L175	L210	L245	L290	L320	L360	L390	L415	L450	L485	L555
2 3/8[3]	2,03	60,3	2,1	56,1	41	88	102	121x	134x	150x	163x	173x	188x	203x	207
2 3/8[3]	2,64	60,3	2,8	54,6	55	117	137	162x	178x	201x	207	207	207	207	207
2 3/8[3]	3,00	60,3	3,2	53,9	69	134	156	185x	204x	207	207	207	207	207	207
2 3/8[3]	3,38	60,3	3,6	53,1	69	150	172	207	207	207	207	207	207	207	207
2 3/8	3,65	60,3	3,9	52,5	69	163	172	207	207	207	207	207	207	207	207
2 3/8	4,05	60,3	4,4	51,5	76	172	172	207	207	207	207	207	207	207	207
2 3/8	4,39	60,3	4,8	50,7	83	172	172	207	207	207	207	207	207	207	207
2 3/8	5,02	60,3	5,5	49,3	90	172	172	207	207	207	207	207	207	207	207
2 3/8	5,67	60,3	6,4	47,5	96	172	172	207	207	207	207	207	207	207	207
2 3/8	6,28	60,3	7,1	46,1	96	172	172	207	207	207	207	207	207	207	207
2 3/8	9,03	60,3	11,1	38,1	96	172	172	207	207	207	207	207	207	207	207
2 7/8[3]	2,47	73,0	2,1	68,8	41	72	85	100x	110x	124x	135x	143x	155x	167x	192x
2 7/8[3]	3,22	73,0	2,8	67,4	55	97	113	133x	147x	166x	180x	191x	207	207	207
2 7/8[3]	3,67	73,0	3,2	66,6	69	110	129	153x	168x	189x	205x	207	207	207	207
2 7/8[3]	4,12	73,0	3,6	65,8	69	124	145	172x	189x	207	207	207	207	207	207
2 7/8	4,53	73,0	4,0	65,0	69	138	161	191x	207	207	207	207	207	207	207
2 7/8	4,97	73,0	4,4	64,2	69	152	172	207	207	207	207	207	207	207	207
2 7/8	5,40	73,0	4,8	63,4	69	166	172	207	207	207	207	207	207	207	207
2 7/8	5,79	73,0	5,2	62,6	69	172	172	207	207	207	207	207	207	207	207
2 7/8	6,13	73,0	5,5	62,0	76	172	172	207	207	207	207	207	207	207	207
2 7/8	7,01	73,0	6,4	60,2	83	172	172	207	207	207	207	207	207	207	207
2 7/8	7,66	73,0	7,0	59,0	90	172	172	207	207	207	207	207	207	207	207
2 7/8	13,69	73,0	14,0	45,0	96	172	172	207	207	207	207	207	207	207	207
3 1/2[3]	3,03	88,9	2,1	84,7	41	60	69	82x	91x	102x	111x	118x	128x	137x	157x
3 1/2[3]	3,95	88,9	2,8	83,3	55	79	93	110x	121x	136x	147x	157x	170x	183x	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L 290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15). Sizes for which an alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with maximum values to be considered) may be requested are marked by "x" after the standard test pressure. L175 values were established arbitrarily.
5) 100 kPA = 1 bar

Table 9 *(continued)* **– Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]										
					L175	L210	L245	L290	L320	L360	L390	L415	L450	L485	L555
3 1/2[3]	4,51	88,9	3,2	82,5	69	91	106	125x	138x	156x	168x	179x	194x	207	207
3 1/2[3]	5,86	88,9	3,6	81,7	69	102	119	141x	158x	175x	190x	202x	207	207	207
3 1/2[3]	5,57	88,9	4,0	80,9	69	113	132	157x	173x	194x	207	207	207	207	207
3 1/2[3]	6,11	88,9	4,4	80,1	69	125	146	172x	190x	207	207	207	207	207	207
3 1/2	6,65	88,9	4,8	79,3	69	136	159	188x	207	207	207	207	207	207	207
3 1/2	7,58	88,9	5,5	77,9	69	156	172	207	207	207	207	207	207	207	207
3 1/2	8,68	88,9	6,4	76,1	-	172	172	207	207	207	207	207	207	207	207
3 1/2	9,66	88,9	7,1	74,7	-	172	172	207	207	207	207	207	207	207	207
3 1/2	10,25	88,9	7,6	73,7	90	172	172	207	207	207	207	207	207	207	207
3 1/2	18,58	88,9	15,2	58,5	-	172	172	207	207	207	207	207	207	207	207
4[3]	3,47	101,6	2,1	97,4	-	52	61	72x	79x	89x	97x	103x	112x	120x	138x
4[3]	4,53	101,6	2,8	96,0	41	69	81	93x	106x	119x	129x	137x	149x	160x	164x
4[3]	5,17	101,6	3,2	95,2	-	79	93	110x	121x	136x	147x	157x	170x	183x	207
4[3]	5,81	101,6	3,6	94,4	55	89	104	123x	136x	153x	168x	176x	191x	206x	207
4[3]	6,40	101,6	4,0	93,6	-	99	116	137x	151x	170x	184x	196x	207	207	207
4	7,03	101,6	4,4	92,8	69	109	127	151x	166x	187x	203x	207	207	207	207
4	7,65	101,6	4,8	92,0	83	119	139	164x	181x	204x	207	207	207	207	207
4	9,11	101,6	5,7	90,2	83	141	165	195x	207	207	207	207	207	207	207
4	10,01	101,6	6,4	88,8	-	159	185	207	207	207	207	207	207	207	207
4	11,16	101,6	7,1	87,4	-	176	193	207	207	207	207	207	207	207	207
4	12,50	101,6	8,1	85,4	117	193	193	207	207	207	207	207	207	207	207
4 1/2[3]	3,92	114,3	2,1	110,1	-	46	54	64x	71x	79x	88x	91x	99x	107x	122x
4 1/2[3]	5,84	114,3	3,2	107,9	55	71	82	97x	108x	121x	131x	139x	151x	163x	188x
4 1/2[3]	6,56	114,3	3,6	107,1	-	79	93	110x	121x	136x	147x	157x	170x	183x	207
4 1/2[3]	7,24	114,3	4,0	106,3	69	86	103	122x	134x	151x	164x	174x	189x	204x	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L 290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15). Sizes for which an alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with maximum values to be considered) may be requested are marked by "x" after the standard test pressure. L175 values were established arbitrarily.
5) 100 kPA = 1 bar

Table 9 *(continued)* – **Plain-end line pipe dimensions**[1], **masses and test pressures**[2] (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]										
					L175	L210	L245	L290	L320	L360	L390	L415	L450	L485	L555
4 1/2	7,95	114,3	4,4	105,5	-	97	113	134x	148x	166x	180x	192x	207	207	207
4 1/2	8,66	114,3	4,8	104,7	83	106	123	146x	161x	181x	197x	207	207	207	207
4 1/2	9,32	114,3	5,2	103,9	-	115	134	158x	175x	197x	207	207	207	207	207
4 1/2	10,01	114,3	5,6	103,1	83	123	144	170x	190x	207	207	207	207	207	207
4 1/2	10,79	114,3	6,0	102,3	83	132	154	183x	202x	207	207	207	207	207	207
4 1/2	11,35	114,3	6,4	101,5	-	141	165	195x	207	207	207	207	207	207	207
4 1/2	12,66	114,3	7,1	100,1	-	157	183	207	207	207	207	207	207	207	207
4 1/2	13,96	114,3	7,9	98,5	-	174	193	207	207	207	207	207	207	207	207
4 1/2	14,98	114,3	8,6	97,1	117	190	193	207	207	207	207	207	207	207	207
4 1/2	19,00	114,3	11,1	92,1	-	193	193	207	207	207	207	207	207	207	207
4 1/2	22,51	114,3	13,5	87,3	-	193	193	207	207	207	207	207	207	207	207
4 1/2	27,54	114,3	17,1	80,1	-	193	193	207	207	207	207	207	207	207	207
5 9/16[3]	4,86	141,3	2,1	137,1	-	37	44	52x	57x	64x	70x	74x	80x	86x	99x
5 9/16[3]	7,26	141,3	3,2	134,9	48	57	67	79x	87x	98x	106x	113x	122x	132x	151x
5 9/16[3]	9,01	141,3	4,0	133,3	59	71	83	99x	109x	122x	132x	141x	153x	185x	189x
5 9/16[3]	10,79	141,3	4,8	131,7	71	96	100	118x	130x	147x	159x	169x	183x	198x	207
5 9/16[3]	12,50	141,3	5,6	130,1	83	100	117	138x	152x	171x	186x	197x	207	207	207
5 9/16[3]	14,62	141,3	6,6	128,1	98	118	137	163x	179x	202x	207	207	207	207	207
5 9/16[3]	15,85	141,3	7,1	127,1	108	127	148	175x	193x	207	207	207	207	207	207
5 9/16[3]	17,50	141,3	7,9	125,5	117	141	164	195x	207	207	207	207	207	207	207
5 9/16[3]	19,17	141,3	8,7	123,9	129	155	181	207	207	207	207	207	207	207	207
5 9/16	20,78	141,3	9,5	122,3	141	169	193	207	207	207	207	207	207	207	207
5 9/16[3]	27,04	141,3	12,7	115,9	189	193	193	207	207	207	207	207	207	207	207
5 9/16[3]	32,96	141,3	15,9	109,5	193	193	193	207	207	207	207	207	207	207	207
5 9/16	38,55	141,3	19,1	103,1	193	193	193	207	207	207	207	207	207	207	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L 290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15). Sizes for which an alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with maximum values to be considered) may be requested are marked by "x" after the standard test pressure. L175 values were established arbitrarily.
5) 100 kPA = 1 bar

Table 9 *(continued)* **– Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
6 5/8[3]	5,80	168,3	2,1	164,1	31	37	54	60	67	73	78	84	91	103
6 5/8[3]	7,59	168,3	2,8	162,7	42	49	72	80	90	97	104	112	121	137
6 5/8[3]	8,88	168,3	3,2	161,9	48	56	83	91	103	111	118	128	138	157
6 5/8[3]	9,76	168,3	3,6	161,1	54	63	93	103	116	125	133	144	156	176
6 5/8[3]	10,78	168,3	4,0	160,3	60	70	103	114	128	139	148	160	173	196
6 5/8	11,85	168,3	4,4	159,5	66	77	114	125	141	153	163	176	190	207
6 5/8	12,92	168,3	4,8	158,7	72	84	124	137	154	167	178	193	207	207
6 5/8	13,92	168,3	5,2	157,9	78	91	134	148	167	181	192	207	207	207
6 5/8	14,98	168,3	5,6	157,1	84	98	145	160	180	195	207	207	207	207
6 5/8	17,02	168,3	6,4	155,5	96	112	165	183	205	207	207	207	207	207
6 5/8	18,97	168,3	7,1	154,1	106	124	184	202	207	207	207	207	207	207
6 5/8	21,04	168,3	7,9	152,5	118	138	204	207	207	207	207	207	207	207
6 5/8	23,08	168,3	8,7	150,9	130	152	207	207	207	207	207	207	207	207
6 5/8	25,03	168,3	9,5	149,3	142	166	207	207	207	207	207	207	207	207
6 5/8	28,57	168,3	11,0	146,3	165	192	207	207	207	207	207	207	207	207
6 5/8	32,71	168,3	12,7	142,9	190	193	207	207	207	207	207	207	207	207
6 5/8	38,39	168,3	14,3	139,7	193	193	207	207	207	207	207	207	207	207
6 5/8	40,05	168,3	15,9	136,5	193	193	207	207	207	207	207	207	207	207
6 5/8	45,35	168,3	18,3	131,7	193	193	207	207	207	207	207	207	207	207
6 5/8	47,06	168,3	19,1	130,1	193	193	207	207	207	207	207	207	207	207
6 5/8	53,73	168,3	22,2	123,9	193	193	207	207	207	207	207	207	207	207
8 5/8[3]	11,35	219,1	3,2	212,7	37	43	64	70	79	85	91	99	106	120
8 5/8[3]	14,11	219,1	4,0	211,1	46	54	79	88	99	107	114	123	133	151
8 5/8	16,94	219,1	4,8	209,5	55	64	95	105	118	128	136	148	159	181
8 5/8	18,26	219,1	5,2	208,7	60	70	103	114	128	139	148	160	173	196
8 5/8	19,66	219,1	5,6	207,9	64	75	111	123	138	150	159	173	186	207
8 5/8	22,36	219,1	6,4	206,3	74	86	127	140	158	171	182	197	207	207
8 5/8	24,70	219,1	7,0	205,1	81	94	139	153	173	187	199	207	207	207
8 5/8	27,70	219,1	7,9	203,3	91	106	157	173	195	207	207	207	207	207
8 5/8	28,55	219,1	8,2	202,7	94	110	163	180	202	207	207	207	207	207
8 5/8	30,42	219,1	8,7	201,7	100	117	173	191	207	207	207	207	207	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).

2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.

3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.

4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).

5) 100 kPA = 1 bar

6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* – **Plain-end line pipe dimensions**[1], **masses and test pressures**[2] (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
8 5/8	33,04	219,1	9,5	200,1	109	127	189	207	207	207	207	207	207	207
8 5/8	38,30	219,1	11,1	196,9	128	149	207	207	207	207	207	207	207	207
8 5/8	43,39	219,1	12,7	193,7	146	170	207	207	207	207	207	207	207	207
8 5/8	48,40	219,1	14,3	190,5	164	192	207	207	207	207	207	207	207	207
8 5/8	53,40	219,1	15,9	187,3	183	193	207	207	207	207	207	207	207	207
8 5/8	60,71	219,1	18,3	182,5	193	193	207	207	207	207	207	207	207	207
8 5/8	63,08	219,1	19,1	180,9	193	193	207	207	207	207	207	207	207	207
8 5/8	67,76	219,1	20,6	177,9	193	193	207	207	207	207	207	207	207	207
8 5/8	72,42	219,1	22,2	174,7	193	193	207	207	207	207	207	207	207	207
8 5/8	81,44	219,1	25,4	168,3	193	193	207	207	207	207	207	207	207	207
10 3/4[3]	17,65	273,1	4,0	265,1	37	43	72	80	90	97	103	112	121	137
10 3/4[3]	21,21	273,1	4,8	263,5	44	52	96	96	108	117	124	134	145	164
10 3/4[3]	22,87	273,1	5,2	262,7	48	56	104	104	117	126	134	146	157	178
10 3/4	24,83	273,1	5,6	261,9	52	60	112	112	125	136	145	157	169	192
10 3/4	28,04	273,1	6,4	260,3	59	69	127	127	143	155	165	179	193	207
10 3/4	31,20	273,1	7,1	258,9	66	76	141	141	159	172	183	199	207	207
10 3/4	34,24	273,1	7,8	257,5	72	84	155	155	175	189	201	207	207	207
10 3/4	38,23	273,1	8,7	255,7	80	94	173	173	195	207	207	207	207	207
10 3/4	40,48	273,1	9,3	254,5	86	100	185	185	207	207	207	207	207	207
10 3/4	48,24	273,1	11,1	250,9	102	119	207	207	207	207	207	207	207	207
10 3/4	54,74	273,1	12,7	247,7	117	137	207	207	207	207	207	207	207	207
10 3/4	61,15	273,1	14,3	244,5	132	154	207	207	207	207	207	207	207	207
10 3/4	67,58	273,1	15,9	241,3	147	171	207	207	207	207	207	207	207	207
10 3/4	77,03	273,1	18,3	236,5	169	193	207	207	207	207	207	207	207	207
10 3/4	86,18	273,1	20,6	231,9	190	193	207	207	207	207	207	207	207	207
10 3/4	92,28	273,1	22,2	228,7	193	193	207	207	207	207	207	207	207	207
10 3/4	98,30	273,1	23,8	225,5	193	193	207	207	207	207	207	207	207	207
10 3/4	104,13	273,1	25,4	222,3	193	193	207	207	207	207	207	207	207	207
10 3/4	126,83	273,1	31,8	209,5	193	193	207	207	207	207	207	207	207	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L 290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* **– Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
12 3/4[3]	23,11	323,9	4,4	315,1	34	40	59	65	73	79	85	92	99	112
12 3/4[3]	25,22	323,9	4,8	314,3	37	44	64	71	80	87	92	100	108	122
12 3/4[3]	27,20	323,9	5,2	313,5	40	47	70	77	87	94	100	108	117	132
12 3/4[3]	29,31	323,9	5,6	312,7	44	51	75	83	93	101	108	117	126	143
12 3/4[3]	33,38	323,9	6,4	311,1	50	58	86	95	107	116	123	133	144	163
12 3/4	37,42	323,9	7,1	309,7	55	64	95	105	118	128	136	148	159	181
12 3/4	41,45	323,9	7,9	308,1	61	72	106	117	132	143	152	165	177	201
12 3/4	43,77	323,9	8,4	307,1	65	76	113	124	140	152	161	175	189	207
12 3/4	45,58	323,9	8,7	306,5	68	79	117	129	145	157	167	181	195	207
12 3/4	49,56	323,9	9,5	304,9	74	86	128	141	158	172	183	198	207	207
12 3/4	53,52	323,9	10,3	303,3	80	93	138	153	172	186	198	207	207	207
12 3/4	57,59	323,9	11,1	301,7	86	101	149	164	185	200	207	207	207	207
12 3/4	65,42	323,9	12,7	298,5	99	115	171	188	207	207	207	207	207	207
12 3/4	73,15	323,9	14,3	295,3	111	130	192	207	207	207	207	207	207	207
12 3/4	80,93	323,9	15,9	292,1	124	144	207	207	207	207	207	207	207	207
12 3/4	88,63	323,9	17,5	288,9	136	159	207	207	207	207	207	207	207	207
12 3/4	96,12	323,9	19,1	285,7	149	173	207	207	207	207	207	207	207	207
12 3/4	103,53	323,9	20,6	282,7	160	187	207	207	207	207	207	207	207	207
12 3/4	110,97	323,9	22,2	279,5	173	193	207	207	207	207	207	207	207	207
12 3/4	118,33	323,9	23,8	276,3	185	193	207	207	207	207	207	207	207	207
12 3/4	125,49	323,9	25,4	273,1	193	193	207	207	207	207	207	207	207	207
12 3/4	132,57	323,9	27,0	269,9	193	193	207	207	207	207	207	207	207	207
12 3/4	139,67	323,9	28,6	266,7	193	193	207	207	207	207	207	207	207	207
12 3/4	153,53	323,9	31,8	260,3	193	193	207	207	207	207	207	207	207	207
14[3]	27,73	355,6	4,8	346,0	34	40	67	73	83	89	95	103	111	126
14[3]	29,91	355,6	5,2	345,2	37	43	72	80	89	97	103	112	121	137
14[3]	30,93	355,6	5,3	345,0	38	44	73	81	91	99	105	114	123	139
14[3]	32,23	355,6	5,6	344,4	40	46	78	86	96	104	111	120	130	147
14[3]	36,71	355,6	6,4	342,8	45	53	89	98	110	119	127	138	148	168

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L 290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* – **Plain-end line pipe dimensions**[1], **masses and test pressures**[2] (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
14	41,17	355,6	7,1	341,4	50	59	98	109	122	132	141	153	165	187
14	45,61	355,6	7,9	339,8	56	65	110	121	136	147	157	170	183	207
14	50,17	355,6	8,7	338,2	62	72	121	133	150	162	173	187	202	207
14	54,57	355,6	9,5	336,6	67	79	132	145	163	177	188	204	207	207
14	58,94	355,6	10,3	335,0	73	85	143	158	177	192	204	207	207	207
14	63,44	355,6	11,1	333,4	79	92	154	170	191	207	207	207	207	207
14	67,78	355,6	11,9	331,8	84	98	165	182	205	207	207	207	207	207
14	72,09	355,6	12,7	330,2	90	105	176	194	207	207	207	207	207	207
14	80,66	355,6	14,3	327,0	101	118	198	207	207	207	207	207	207	207
14	89,28	355,6	15,9	323,8	113	131	207	207	207	207	207	207	207	207
14	97,81	355,6	17,5	320,6	124	145	207	207	207	207	207	207	207	207
14	106,13	355,6	19,1	317,4	135	158	207	207	207	207	207	207	207	207
14	114,37	355,6	20,6	314,4	146	170	207	207	207	207	207	207	207	207
14	122,65	355,6	22,2	311,2	157	184	207	207	207	207	207	207	207	207
14	130,85	355,6	23,8	308,0	169	193	207	207	207	207	207	207	207	207
14	138,84	355,6	25,4	304,8	180	193	207	207	207	207	207	207	207	207
14	146,74	355,6	27,0	301,6	191	193	207	207	207	207	207	207	207	207
14	154,69	355,6	28,6	298,4	193	193	207	207	207	207	207	207	207	207
14	170,21	355,6	31,8	292,1	193	193	207	207	207	207	207	207	207	207
16[3]	31,75	406,4	4,8	396,8	30	35	58	64	72	78	83	90	97	110
16[3]	34,25	406,4	5,2	396,0	32	38	63	70	78	85	90	98	105	120
16[3]	36,91	406,4	5,6	395,2	35	41	68	75	84	91	97	105	114	129
16[3]	42,05	406,4	6,4	393,6	40	46	78	86	96	104	111	120	130	147
16[3]	47,17	406,4	7,1	392,2	44	51	86	95	107	116	123	134	144	163
16	52,27	406,4	7,9	390,6	49	57	96	106	119	129	137	149	160	182
16	57,52	406,4	8,7	389,0	54	63	106	116	131	142	151	164	177	200
16	62,58	406,4	9,5	387,4	59	69	115	127	143	155	165	179	193	207
16	67,62	406,4	10,3	385,8	64	75	125	138	155	168	179	194	207	207
16	72,80	406,4	11,1	384,2	69	80	135	149	167	181	193	207	207	207
16	77,79	406,4	11,9	382,6	74	86	144	159	179	194	207	207	207	207
16	82,77	406,4	12,7	381,0	79	92	154	170	191	207	207	207	207	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* **– Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
16	92,66	406,4	14,3	377,8	89	103	173	191	207	207	207	207	207	207
16	102,63	406,4	15,9	374,6	99	115	193	207	207	207	207	207	207	207
16	112,51	406,4	17,5	371,4	109	127	207	207	207	207	207	207	207	207
16	122,15	406,4	19,1	368,2	118	138	207	207	207	207	207	207	207	207
16	131,71	406,4	20,6	365,2	128	149	207	207	207	207	207	207	207	207
16	141,34	406,4	22,2	362,0	138	161	207	207	207	207	207	207	207	207
16	150,89	406,4	23,8	358,8	148	172	207	207	207	207	207	207	207	207
16	160,20	406,4	25,4	355,6	158	184	207	207	207	207	207	207	207	207
16	189,43	406,4	27,0	352,4	167	193	207	207	207	207	207	207	207	207
16	178,72	406,4	28,6	349,2	177	193	207	207	207	207	207	207	207	207
16	187,93	406,4	30,2	346,0	187	193	207	207	207	207	207	207	207	207
16	196,91	406,4	31,8	342,8	193	193	207	207	207	207	207	207	207	207
18[3]	35,76	457,0	4,8	447,4	26	31	52	57	64	70	74	80	87	207
18[3]	41,59	457,0	5,6	445,8	31	36	60	67	75	81	86	94	101	207
18[3]	47,39	457,0	6,4	444,2	35	41	69	76	86	93	99	107	115	207
18[3]	53,18	457,0	7,1	442,8	39	46	77	85	95	103	110	119	128	207
18	58,94	457,0	7,9	441,2	44	51	85	94	106	115	122	132	143	207
18	64,87	457,0	8,7	439,6	48	56	94	104	117	126	134	146	157	207
18	70,59	457,0	9,5	438,0	52	61	102	113	127	138	147	159	171	207
18	78,29	457,0	10,3	436,4	57	66	111	123	138	149	159	172	186	207
18	82,15	457,0	11,1	434,8	61	71	120	132	149	161	171	186	200	207
18	87,81	457,0	11,9	433,2	66	77	128	142	159	173	184	199	207	207
18	93,45	457,0	12,7	431,6	70	82	137	151	170	184	196	207	207	207
18	104,67	457,0	14,3	428,4	79	92	154	170	192	207	207	207	207	207
18	115,98	457,0	15,9	425,2	88	102	172	189	207	207	207	207	207	207
18	127,21	457,0	17,5	422,0	96	113	189	207	207	207	207	207	207	207
18	138,17	457,0	19,1	418,8	105	123	206	207	207	207	207	207	207	207
18	149,06	457,0	20,6	415,8	114	133	207	207	207	207	207	207	207	207
18	160,03	457,0	22,2	412,6	122	143	207	207	207	207	207	207	207	207
18	170,92	457,0	23,8	409,4	131	153	207	207	207	207	207	207	207	207
18	181,56	457,0	25,4	406,2	140	163	207	207	207	207	207	207	207	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* – **Plain-end line pipe dimensions**[1], **masses and test pressures**[2] (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
18	192,11	457,0	27,0	403,0	149	174	207	207	207	207	207	207	207	207
18	202,75	457,0	28,6	399,6	158	184	207	207	207	207	207	207	207	207
18	213,31	457,0	30,2	396,6	167	193	207	207	207	207	207	207	207	207
18	223,61	457,0	31,8	393,4	175	193	207	207	207	207	207	207	207	207
20[3]	46,27	508,0	5,6	496,8	28	32	58	63	71	77	82	89	96	109
20[3]	52,73	508,0	6,4	495,2	32	37	66	73	82	88	94	102	110	125
20[3]	59,18	508,0	7,1	493,8	35	41	73	81	91	98	104	113	122	138
20	65,60	508,0	7,9	492,2	39	46	81	90	101	109	116	126	136	154
20	72,21	508,0	8,7	490,6	43	50	89	99	111	120	128	139	150	170
20	78,60	508,0	9,5	489,0	47	55	98	108	121	131	140	151	163	185
20	84,96	508,0	10,3	487,4	51	60	106	117	131	142	151	164	177	201
20	91,51	508,0	11,1	485,8	55	64	114	126	142	153	163	177	191	207
20	97,83	508,0	11,9	484,2	59	69	122	135	152	164	175	190	205	207
20	104,13	508,0	12,7	482,6	63	74	131	144	162	176	187	203	207	207
20	116,67	508,0	14,3	479,4	71	83	147	162	182	198	207	207	207	207
20	129,33	508,0	15,9	476,2	79	92	163	180	203	207	207	207	207	207
20	141,90	508,0	17,5	473,0	87	101	180	198	207	207	207	207	207	207
20	154,19	508,0	19,1	469,8	95	111	196	207	207	207	207	207	207	207
20	166,40	508,0	20,6	466,8	102	119	207	207	207	207	207	207	207	207
20	178,72	508,0	22,2	463,6	110	128	207	207	207	207	207	207	207	207
20	190,96	508,0	23,8	460,4	118	138	207	207	207	207	207	207	207	207
20	202,92	508,0	25,4	457,2	126	147	207	207	207	207	207	207	207	207
20	214,80	508,0	27,0	454,0	134	156	207	207	207	207	207	207	207	207
20	226,78	508,0	28,6	450,8	142	166	207	207	207	207	207	207	207	207
20	238,68	508,0	30,2	447,6	150	175	207	207	207	207	207	207	207	207
20	250,31	508,0	31,8	444,4	158	184	207	207	207	207	207	207	207	207
20	261,86	508,0	33,3	441,4	165	193	207	207	207	207	207	207	207	207
20	273,51	508,0	34,9	438,2	173	193	207	207	207	207	207	207	207	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L 290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* – **Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
22[3]	50,94	559,0	5,6	547,8	25	29	52	58	65	70	75	81	87	99
22[3]	58,07	559,0	6,4	546,2	29	34	60	66	74	80	86	93	100	113
22[3]	65,18	559,0	7,1	544,8	32	37	66	73	82	89	95	103	111	126
22	72,27	559,0	7,9	543,2	36	42	74	81	92	99	106	114	123	140
22	79,56	559,0	8,7	541,6	39	46	81	90	101	109	116	126	136	154
22	86,61	559,0	9,5	540,0	43	50	89	98	110	119	127	138	148	168
22	93,63	559,0	10,3	538,4	46	54	96	106	119	129	138	149	161	182
22	100,86	559,0	11,1	536,8	50	58	104	114	129	139	148	161	173	197
22	107,85	559,0	11,9	535,2	54	63	111	123	138	149	159	172	186	207
22	114,81	559,0	12,7	533,6	57	67	119	131	147	159	170	184	198	207
22	126,67	559,0	14,3	530,4	64	75	134	147	166	180	191	207	207	207
22	142,68	559,0	15,9	527,2	72	84	148	164	184	200	207	207	207	207
22	156,60	559,0	17,5	524,0	79	92	163	180	203	207	207	207	207	207
22	170,21	559,0	19,1	520,8	86	100	178	197	207	207	207	207	207	207
22	183,75	559,0	20,6	517,8	93	108	192	207	207	207	207	207	207	207
22	197,41	559,0	22,2	514,6	100	117	207	207	207	207	207	207	207	207
22	211,00	559,0	23,8	511,4	107	125	207	207	207	207	207	207	207	207
22	224,28	559,0	25,4	508,2	115	134	207	207	207	207	207	207	207	207
22	237,48	559,0	27,0	505,0	122	142	207	207	207	207	207	207	207	207
22	250,81	559,0	28,6	501,8	129	150	207	207	207	207	207	207	207	207
22	264,06	559,0	30,2	498,6	136	159	207	207	207	207	207	207	207	207
22	277,01	559,0	31,8	495,4	143	167	207	207	207	207	207	207	207	207
22	289,88	559,0	33,3	492,4	150	175	207	207	207	207	207	207	207	207
22	302,88	559,0	34,9	489,2	157	184	207	207	207	207	207	207	207	207
22	315,79	559,0	36,5	486,0	165	192	207	207	207	207	207	207	207	207
22	328,41	559,0	38,1	482,8	172	193	207	207	207	207	207	207	207	207
24[3]	63,41	610,0	6,4	597,2	26	31	55	60	68	74	78	85	92	104
24[3]	71,18	610,0	7,1	595,8	29	34	61	67	75	82	87	94	102	115
24	78,93	610,0	7,9	594,2	33	38	68	75	84	91	97	105	113	128
24	86,91	610,0	8,7	592,6	36	42	74	82	92	100	107	116	125	141
24	94,62	610,0	9,5	591,0	39	46	81	90	101	109	116	126	136	154

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* – **Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
24	102,31	610,0	10,3	589,4	42	49	88	98	110	119	126	137	148	167
24	110,22	610,0	11,1	587,8	46	53	95	105	118	128	136	147	159	180
24	117,86	610,0	11,9	586,2	49	57	102	112	126	137	146	158	170	193
24	125,49	610,0	12,7	584,6	52	61	109	120	135	146	156	169	182	206
24	140,68	610,0	14,3	581,4	59	69	122	135	152	165	175	190	205	207
24	156,03	610,0	15,9	578,2	66	77	136	150	169	183	195	207	207	207
24	171,29	610,0	17,5	575,0	72	84	150	165	186	201	207	207	207	207
24	186,23	610,0	19,1	571,8	79	92	163	180	203	207	207	207	207	207
24	201,09	610,0	20,6	568,8	85	99	176	195	207	207	207	207	207	207
24	216,10	610,0	22,2	565,6	92	107	190	207	207	207	207	207	207	207
24	231,03	610,0	23,8	562,4	98	115	204	207	207	207	207	207	207	207
24	245,64	610,0	25,4	559,2	105	122	207	207	207	207	207	207	207	207
24	260,17	610,0	27,0	556,0	112	130	207	207	207	207	207	207	207	207
24	274,84	610,0	28,6	552,8	118	138	207	207	207	207	207	207	207	207
24	289,44	610,0	30,2	549,6	125	146	207	207	207	207	207	207	207	207
24	303,71	610,0	31,8	546,4	131	153	207	207	207	207	207	207	207	207
24	317,91	610,0	33,3	543,4	138	160	207	207	207	207	207	207	207	207
24	332,25	610,0	34,9	540,2	144	168	207	207	207	207	207	207	207	207
24	346,50	610,0	36,5	537,0	151	176	207	207	207	207	207	207	207	207
24	360,45	610,0	38,1	533,8	157	184	207	207	207	207	207	207	207	207
24	374,31	610,0	39,7	530,6	164	191	207	207	207	207	207	207	207	207
26[3]	68,75	660,0	6,4	647,2	24	29	51	56	63	68	72	79	85	96
26[3]	77,18	660,0	7,1	645,8	27	32	56	62	70	76	80	87	94	107
26	85,60	660,0	7,9	644,2	30	35	62	69	78	84	89	97	104	119
26	94,26	660,0	8,7	642,6	33	39	69	76	85	93	98	107	115	131
26	102,63	660,0	9,5	641,0	36	42	75	83	93	101	108	117	126	143
26	110,98	660,0	10,3	639,4	39	46	81	90	101	110	117	126	136	155
26	119,57	660,0	11,1	637,8	42	49	88	97	109	118	126	136	147	167
26	127,88	660,0	11,9	636,2	45	53	94	104	117	127	135	146	157	179
26	136,17	660,0	12,7	634,6	48	57	100	111	125	135	144	156	168	191
26	152,68	660,0	14,3	631,4	55	64	113	125	140	152	162	176	189	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L 290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* **– Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
26	169,38	660,0	15,9	628,2	61	71	126	139	156	169	180	195	207	207
26	185,99	660,0	17,5	625,0	67	78	138	153	172	186	198	207	207	207
26	202,25	660,0	19,1	621,8	73	85	151	167	188	203	207	207	207	207
26	218,43	660,0	20,6	618,8	79	92	163	180	202	207	207	207	207	207
26	234,79	660,0	22,2	615,6	85	99	176	194	207	207	207	207	207	207
26	251,07	660,0	23,8	612,4	91	106	188	207	207	207	207	207	207	207
26	267,00	660,0	25,4	609,2	97	113	201	207	207	207	207	207	207	207
28[3]	74,09	711,0	6,4	698,2	23	26	47	52	58	63	67	73	79	89
28[3]	83,19	711,0	7,1	696,8	25	29	52	58	65	70	75	81	87	99
28	92,26	711,0	7,9	695,2	28	33	58	64	72	78	83	90	97	110
28	101,61	711,0	8,7	693,6	31	36	64	70	79	86	91	99	107	121
28	110,64	711,0	9,5	692,0	34	39	70	77	87	94	100	108	117	132
28	119,65	711,0	10,3	690,4	37	43	76	83	94	102	108	117	126	143
28	128,93	711,0	11,1	688,8	39	46	81	90	101	110	117	126	136	155
28	137,90	711,0	11,9	687,2	42	49	87	96	108	117	125	136	146	166
28	146,85	711,0	12,7	685,6	45	53	93	103	116	125	133	145	156	177
28	164,69	711,0	14,3	682,4	51	59	105	116	130	141	150	163	176	199
28	182,73	711,0	15,9	679,2	56	66	117	129	145	157	167	181	195	207
28	200,68	711,0	17,5	676,0	62	72	128	142	159	173	184	199	207	207
28	218,27	711,0	19,1	672,8	68	79	140	155	174	189	201	207	207	207
28	235,78	711,0	20,6	669,8	73	85	151	167	188	203	207	207	207	207
28	253,48	711,0	22,2	666,6	79	92	163	180	202	207	207	207	207	207
28	271,10	711,0	23,8	663,4	84	98	175	193	207	207	207	207	207	207
28	288,36	711,0	25,4	660,2	90	105	186	206	207	207	207	207	207	207
30[3]	79,43	762,0	6,4	749,2	21	25	44	48	54	59	63	68	73	83
30[3]	89,19	762,0	7,1	747,8	23	27	49	54	60	65	70	75	81	92
30	98,93	762,0	7,9	746,2	26	30	54	60	67	73	77	84	91	103
30	108,95	762,0	8,7	744,6	29	34	60	66	74	80	85	92	100	113
30	118,65	762,0	9,5	743,0	31	37	65	72	81	88	93	101	109	123

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L 290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* – **Plain-end line pipe dimensions**[1], **masses and test pressures**[2] (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
30	128,32	762,0	10,3	741,4	34	40	71	78	88	95	101	109	118	134
30	138,29	762,0	11,1	739,8	37	43	76	84	94	102	109	118	127	144
30	147,92	762,0	11,9	738,2	39	46	82	90	101	110	117	126	136	155
30	157,53	762,0	12,7	736,6	42	49	87	96	108	117	125	135	146	165
30	176,69	762,0	14,3	733,4	47	55	98	108	122	132	140	152	164	186
30	196,08	762,0	15,9	730,2	53	61	109	120	135	146	156	169	182	207
30	215,38	762,0	17,5	727,0	58	68	120	132	149	161	172	186	200	207
30	234,29	762,0	19,1	723,8	63	74	131	144	162	176	187	203	207	207
30	253,12	762,0	20,6	720,8	68	79	141	156	175	190	202	207	207	207
30	272,17	762,0	22,2	717,6	73	86	152	168	189	205	207	207	207	207
30	291,14	762,0	23,8	714,4	79	92	163	180	202	207	207	207	207	207
30	309,72	762,0	25,4	711,2	84	98	174	192	207	207	207	207	207	207
30	328,22	762,0	27,0	708,0	89	104	185	204	207	207	207	207	207	207
30	346,93	762,0	28,6	704,8	95	110	196	207	207	207	207	207	207	207
30	365,56	762,0	30,2	701,6	100	117	207	207	207	207	207	207	207	207
30	383,81	762,0	31,8	698,4	105	123	207	207	207	207	207	207	207	207
32[3]	84,77	813,0	6,4	800,2	20	23	41	45	51	55	59	64	69	78
32[3]	95,19	813,0	7,1	798,8	22	26	46	50	57	61	65	71	76	86
32	105,59	813,0	7,9	797,2	24	29	51	56	63	68	73	79	85	96
32	116,30	813,0	8,7	795,6	27	31	56	62	69	75	80	87	93	106
32	126,66	813,0	9,5	794,0	29	34	61	67	76	82	87	95	102	116
32	136,99	813,0	10,3	792,4	32	37	66	73	82	89	95	103	111	125
32	147,64	813,0	11,1	790,8	34	40	71	79	88	96	102	111	119	135
32	147,94	813,0	11,9	789,2	37	43	76	84	95	103	109	119	128	145
32	168,21	813,0	12,7	787,6	39	46	82	90	101	110	117	127	136	155
32	188,70	813,0	14,3	784,4	44	52	92	101	114	123	131	142	154	174
32	209,43	813,0	15,9	781,2	49	57	102	113	127	137	146	158	171	194
32	230,08	813,0	17,5	787,0	54	63	112	124	139	151	161	174	188	207
32	250,31	813,0	19,1	774,8	59	69	123	135	152	165	175	190	205	207
32	270,47	813,0	20,6	771,8	64	74	132	146	164	178	189	205	207	207
32	290,86	813,0	22,2	768,6	69	80	143	157	177	192	204	207	207	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* – **Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
32	311,17	813,0	23,8	765,4	74	86	153	169	190	206	207	207	207	207
32	331,08	813,0	25,4	762,2	79	92	163	180	202	207	207	207	207	207
32	350,90	813,0	27,0	759,0	84	98	173	191	207	207	207	207	207	207
32	370,96	813,0	28,6	755,8	89	103	184	203	207	207	207	207	207	207
32	390,94	813,0	30,2	752,6	94	109	194	207	207	207	207	207	207	207
32	410,51	813,0	31,8	749,4	99	115	204	207	207	207	207	207	207	207
34[3]	90,11	864,0	6,4	851,2	19	22	39	43	48	52	55	60	65	73
34[3]	101,19	864,0	7,1	849,8	21	24	43	47	53	58	61	67	72	81
34	112,25	864,0	7,9	848,2	23	27	48	53	59	64	68	74	80	91
34	123,65	864,0	8,7	846,6	25	30	53	58	65	71	75	82	88	100
34	134,67	864,0	9,5	845,0	28	32	57	63	71	77	82	89	96	109
34	145,67	864,0	10,3	843,4	30	35	62	69	77	84	89	97	104	118
34	157,00	864,0	11,1	841,8	32	38	67	74	83	90	96	104	112	127
34	167,95	864,0	11,9	840,2	35	40	72	79	89	97	103	112	120	136
34	178,89	864,0	12,7	838,6	37	43	77	85	95	103	110	119	128	146
34	200,70	864,0	14,3	835,4	42	49	86	95	107	116	124	134	144	164
34	222,78	864,0	15,9	832,2	46	54	96	106	119	129	137	149	161	182
34	244,77	864,0	17,5	829,0	51	60	106	117	131	142	151	164	177	201
34	266,33	864,0	19,1	825,8	56	65	115	127	143	155	165	179	193	207
34	287,81	864,0	20,6	822,8	60	70	124	137	155	167	178	193	207	207
34	309,55	864,0	22,2	819,6	65	76	134	148	167	180	192	207	207	207
34	331,21	864,0	23,8	816,4	69	81	144	159	179	193	206	207	207	207
34	352,44	864,0	25,4	813,2	74	86	153	169	191	206	207	207	207	207
34	373,59	864,0	27,0	810,0	79	92	163	180	203	207	207	207	207	207
34	394,99	864,0	28,6	806,8	83	97	173	191	207	207	207	207	207	207
34	416,31	864,0	30,2	803,6	88	103	182	201	207	207	207	207	207	207
34	437,21	864,0	31,8	800,4	93	108	192	207	207	207	207	207	207	207
36[3]	95,45	914,0	6,4	901,2	18	21	37	40	45	49	52	57	61	69
36[3]	107,20	914,0	7,1	899,8	20	23	41	45	50	55	58	63	68	77
36	118,92	914,0	7,9	898,2	22	25	45	50	56	61	65	70	75	86
36	131,00	914,0	8,7	896,6	24	28	50	55	62	67	71	77	83	94

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
3) These sizes are special plain-end mass sizes. All other sizes are regular-mass, see 7.6.8 for applicable mass tolerances. For grades L290 and higher masses intermediate to regular-masses shall be considered regular-mass; masses intermediate to special-plain-end masses and masses intermediate between the heaviest tabulated special-plain-end masses and the highest regular-masses shall be considered special-plain-end mass.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* – **Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
36	142,68	914,0	9,5	895,0	26	31	54	60	67	73	78	84	91	103
36	154,34	914,0	10,3	893,4	28	33	59	65	73	79	84	91	98	112
36	166,35	914,0	11,1	891,8	31	36	63	70	79	85	91	98	106	120
36	177,97	914,0	11,9	890,2	33	38	68	75	84	91	97	105	114	129
36	189,57	914,0	12,7	888,6	35	41	73	80	90	98	104	113	121	138
36	212,70	914,0	14,3	885,4	39	46	82	90	101	110	117	127	137	155
36	236,13	914,0	15,9	882,2	44	51	91	100	113	122	130	141	152	172
36	259,47	914,0	17,5	879,0	48	56	100	110	124	134	143	155	167	190
36	282,35	914,0	19,1	875,8	53	61	109	120	135	147	156	169	182	207
36	305,16	914,0	20,6	872,8	57	66	118	130	146	158	168	183	197	207
36	328,24	914,0	22,2	869,6	61	71	127	140	157	171	181	197	207	207
36	351,25	914,0	23,8	866,4	66	77	136	150	169	183	195	207	207	207
36	373,80	914,0	25,4	863,2	70	82	145	160	180	195	207	207	207	207
36	396,27	914,0	27,0	860,0	74	87	154	170	191	207	207	207	207	207
36	419,02	914,0	28,6	856,8	79	92	163	180	203	207	207	207	207	207
36	441,69	914,0	30,2	853,6	83	97	172	190	207	207	207	207	207	207
36	463,91	914,0	31,8	850,4	88	102	182	200	207	207	207	207	207	207
38	125,58	965,0	7,9	949,2	21	24	43	47	53	57	61	66	71	81
38	138,35	965,0	8,7	947,6	23	27	47	52	58	63	67	73	79	89
38	150,69	965,0	9,5	946,0	25	29	51	57	64	69	74	80	86	97
38	163,01	965,0	10,3	944,4	27	31	56	61	69	75	80	86	93	106
38	175,71	965,0	11,1	942,8	29	34	60	66	75	81	86	93	100	114
38	187,99	965,0	11,9	941,2	31	36	64	71	80	87	92	100	108	122
38	200,25	965,0	12,7	939,6	33	39	69	76	85	92	98	107	115	130
38	224,71	965,0	14,3	936,4	37	44	77	85	96	104	111	120	129	147
38	249,48	965,0	15,9	933,2	42	48	86	95	107	116	123	133	144	163
38	274,16	965,0	17,5	930,0	46	53	95	104	118	127	135	147	158	180
38	298,37	965,0	19,1	926,8	50	58	103	114	128	139	148	160	173	196
38	322,50	965,0	20,6	923,8	54	63	111	123	138	150	159	173	186	207
38	346,93	965,0	22,2	920,6	58	68	120	133	149	161	172	186	201	207
38	371,28	965,0	23,8	917,4	62	73	129	142	160	173	184	200	207	207
38	395,16	965,0	25,4	914,2	66	77	137	152	171	185	197	207	207	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* **– Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
38	418,96	965,0	27,0	911,0	71	82	146	161	181	196	207	207	207	207
38	443,05	965,0	28,6	907,8	75	87	155	171	192	207	207	207	207	207
38	467,06	965,0	30,2	904,6	79	92	163	180	203	207	207	207	207	207
38	490,61	965,0	31,8	901,4	83	97	172	190	207	207	207	207	207	207
40	132,25	1016,0	7,9	1000,2	20	23	41	45	50	55	58	63	68	77
40	145,69	1016,0	8,7	998,6	22	25	45	49	55	60	64	69	75	85
40	158,70	1016,0	9,5	997,0	24	27	49	54	61	66	70	76	82	93
40	171,68	1016,0	10,3	995,4	26	30	53	58	66	71	76	82	89	100
40	185,06	1016,0	11,1	993,8	28	32	57	63	71	77	82	88	95	108
40	198,01	1016,0	11,9	992,2	30	34	61	67	76	82	87	95	102	116
40	210,93	1016,0	12,7	990,6	32	37	65	72	81	88	93	101	109	124
40	236,71	1016,0	14,3	987,4	35	41	73	81	91	99	105	114	123	139
40	262,83	1016,0	15,9	984,2	39	46	82	90	101	110	117	127	137	155
40	288,86	1016,0	17,5	981,0	43	51	90	99	112	121	129	140	150	171
40	314,39	1016,0	19,1	977,8	47	55	98	108	122	132	140	152	164	186
40	339,84	1016,0	20,6	974,8	51	60	106	117	131	142	151	164	177	201
40	365,62	1016,0	22,2	971,6	55	64	114	126	142	153	163	177	191	207
40	391,32	1016,0	23,8	968,4	59	69	122	135	152	164	175	190	205	207
40	416,52	1016,0	25,4	965,2	63	74	131	144	162	176	187	203	207	207
40	441,64	1016,0	27,0	962,0	67	78	139	153	172	187	199	207	207	207
40	467,08	1016,0	28,6	958,8	71	83	147	162	182	198	207	207	207	207
40	492,44	1016,0	30,2	955,6	75	87	155	171	193	207	207	207	207	207
40	517,31	1016,0	31,8	952,4	79	92	163	180	203	207	207	207	207	207
42	153,04	1067,0	8,7	1049,6	21	24	43	47	53	57	61	66	71	81
42	166,71	1067,0	9,5	1048,0	22	26	46	51	58	63	67	72	78	88
42	180,35	1067,0	10,3	1046,4	24	28	50	56	63	68	72	78	84	96
42	194,42	1067,0	11,1	1044,8	26	31	54	60	67	73	78	84	91	103
42	208,03	1067,0	11,9	1043,2	28	33	58	64	72	78	83	90	97	110
42	221,61	1067,0	12,7	1041,6	30	35	62	69	77	84	89	96	104	118
42	248,72	1067,0	14,3	1038,4	34	39	70	77	87	94	100	109	117	133
42	276,18	1067,0	15,9	1035,2	38	44	78	86	97	105	111	121	130	148

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* – **Plain-end line pipe dimensions**[1], **masses and test pressures**[2] (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
42	303,55	1067,0	17,5	1032,0	41	48	86	94	106	115	123	133	143	162
42	330,41	1067,0	19,1	1028,8	45	53	93	103	116	126	134	145	156	177
42	357,19	1067,0	20,6	1025,8	49	57	101	111	125	136	144	156	169	191
42	384,31	1067,0	22,2	1022,6	52	61	109	120	135	146	155	169	182	206
42	411,35	1067,0	23,8	1019,4	56	66	116	128	145	157	167	181	195	207
42	437,88	1067,0	25,4	1016,2	60	70	124	137	154	167	178	193	207	207
42	464,33	1067,0	27,0	1013,0	64	74	132	146	164	178	189	205	207	207
42	491,11	1067,0	28,6	1009,8	68	79	140	154	174	188	200	207	207	207
42	517,82	1067,0	30,2	1006,6	71	83	148	163	183	199	207	207	207	207
42	544,01	1067,0	31,8	1003,4	75	88	156	172	193	207	207	207	207	207
44	160,39	1118,0	8,7	1100,6	20	23	41	45	50	55	58	63	68	77
44	174,72	1118,0	9,5	1099,0	21	25	44	49	55	60	63	69	74	84
44	189,03	1118,0	10,3	1097,4	23	27	48	53	60	65	69	75	80	91
44	203,78	1118,0	11,1	1095,8	25	29	52	57	64	70	74	80	87	98
44	218,04	1118,0	11,9	1094,2	27	31	56	61	69	75	80	86	93	105
44	232,29	1118,0	12,7	1092,6	29	33	59	65	74	80	85	92	99	112
44	260,72	1118,0	14,3	1089,4	32	38	67	74	83	90	96	104	112	127
44	289,53	1118,0	15,9	1086,2	36	42	74	82	92	100	106	115	124	141
44	318,25	1118,0	17,5	1083,0	39	46	82	90	101	110	117	127	137	155
44	346,43	1118,0	19,1	1079,8	43	50	89	98	111	120	128	138	149	169
44	374,53	1118,0	20,6	1076,8	46	54	96	106	119	129	138	149	161	182
44	403,00	1118,0	22,2	1073,6	50	58	104	114	129	139	148	161	173	197
44	431,39	1118,0	23,8	1070,4	54	63	111	123	138	149	159	172	186	207
44	459,24	1118,0	25,4	1067,2	57	67	119	131	147	159	170	184	198	207
44	487,01	1118,0	27,0	1064,0	61	71	126	139	156	170	180	196	207	207
44	515,14	1118,0	28,6	1060,8	64	75	134	147	166	180	191	207	207	207
44	543,19	1118,0	30,2	1057,6	68	79	141	156	175	190	202	207	207	207
44	570,71	1118,0	31,8	1054,4	72	84	148	164	184	200	207	207	207	207
46	167,74	1168,0	8,7	1150,6	20	23	41	45	50	55	58	63	68	77
46	182,73	1168,0	9,5	1149,0	21	25	44	49	55	60	63	69	74	84
46	197,70	1168,0	10,3	1147,4	23	27	48	53	60	65	69	75	80	91
46	213,13	1168,0	11,1	1145,8	25	29	52	57	64	70	74	80	87	98
46	228,06	1168,0	11,9	1144,2	27	31	56	61	69	75	80	86	93	105

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* **– Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
46	242,97	1168,0	12,7	1142,6	29	33	59	65	74	80	85	92	99	112
46	272,73	1168,0	14,3	1139,4	32	38	67	74	83	90	96	104	112	127
46	302,88	1168,0	15,9	1136,2	36	42	74	82	92	100	106	115	124	141
46	332,95	1168,0	17,5	1133,0	39	46	82	90	101	110	117	127	137	155
46	362,45	1168,0	19,1	1129,8	43	50	89	98	111	120	128	138	149	169
46	391,88	1168,0	20,6	1126,8	46	54	96	106	119	129	138	149	161	182
46	421,69	1168,0	22,2	1123,6	50	58	104	114	129	139	148	161	173	197
46	451,42	1168,0	23,8	1120,4	54	63	111	123	138	149	159	172	186	207
46	480,60	1168,0	25,4	1117,2	57	67	119	131	147	159	170	184	198	207
46	509,69	1168,0	27,0	1114,0	61	71	126	139	156	170	180	196	207	207
46	539,17	1168,0	28,6	1110,8	64	75	134	147	166	180	191	207	207	207
46	568,57	1168,0	30,2	1107,6	68	79	141	156	175	190	202	207	207	207
46	597,41	1168,0	31,8	1104,4	72	84	148	164	184	200	207	207	207	207
48	175,08	1219,0	8,7	1201,6	18	21	37	41	46	50	53	58	62	71
48	190,74	1219,0	9,5	1200,0	20	23	41	45	51	55	58	63	68	77
48	206,37	1219,0	10,3	1198,4	21	25	44	49	55	59	63	68	74	84
48	222,49	1219,0	11,1	1196,8	23	27	48	52	59	64	68	74	79	90
48	238,08	1219,0	11,9	1195,2	25	29	51	56	63	69	73	79	85	97
48	253,65	1219,0	12,7	1193,6	26	31	54	60	68	73	78	84	91	103
48	284,73	1219,0	14,3	1190,4	30	34	61	68	76	82	88	95	102	116
48	316,23	1219,0	15,9	1187,2	33	38	68	75	85	92	97	106	114	129
48	347,64	1219,0	17,5	1184,0	36	42	75	83	93	101	107	116	125	142
48	378,47	1219,0	19,1	1180,8	39	46	82	90	102	110	117	127	137	155
48	409,22	1219,0	20,6	1177,8	43	50	88	97	110	119	126	137	148	167
48	440,38	1219,0	22,2	1174,6	46	54	95	105	118	128	136	148	159	180
48	471,46	1219,0	23,8	1171,4	49	57	102	112	127	137	146	158	170	193
48	501,96	1219,0	25,4	1168,2	53	61	109	120	135	146	156	169	182	206
48	532,38	1219,0	27,0	1165,0	56	65	116	128	144	155	165	179	193	207
48	563,20	1219,0	28,6	1161,8	59	69	122	135	152	165	175	190	205	207
48	593,94	1219,0	30,2	1158,6	62	73	129	143	161	174	185	201	207	207
48	624,11	1219,0	31,8	1155,4	66	77	136	150	169	183	195	207	207	207

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* – **Plain-end line pipe dimensions**[1], **masses and test pressures**[2] (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
52	206,76	1321,0	9,5	1302,0	18	21	38	41	47	50	54	58	63	71
52	223,72	1321,0	10,3	1300,4	20	23	41	45	51	55	58	63	68	77
52	241,20	1321,0	11,1	1298,8	21	25	44	48	54	59	63	68	73	83
52	258,11	1321,0	11,9	1297,2	23	26	47	52	58	63	67	73	79	89
52	275,01	1321,0	12,7	1295,6	24	28	50	55	62	67	72	78	84	95
52	308,74	1321,0	14,3	1292,4	27	32	57	62	70	76	81	88	95	107
52	342,93	1321,0	15,9	1289,2	30	35	63	69	78	84	90	97	105	119
52	377,03	1321,0	17,5	1286,0	33	39	69	76	86	93	99	107	116	131
52	410,51	1321,0	19,1	1282,8	36	43	75	83	94	102	108	117	126	143
52	443,91	1321,0	20,6	1279,8	39	46	81	90	101	109	116	126	136	154
52	477,76	1321,0	22,2	1276,6	42	49	88	97	109	118	126	136	147	166
52	511,53	1321,0	23,8	1273,4	45	53	94	104	117	126	135	146	157	178
52	544,68	1321,0	25,4	1270,2	48	57	100	111	125	135	144	156	168	190
52	577,75	1321,0	27,0	1267,0	52	60	107	118	132	143	153	166	178	202
52	611,26	1321,0	28,6	1263,8	55	64	113	125	140	152	162	175	189	207
52	644,69	1321,0	30,2	1260,6	58	67	119	132	148	160	171	185	200	207
52	677,51	1321,0	31,8	1257,4	61	71	126	139	156	169	180	195	207	207
56	222,78	1422,0	9,5	1403,0	17	20	35	38	43	47	50	54	58	66
56	241,06	1422,0	10,3	1401,4	18	21	38	42	47	51	54	59	63	72
56	259,91	1422,0	11,1	1399,8	20	23	41	45	51	55	58	63	68	77
56	278,15	1422,0	11,9	1398,2	21	25	44	48	54	59	63	68	73	83
56	296,37	1422,0	12,7	1396,6	23	26	47	51	58	63	67	72	78	88
56	332,75	1422,0	14,3	1393,4	25	30	52	58	65	71	75	81	88	100
56	369,63	1422,0	15,9	1390,2	28	33	58	64	72	78	84	91	98	111
56	406,42	1422,0	17,5	1387,0	31	36	64	71	80	86	92	100	107	122
56	442,55	1422,0	19,1	1383,8	34	39	70	77	87	94	100	109	117	133
56	478,60	1422,0	20,6	1380,8	37	43	76	83	94	102	108	117	126	143
56	515,14	1422,0	22,2	1377,6	39	46	81	90	101	110	117	126	136	155

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* **– Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
56	551,60	1422,0	23,8	1374,4	42	49	87	96	108	117	125	136	146	166
56	587,40	1422,0	25,4	1371,2	45	53	93	103	116	125	133	145	156	177
56	623,12	1422,0	27,0	1368,0	48	56	99	109	123	133	142	154	166	188
56	659,32	1422,0	28,6	1364,8	51	59	105	116	130	141	150	163	176	199
56	695,45	1422,0	30,2	1361,6	54	62	111	122	138	149	159	172	185	207
56	730,91	1422,0	31,8	1358,4	56	66	117	129	145	157	167	181	195	207
60	238,80	1524,0	9,5	1505,0	16	18	33	36	40	44	47	50	54	62
60	258,40	1524,0	10,3	1503,4	17	20	35	39	44	47	50	55	59	67
60	278,62	1524,0	11,1	1501,8	18	21	38	42	47	51	54	59	64	72
60	298,19	1524,0	11,9	1500,2	20	23	41	45	51	55	58	63	68	77
60	317,73	1524,0	12,7	1498,6	21	25	44	48	54	59	62	68	73	83
60	356,76	1524,0	14,3	1495,4	24	28	49	54	61	66	70	76	82	93
60	396,33	1524,0	15,9	1492,2	26	31	54	60	68	73	78	85	91	103
60	435,82	1524,0	17,5	1489,0	29	34	60	66	74	81	86	93	100	114
60	474,59	1524,0	19,1	1485,8	32	37	65	72	81	88	94	102	109	124
60	513,29	1524,0	20,6	1482,8	34	40	70	78	88	95	101	109	118	134
60	552,52	1524,0	22,2	1479,6	37	43	76	84	94	102	109	118	127	144
60	591,67	1524,0	23,8	1476,4	39	46	82	90	101	110	117	126	136	155
60	630,12	1524,0	25,4	1473,2	42	49	87	96	108	117	125	135	146	165
60	668,48	1524,0	27,0	1470,0	45	52	92	102	115	124	132	144	155	175
60	707,38	1524,0	28,6	1466,8	47	55	98	108	122	132	140	152	164	186
60	746,20	1524,0	30,2	1463,6	50	58	103	114	128	139	148	161	173	196
60	784,31	1524,0	31,8	1460,4	53	61	109	120	135	146	156	169	182	207
64	254,82	1626,0	9,5	1607,0	15	17	30	34	38	41	44	47	51	58
64	275,75	1626,0	10,3	1605,4	16	19	33	36	41	44	47	51	55	63
64	297,33	1626,0	11,1	1603,8	17	20	36	39	44	48	51	55	60	68
64	318,33	1626,0	11,9	1602,2	18	22	38	42	47	51	55	59	64	72
64	339,09	1626,0	12,7	1600,6	20	23	41	45	51	55	58	63	68	77
64	380,77	1626,0	14,3	1597,4	22	26	46	51	57	62	66	71	77	87
64	423,03	1626,0	15,9	1594,2	25	29	51	56	63	69	73	79	85	97
64	465,21	1626,0	17,5	1591,0	27	32	56	62	70	76	80	87	94	107
64	506,63	1626,0	19,1	1587,8	30	35	61	68	76	82	88	95	103	116
64	547,98	1626,0	20,6	1584,8	32	37	66	73	82	89	95	103	111	125
64	589,90	1626,0	22,2	1581,6	34	40	71	79	88	96	102	111	119	135

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(continued)* – **Plain-end line pipe dimensions**[1], **masses and test pressures**[2] (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
64	631,75	1626,0	23,8	1578,4	37	43	76	84	95	103	109	119	128	145
64	672,84	1626,0	25,4	1575,2	39	46	82	90	101	110	117	127	136	155
64	713,85	1626,0	27,0	1572,0	42	49	87	96	108	117	124	135	145	164
64	755,44	1626,0	28,6	1568,8	44	52	92	101	114	123	131	142	154	174
64	796,95	1626,0	30,2	1565,6	47	55	97	107	120	130	139	150	162	184
64	837,71	1626,0	31,8	1562,4	49	57	102	113	127	137	146	158	171	194
68	338,26	1727,00	11,90	1703,2	17	20	36	40	45	48	51	56	60	68
68	360,45	1727,00	12,70	1701,6	19	22	38	42	48	52	55	60	64	73
68	404,77	1727,00	14,30	1698,4	21	24	43	48	54	58	62	67	72	82
68	449,73	1727,00	15,90	1695,2	23	27	48	53	60	65	69	75	80	91
68	494,60	1727,00	17,50	1692,0	26	30	53	58	66	71	76	82	88	100
68	538,67	1727,00	19,10	1688,8	28	33	58	64	72	78	83	90	97	109
68	582,66	1727,00	20,60	1685,8	30	35	62	69	77	84	89	97	104	118
68	627,28	1727,00	22,20	1682,6	32	38	67	74	83	90	96	104	112	127
68	671,82	1727,00	23,80	1679,4	35	41	72	79	89	97	103	112	120	136
68	715,56	1727,00	25,40	1676,2	37	43	77	85	95	103	110	119	128	146
68	759,22	1727,00	27,00	1673,0	39	46	82	90	101	110	117	127	136	155
68	803,50	1727,00	28,60	1669,8	42	49	86	95	107	116	124	134	145	164
68	847,70	1727,00	30,20	1666,6	44	51	91	101	113	123	131	142	153	173
68	891,11	1727,00	31,80	1663,4	46	54	96	106	119	129	138	149	161	182
72	381,81	1829,00	12,70	1803,6	17	20	36	40	45	49	52	56	61	69
72	428,78	1829,00	14,30	1800,4	20	23	41	45	51	55	58	63	68	77
72	476,43	1829,00	15,90	1797,2	22	26	45	50	56	61	65	70	76	86
72	523,99	1829,00	17,50	1794,0	24	28	50	55	62	67	71	78	84	95
72	570,71	1829,00	19,10	1790,8	26	31	55	60	68	73	78	85	91	103
72	617,35	1829,00	20,60	1787,8	28	33	59	65	73	79	84	91	98	112
72	664,66	1829,00	22,20	1784,6	31	36	63	70	79	85	91	98	106	120
72	711,89	1829,00	23,80	1781,4	33	38	68	75	84	91	97	105	114	129
72	758,28	1829,00	25,40	1778,2	35	41	72	80	90	97	104	112	121	137
72	804,59	1829,00	27,00	1775,0	37	43	77	85	96	104	110	120	129	146

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

Table 9 *(concluded)* **– Plain-end line pipe dimensions[1], masses and test pressures[2]** (to be ordered according to outside diameter)

Designation Size	Mass *M*	Outside diameter *D* mm	Wall thickness *T* mm	Inside diameter *d* mm	Minimum test pressure[4], 100 kPa[5]									
					L210[6]	L245[6]	L290	L320	L360	L390	L415	L450	L485	L555
72	851,56	1829,00	28,60	1771,8	39	46	82	90	101	110	117	127	137	155
72	898,45	1829,00	30,20	1768,6	42	49	86	95	107	116	123	134	144	163
72	944,51	1829,00	31,80	1765,4	44	51	91	100	113	122	130	141	152	172
76	403,17	1930,00	12,70	1904,6	17	19	34	38	43	46	49	53	57	65
76	452,79	1930,00	14,30	1901,4	19	22	39	43	48	52	55	60	65	73
76	503,13	1930,00	15,90	1898,2	21	24	43	47	53	58	62	67	72	82
76	553,38	1930,00	17,50	1895,0	23	27	47	52	59	64	68	73	79	90
76	602,75	1930,00	19,10	1891,8	25	29	52	57	64	69	74	80	86	98
76	652,04	1930,00	20,60	1888,8	27	31	56	61	69	75	80	86	93	106
76	702,04	1930,00	22,20	1885,6	29	34	60	66	75	81	86	93	100	114
76	751,96	1930,00	23,80	1882,4	31	36	64	71	80	87	92	100	108	122
76	801,00	1930,00	25,40	1879,2	33	39	69	76	85	92	98	107	115	130
76	849,96	1930,00	27,00	1876,0	35	41	73	81	91	98	105	113	122	138
76	899,62	1930,00	28,60	1872,8	37	44	77	85	96	104	111	120	129	147
76	949,20	1930,00	30,20	1869,6	39	46	82	90	101	110	117	127	137	155
76	997,91	1930,00	31,80	1866,4	42	48	86	95	107	116	123	133	144	163
80	476,80	2032,00	14,30	2003,4	18	21	37	41	46	49	53	57	61	70
80	529,83	2032,00	15,90	2000,2	20	23	41	45	51	55	58	63	68	77
80	582,77	2032,00	17,50	1997,0	22	25	45	50	56	60	64	70	75	85
80	634,79	2032,00	19,10	1993,8	24	28	49	54	61	66	70	76	82	93
80	686,73	2032,00	20,60	1990,,8	26	30	53	58	66	71	76	82	89	100
80	739,42	2032,00	22,20	1987,6	28	32	57	63	71	77	82	88	95	108
80	792,03	2032,00	23,80	1984,4	30	34	61	67	76	82	87	95	102	116
80	843,72	2032,00	25,40	1981,2	32	37	65	72	81	88	93	101	109	124
80	895,33	2032,00	27,00	1978,0	33	39	69	77	86	93	99	108	116	132
80	947,68	2032,00	28,60	1974,8	35	41	73	81	91	99	105	114	123	139
80	999,95	2032,00	30,20	1971,6	37	44	78	86	96	104	111	120	130	147
80	1051,31	2032,00	31,80	1968,4	39	46	82	90	101	110	117	127	137	155

1) Outside diameter and wall thickness dimensions shown are subject to tolerances as described in 7.6.8. Inside diameters are nominal and are given here for information (see 7.6.2).
2) Test pressures apply to the standard grades. For pressures applicable for other grades see 8.10.9.3.
4) The test pressures have been calculated on the basis of the formula in 8.10.9.3 as standard test pressure considering specified maximum values (see table 15).
5) 100 kPA = 1 bar
6) An alternative test pressure (1,25x standard test pressure, rounded to the next higher 100 kPA with a maximum value of 19 300 kPa to be considered) may be requested.

7.6.8 Tolerances on dimensions and masses

7.6.8.1 Outside diameter *D*

The outside diameter tolerances shall be as follows:

Pipe body

≤ 48,3 mm	+ 0,41 mm – 0,79 mm
60,3 mm to 114,3 mm grade L175, butt-weld only	± 1,00 %
60,3 mm to 457,0 mm	± 0,75 %
508,0 mm to 914,0 mm	
Non-expanded	± 1,00 %
Cold expanded	+ 0,75 % – 0,25 %
> 914,0 mm	
Non-expanded	± 1,00 %
Cold expanded	+ 6,35 mm – 3,20 mm

NOTE 6 In the case of cold expanded pipe outside diameter > 914,0 mm hydrostatically tested to pressures in excess of standard test pressures, other tolerances may be agreed upon between manufacturer and purchaser.

7.6.8.2 Pipe ends

For a distance of 101,6 mm from the end of the pipe, pipe outside diameters ≤ 273,1 mm shall not be more than 0,40 mm smaller than the specified outside diameter and shall permit the passage, over the ends, of a ring gauge which has a bore 1,59 mm larger than the specified outside diameter of the pipe.

For a distance of 101,6 mm from the end of the pipe, pipe outside diameters between 323,9 mm and 508,0 mm inclusive, shall not be more than 0,79 mm smaller than the specified outside diameter and shall permit the passage, over the ends, of a ring gauge which has a bore 2,38 mm larger than the specified outside diameter of the pipe.

For pipe with filler metal welds, it shall be permissible to notch or slot the ring gauge to permit the passage of the gauge over the weld bead.

At the option of the manufacturer, minimum pipe outside diameters ≤ 508,0 mm may be measured with a diameter tape.

For a distance of 101,6 mm from the end of the pipe, pipe outside diameters > 508,0 mm shall be neither more than 0,79 mm smaller nor more than 2,38 mm larger than the specified outside diameter, as measured with a diameter tape.

By agreement between the interested parties, at the ends the tolerance on outside diameter may be applied instead to the inside diameter.

On welded expanded pipe with outside diameters > 508,0 mm the diameter, measured at one end of the pipe with a diameter tape, shall not differ by more than 2,38 mm from that of the other end. At the manufacturer's option, these measurements may be made on the inside diameter.

7.6.8.3 Out-of-roundness

For pipe outside diameters > 508,0 mm, and for a distance of 101,6 mm from the end of the pipe,

- the maximum outside diameter shall not be more than 1 % larger than specified, and
- the minimum outside diameter shall not be more than 1 % smaller than specified,

measured with a bar gauge caliper or other device capable of measuring the actual minimum and maximum diameters.

7.6.8.4 Wall thickness

The wall thickness tolerances shall be consistent with those given in table 10.

Table 10 – Wall thickness tolerances

Outside diameter and type of pipe	Wall thickness tolerances in %	
	L175, L210, L245	L290 to L555
≤ 73,0 mm, seamless and welded	+ 20,0 - 12,5	+ 15,0 - 12,5
88,9 mm, seamless and welded	+ 18,0 - 12,5	+ 15,0 - 12,5
101,6 mm to 457,0 mm, seamless and welded	+ 15,0 - 12,5	+ 15,0 - 12,5
≤ 508,0 mm, welded	+ 17,5 - 10,0	+ 19,5 - 8,0
≤ 508,0 mm, seamless	+ 15,0 - 12,5	+ 17,5 - 10,0

7.6.8.5 Mass

Single lengths:

Threaded-, regular-mass
extra-strong and double-extra-strong pipe, except grade L175 ..... + 10 %
- 3,5 %

Special plain-end pipe or grade L175 pipe ..... + 10 %
- 5 %

Carload lots:

All grades except L175 ..... - 1,75 %
grade L175 ..... - 2,5 %

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

When a wall thickness minus tolerance less than that shown above is agreed upon between the interested parties, the plus tolerances shall be increased by an amount (percentage) equal to the decrease in minus tolerance, and the plus mass tolerance shall be increased to 22,5 % less than the wall thickness minus tolerance.

Mass tolerances apply to the calculated masses for threaded-and-coupled pipe and to the tabulated masses for plain-end pipe.

7.6.8.6 Length

The pipe shall be delivered in lengths as specified in table 11.

Table 11 – Lengths and tolerances on lengths

Nominal length m	Minimum length m	Minimum average length for each order item[1)] m	Maximum length m
Threaded-and-coupled pipe			
6	4,88	5,33	6,86
12	6,71	10,67	13,72
Plain-end pipe			
6	2,74	5,33	6,86
12	4,27	10,67	13,72
15	5,33	13,35	16,76
18	6,40	16,00	19,81
24	8,53	21,34	25,91
NOTE - Nominal lengths of 6 m were formerly designated "single random lengths", and those of 12 m "double random lengths".			
1) By agreement between the interested parties these tolerances shall apply to each carload.			

7.6.9 Pipe ends and thread protectors

7.6.9.1 Pipe ends - General

Pipe shall be made threaded or plain-end as set forth in tables 6, 7, 8 and 9 or with bell and spigot ends in accordance with 7.6.9.4. Extra-strong line pipes shall be made with plain ends, except that the ends shall be threaded-and-coupled if so specified on the purchase order. Spiral weld may not be threaded. The inside and outside edges of the ends of all pipe shall be free of burrs.

7.6.9.2 Threaded ends

Threaded ends shall conform to the threading, thread inspection and gauging requirements specified in ISO 10422, latest edition. One end of each length of threaded pipe shall be provided with a coupling conforming to the requirements of annex C in effect at the date of manufacture of each coupling (see note 7), and the other end with thread protection conforming to the requirements of 7.6.9.6. Couplings shall be screwed onto the pipe handling-tight (see note 8), except that they shall be applied power-tight if so specified on the purchase order. A thread compound shall be applied to cover the full surface of either the coupling or pipe engaged thread before making up the joint. All exposed threads shall be coated with this thread compound. Unless otherwise specified on the purchase order, the manufacturer may use any thread compound which meets the performance objectives set forth in API Bulletin 5A2. A storage compound of distinct colour may be substituted for this thread compound on all exposed threads. Whichever compound is used, it shall be applied to a surface that is clean and reasonably free of moisture and cuttings fluids.

NOTES

7 Unless otherwise specified on the purchase order it is not mandatory that both the pipe and coupling of each threaded and coupled product be manufactured to the same edition of this standard.

8 Handling tight shall be defined as sufficiently tight that the coupling cannot be removed except by use of a wrench.

9 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 laying the pipe. This procedure has been found necessary to prevent thread leakage, especially in gas lines, because manufacturer applied couplings made up power-tight, although leak-proof at the time of make-up, may not always remain so after transportation, handling and laying.

7.6.9.3 Plain ends

Unless otherwise ordered, plain-end pipe (other than double-extra-strong pipe) with ≥ 60,3 mm outside diameter shall be furnished with ends bevelled on an angle of $30^{\circ}{}^{+5^{\circ}}_{0}$ measured from a line drawn perpendicular to the axis of the pipe, and with a root face of (1,59 ± 0,79) mm. Double-extra strong plain-end pipe with outside diameters ≥ 60,3 mm shall be made with square-cut ends, unless bevelled ends (as above) are specified on the purchase order. For seamless pipe where internal machining is required to maintain the root face tolerance, the angle of the internal taper, measured from the longitudinal axis, shall be no larger than that listed below.

Specified wall thickness mm	Maximum angle of taper degrees
< 10,6	7
10,6 to 14,1	9,5
14,1 to 16,9	11
> 16,9	14

For the removal of an internal burr on welded pipe outside diameters ≥ 114,3 mm the internal taper, measured from the longitudinal axis, shall be no larger than 7°.

The end finish of pipe outside diameters < 60,3 mm shall be specified on the purchase order. For pipe outside diameters ≥ 60,3 mm the pipe ends shall be cut within 1,59 mm. Pipe ends from each end-finishing machine shall be checked for compliance at least three times per 8-hour working shift.

Both ends of pipe with filler metal welds shall have the inside reinforcement removed for a distance of approximately 101,6 mm from the end of the pipe.

NOTE 10 The purchaser is directed to the applicable code for the recommended angle of pipe bevel.

7.6.9.4 Belled ends

When so specified on the purchase order, pipe with wall thickness ≤ 3,58 mm shall be furnished with one end belled for bell and spigot joints in accordance with figure 2. The belled end shall be visually inspected for workmanship and injurious defects.

Dimensions in millimetres

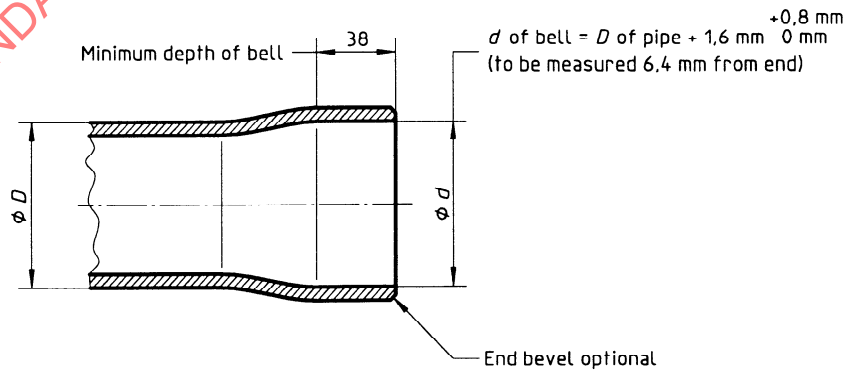


Figure 2 – Belled end for bell and spigot joint

7.6.9.5 Plain ends for special couplings

When so specified on the purchase order, pipe shall be made with ends suitable for use with special couplings (see note 11). Such pipe shall be sufficiently free from indentations, projections, or roll marks for a distance of 203 mm from the end of the pipe, to permit proper make-up coupling.

Note 11 Dresser and Victaulic are examples for suitable products available commercially. This information is given for the convenience of the user of this part of ISO 3183 and does not constitute an endorsement by ISO of these products.

7.6.9.6 Thread protectors

On nominal pipe sizes smaller than 2, the thread protectors shall be suitable fabric wrappings, or suitable metal, fiber, or plastic protectors. On nominal pipe sizes 2 and larger, the thread protectors shall be of such design, material, and mechanical strength to protect the thread and end of the pipe from damage under normal handling and transportation. The thread protectors shall cover the full length of the thread on the pipe and exclude water and dirt from the thread during transportation and normal storage period. Normal storage period shall be considered as approximately one year. The thread formed in protectors shall be such that the pipe threads are not damaged by the protectors. 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 of -46 °C to +66 °C.

8 Testing and inspection

8.1 Type of documents on inspection and testing

8.1.1 General

Upon request by the purchaser, the manufacturer shall provide a document of compliance stating that the material has been manufactured, sampled, tested and inspected in accordance with this part of ISO 3183 and has been found to meet the requirements.

Where additional information is required, including the results of mechanical testing, SR6 (see annex D) or one of the inspection documents of ISO 10474 shall be specified on the purchase order.

8.1.2 Test reports on chemical analysis

The results of all specified chemical analysis shall be available to the purchaser upon request. When SR6 is specified by the purchaser (see annex D), a report containing all chemical analyses required by this specification shall be provided by the manufacturer.

For grade L175, in place of the test report, the manufacturer may certify that the pipe delivered was produced in conformity with the requirements for chemical properties and tests of this part of ISO 3183.

8.2 Purchaser inspection

For the purchaser's inspection see annex F.

8.3 Retention of records

Tests and inspections requiring retention of records in this part of ISO 3183 are shown in table 12. Such records shall be retained by the manufacturer and shall be made available to the purchaser upon request for a period of three years after the date of purchase from the manufacturer.

Table 12 – Retention of records

Requirement	Reference
Chemical composition	7.2
Cast analysis	8.4.2
Product analysis	8.4.3
Mechanical tests	8.5
Tensile tests	8.5.1.1
Weld tensile tests	8.5.1.1
Mill control tests	8.5.1.1
Guided bend tests	8.5.1.4
Fracture toughness tests	8.5.1, 6, SR3, SR4
Hydrostatic tests	8.6
Tester recorder charts (where used)	8.10.9.2
Supplementary hydrostatic tests	8.10.9.4
Non-destructive inspection	8.9
Film (where used)	8.10.11.1
Fluoroscopic operator qualifications	8.10.11.2.2
Welded jointers	
Film	A.4
Repair welding procedure	
Transverse tensile test	B.2.2.2
Transverse guided bend test	B.2.2.3
Nick break test	B.2.2.4
Procedure specification	B.1
Procedure qualification	B.2
Personnel performance qualification	B.3
Calibration tests	various paragraphs

8.4 Testing of chemical composition

8.4.1 Elements analysed

As a minimum, each required analysis shall include the determination of carbon, manganese, phosphorus, sulfur and silicon; niobium, vanadium, titanium, or combinations thereof, if added during steelmaking; and any other alloying element added during steelmaking for other than deoxidation purpose.

8.4.2 Cast analysis

The steel manufacturer shall determine the analysis of each cast of steel used in the manufacture of pipe specified on the purchase order. The analysis so determined shall conform to the requirements of 7.2.1.

For grade L555, cast analysis limits have not been defined, only product analysis limits.

8.4.3 Product analysis

8.4.3.1 Sampling frequency

The manufacturer shall determine the analysis of two samples representing each cast of steel used for the production of pipe under this part of ISO 3183.

8.4.3.2 Sampling methods

Seamless pipe
At the option of the manufacturer, samples used for product analysis shall be taken either from tensile test specimens or from the finished pipe.

Welded pipe
At the option of the manufacturer, samples used for product analysis shall be taken from either finished pipe, plate, strip, tensile test specimens or flattening test specimens. The location of the samples shall be a minimum of 90° from the weld, of longitudinally welded pipe. For spiral weld, the sample location shall be at a position of not less than one-quarter the distance between adjacent weld convolutions as measured from either edge of the weld. For pipe manufactured from plate or strip, the product analysis may be made by the supplier of the plate or strip providing the analyses are made in accordance with the frequency requirement of this part of ISO 3183.

8.5 Testing of mechanical and technological characteristics

For double seam welded pipes all weld tests shall be performed after forming and welding.

8.5.1 Testing frequency

8.5.1.1 Tensile test

Tensile tests shall be made at the frequency shown in table 13.

Table 13 – Frequency of tensile testing

Size designation	Tensile tests	Weld tensile tests	Control tensile tests
≤ 1 1/2 nominal size grade L175 welded	1 per 25 t or fraction thereof		
≥ 2 nominal size grade L175 welded	1 per 50 t or fraction thereof		
≤ 141,3 mm except for grade L175 welded	1 per 400 lengths		
≥ 168,3 mm to 323,9 mm > 323,9 mm	1 per 200 lengths 1 per 100 lengths per cold expansion amount[1)]		One per cast on all sizes except for grade L175
219,1 mm to 323,9 mm > 323,9 mm		1 per 200 lengths 1 per 100 lengths[1)] per cold expansion amount[2)]	

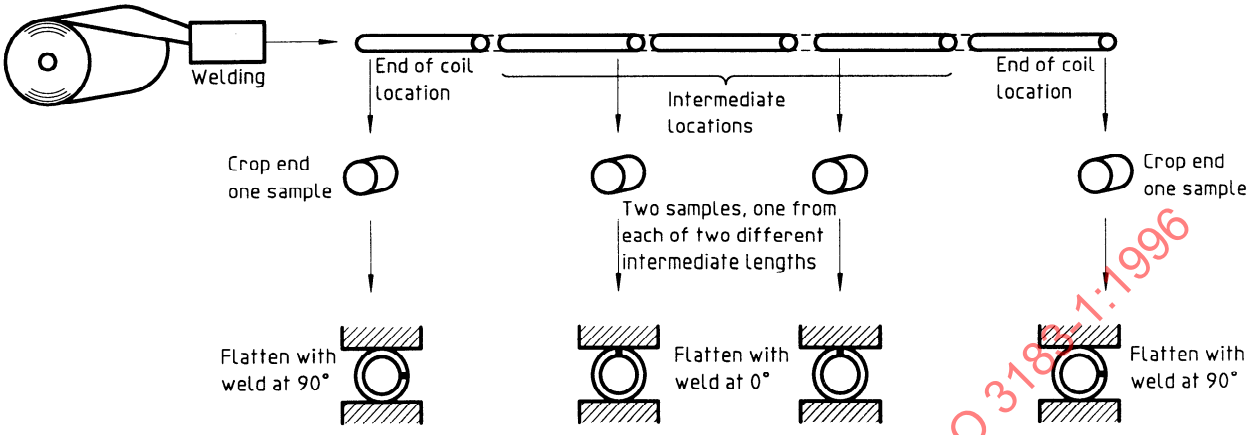
1) Pipe manufactured with the same nominal amount of cold expansion ± 0,2 % shall be considered to have the same cold expansion amount.
2) Each weld for two-seam pipe.

One control tensile test per cast shall be made and a record of such test shall be available to the purchaser for pipe other than grade L175. For longitudinal seam welded pipe, such tensile tests shall be made using samples taken from either plate or strip or finished pipe at the option of the manufacturer.

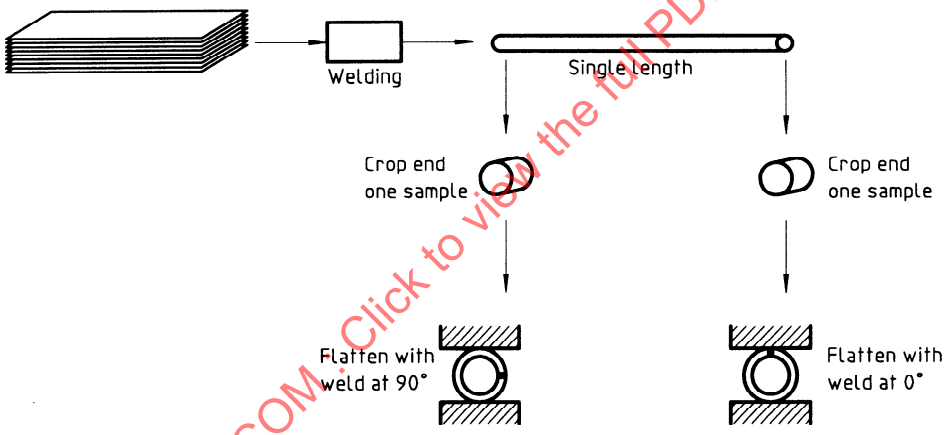
8.5.1.2 Flattening test for electric-welded and continuous welded pipe (see also figure 3)

- Electric-welded pipe grades higher than L175 non-expanded in multiple lengths.
  - One sample from each crop end (2 per coil) and two samples of two different intermediate lengths.
  - When a weld stop condition occurs during production of a multiple length, flattening tests with the weld at 90° shall be made from the crop ends resulting from each side of the weld stop and may be substituted for the intermediate flattening test.
- Electric-welded pipe grades higher than L175 non-expanded produced in single length.
  - One sample from each crop end (2 per single length).
- Grade L175 welded, outside diameter ≥ 73,0 mm.
  - One test from one length per lot of 50 t or fraction thereof.

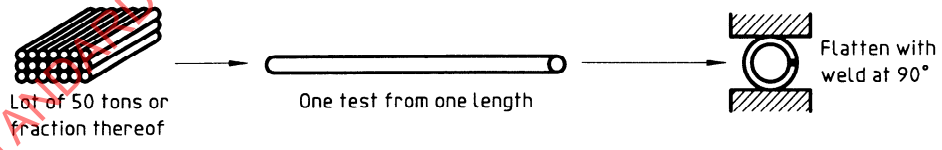
– Electric-welded pipe grades higher than L175 cold expanded.
  • One test, 101,6 mm min. in length, per lot of 100 lengths or less, each size.



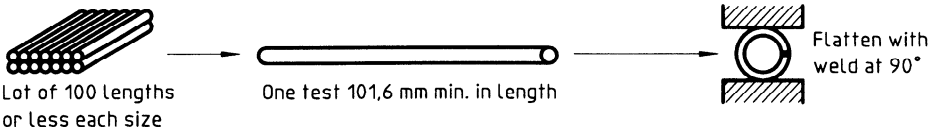
Electric-welded pipe grades higher than L175, non-expanded in multiple lengths



Electric-welded pipe grades higher than L175, non-expanded produced in single length



Grade L175 welded pipe, outside diameter ≥ 73,0 mm



Electric-welded pipe grades higher than L175, cold expanded

Figure 3 – Flattening tests (see 8.5.1.2 and 8.5.2.2)

8.5.1.3 Bend test

Bend tests are applied for welded grade L175 pipe of nominal size 2 and smaller with a frequency of

– one test per 25 t or fraction thereof, nominal size 1 1/2 and smaller

and

–one test per 50 t, or fraction thereof, for pipe of nominal size 2.

8.5.1.4 Manipulation tests for submerged arc- and gas metal arc-welds

Submerged arc- and gas metal arc-welded pipe shall be tested by the guided-bend test.

Two test specimens shall be taken from the helical or each longitudinal seam weld in a length of pipe from each lot of 50 lengths or less of each combination of outside diameter, wall thickness, and grade; and from a strip end weld in length of pipe from each lot of 50 lengths or less of each combination of outside diameter wall thickness, and grade of finished helical seam pipe containing strip end welds.

8.5.1.5 Weld ductility test

For electric-welded pipe one test shall be made on a length of pipe from each lot size as indicated in table 14.

Table 14 – Test frequency for electric-welded pipe

Grade	Outside diameter mm	Lot size No. of lengths
L175, L210 and L245	60,3 to 141,3	400 or less
L175, L210 and L245	168,3 to 323,9	200 or less
L290 and higher	60,3 to 323,9	200 or less
All grades	≥ 355,6	100 or less

For multiple-length pipe, a length shall be considered as each section cut from a particular multiple length.

The weld ductility test may also serve as one of the flattening tests of 8.5.1.2 by compliance with appropriate amounts of flattening.

8.5.1.6 Fracture toughness tests

(Lot size, see SR3 and SR4 in annex D.)

8.5.1.6.1 For grade L555 three specimens representing one test shall be taken

– from one length of pipe from each cast for determining the shear area,

– from each lot for determining the absorbed energy.

8.5.1.6.2 For grade L555 three specimens shall be taken from one length of pipe from each cast supplied in the order for drop weight tear testing on welded pipe of all diameters.

8.5.1.7 Metallographic examination

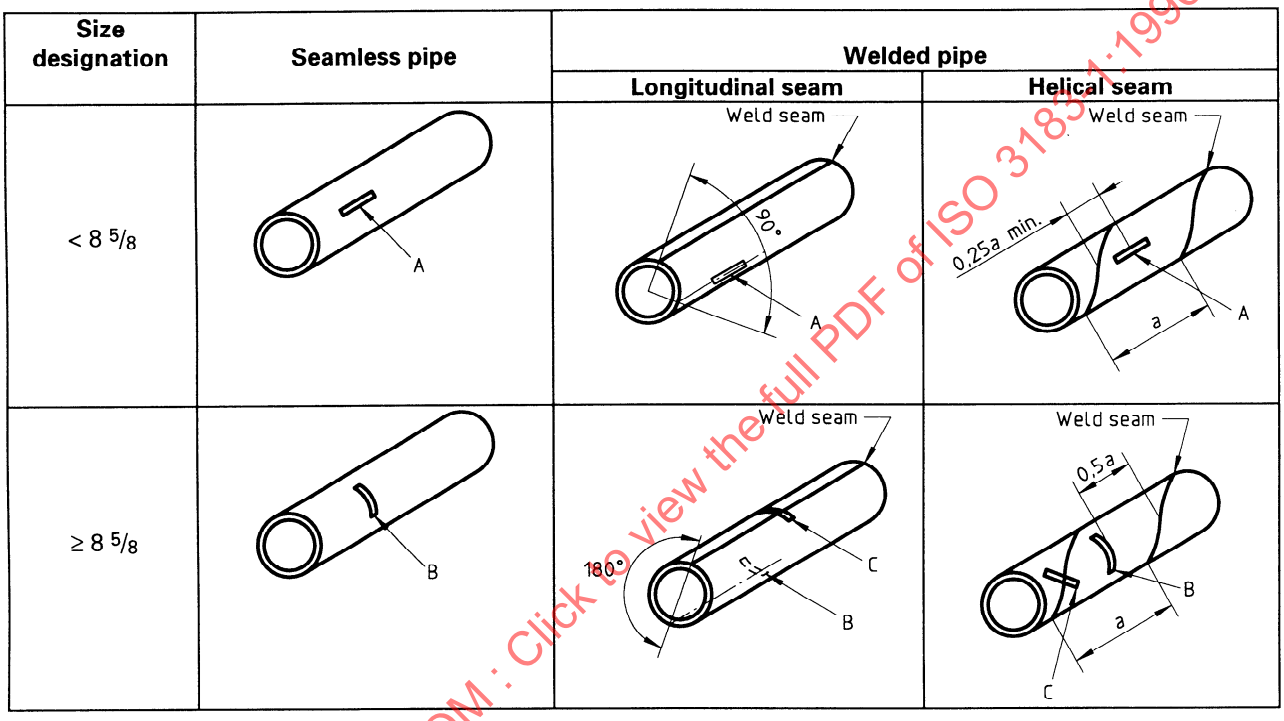
Such examinations shall be performed at least once per working turn, or more frequently where grade, diameter, or wall thickness changes are made, or where significant excursions from operating heat-treatment conditions are encountered for the grades covered in 7.4.

8.5.2 Location and orientation of test pieces for mechanical and technological tests

8.5.2.1 Tensile test

Tensile test orientation shall be as shown in figure 4. At the option of the manufacturer for longitudinal seam welded pipe, the longitudinal specimens may be taken from the strip parallel to the rolling directions and approximately midway between edge and centre.

Weld tensile test specimens shall be taken at 90° to the weld with the weld at the centre, as shown in figure 4.



A = Strip specimen (any circumferential location for seamless).
B = Transverse specimen (any circumferential location for seamless). For double seam pipe the specimen shall be taken from a location midway between the welds.
C = Transverse weld specimen.

Figure 4 – Orientation of tensile test specimens

8.5.2.2 **Flattening test** (see also figure 3)

- Electric-welded pipe grades higher than L175 non-expanded in multiple lengths.
  - Specimen with end of coil location to be flattened with weld at 90°.
  - Specimen from intermediate locations to be flattened with weld at 0°.
- Electric-welded pipe grades higher than L175 non-expanded produced in single length.
  - Samples from the crop end locations to be flattened 50 % of them with a weld position of 0° and 50 % of them with a weld position at 90°.

– Cold expanded electric-welded pipe grades higher than L175 and all other welded pipe, in grade L175, outside diameter > 73 mm.
  - Samples to be flattened with weld at 90°.

NOTE 12 Flattening tests with the weld at the 0° orientation may be conducted at 180° and the 90° orientation at 270° by agreement between the interested parties.

8.5.2.3 Bend test

A full-section specimen of appropriate length shall be taken for bending.

8.5.2.4 Manipulation tests for submerged arc- and gas metal arc-welds

For the guided-bend test the test specimens one face-bend and one root-bend, both conforming to figure 5, shall be taken from the helical or longitudinal weld and shall not contain repair welds.

8.5.2.5 Weld ductility test

For the weld ductility test a full-section specimen of 50,8 mm minimum length shall be used.

8.5.2.6 Fracture toughness test

The specimens shall be oriented circumferentially from a location 90° from the weld, with the axis of the notch oriented through the pipe wall thickness as shown in figure D.2. For pipe outside diameters ≤ 168,3 mm, longitudinal specimens shall be used.

8.5.2.7 Metallographic examination

The test specimen shall be taken from a weld cross-section.

8.6 Hydrostatic test

Each length of pipe shall withstand, without a leakage, an inspection hydrostatic test to at least the pressure and holding time specified in 8.10.9.

8.7 Dimensional testing and weighing

8.7.1 Consistency with all dimensional and mass requirements shall be ensured by adequate methods as defined in 8.10.10.

8.7.2 For pipe outside diameters ≥ 114,3 mm the outside diameter measurements on the body of the pipe shall be made on a random basis; there shall not be less than three measurements per 8-hour working turn.

8.7.3 Each length of pipe shall be measured for conformity with wall thickness requirements.

8.7.4 Pipe outside diameters < 114,3 mm in grades L175, L210 and L245 shall be reasonably straight.

All other pipe shall be random checked for conformity with straightness requirements.

8.8 Visual examination

All pipe shall be visually examined (see annex G).

8.9 Non-destructive testing

Except for grade L175 pipe, the weld seams of welded pipe outside diameters ≥ 60,3 mm shall be inspected full length (100 %) in accordance with the methods specified in 8.10.11.1. In addition, the strip end weld in finished helical seam pipe shall be so inspected. The location of equipment in the manufacturer's facility shall be at the discretion of the manufacturer.

By agreement between the interested parties, and when specified on the purchase order, seamless pipes shall be non-destructively tested in accordance with SR2 (annex D).

By agreement between interested parties, and when specified on the purchase order, electric-welds shall be non-destructively tested in accordance with SR7 (annex D).

8.10 Test methods and results

If test equipment, whose calibration or verification is required under the provisions of this part of ISO 3183, is subjected to such unusual or severe conditions that its accuracy would become questionable, recalibration or a new verification shall be performed before further use of the equipment.

8.10.1 Chemical analysis

Methods and practices relating to chemical analysis shall be performed in accordance with ASTM A 751.

The results of chemical analysis shall comply with the requirements in 7.2.

8.10.2 Tensile test

8.10.2.1 General

Testing procedure shall conform to the requirements of the latest edition of ISO 6892 or ASTM A 370, annex II.

The results of the tensile test shall meet the requirements for the steel grade concerned shown in table 3.

8.10.2.1.1 Tensile test machines shall have been calibrated within 15 months preceding any test in accordance with the procedures of ASTM E 4. Where yield strength is determined by the use of extensometers, such extensometers shall be calibrated within the preceding 15 months in accordance with the procedures of ASTM E 83.

8.10.2.1.2 All tensile tests, except transverse weld and ring tests, shall include determination of the yield strength for 0,5 % total elongation ($R_{t0,5}$), the ultimate tensile strength (R_m) and the percentage of elongation after fracture (A) and shall be performed at room temperature.

The percentage elongation after fracture shall be reported with reference to a gauge length of 5,65 $\sqrt{S_o}$ where S_o is the initial cross sectional area of the gauge length. If other gauge lengths are used, the elongation referred to a gauge length of 5,65 $\sqrt{S_o}$ shall be determined in accordance with ISO 2566-1.

The strain rate shall be in accordance with the requirements of ISO 6892.

When determining the elongation, the record or report shall show the nominal width of the test specimen where strip specimens are used, the diameter and gauge length where round bar specimens are used, or state if full section specimens are used. For L175 pipe, the manufacturer may certify that the material furnished has been tested and meets the mechanical requirements of grade L175.

Hot flattening, artificial ageing or heat-treatment of tensile specimens is not permitted.

8.10.2.1.3 At the option of the manufacturer, the specimen may be either full section, strip specimen, or round bar specimen as defined below. The type, size and orientation of the specimens shall be reported.

If suitable testing grips, with curved faces are used or if the ends of specimens are machined to reduce the curvatures in the grip area, strip specimens

- shall be approximately 31,8 mm wide in gauge length;

otherwise they shall be

- approximately 19,0 mm wide for pipe outside diameters < 101,6 mm;
- approximately 25,4 mm wide for pipe outside diameters 101,6 mm to < 219,1 mm, and
- approximately 38,1 mm wide for pipe outside diameters ≥ 219,1 mm.

Alternatively, when grips with curved faces are not available, the ends of the specimens may be flattened without heating.

8.10.2.2 Longitudinal tensile tests

At the option of the manufacturer longitudinal tests may utilize a full section specimen, a strip specimen or, for pipe with wall thickness greater than 19,1 mm, a 12,7 mm diameter round bar specimen. The strip specimen shall be tested without flattening.

8.10.2.3 Transverse tensile tests

The transverse tensile properties shall be determined, at the option of the manufacturer, by one of the following methods.

a) The yield strength, ultimate tensile strength and elongation values shall be determined on either a flattened rectangular specimen or a 12,7 mm or 8,9 mm round bar specimen.

b) The yield strength shall be determined by the hydraulic ring expansion test in accordance with ASTM A 370. The ultimate tensile strength and elongation values shall be determined from a flattened rectangular specimen.

The same method of testing shall be employed for all lots in an order item. All transverse tensile specimens shall be as shown in ISO 6892 or ASTM A 370, annex II. All specimens shall represent the full wall thickness of the pipe from which the specimen was cut, except for round bar tensile specimens.

Transverse round bar specimens are to be prepared from non-flattened pipe sections. 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 a 8,9 mm specimen, round bar tensile specimens are not permitted.

8.10.2.4 Weld tensile tests

Weld tensile properties shall be determined on a flattened rectangular specimen representing the full wall thickness of the pipe. Weld reinforcement may be removed at the manufacturer's option. Weld tensile tests need not include determination of yield strength and elongation.

Flattening of transverse and weld specimens shall be performed at room temperature.

8.10.3 Flattening test

The flattening test shall be performed with weld position given in 8.5.2.2, in conformity with ISO 8492. Acceptable criteria shall be as follows:

- Electric-welded pipe in grades higher than L175.
  - For all pipe diameters to thickness ratios (D/T) ≤ 10 - flatten to 2/3 of the original outside diameter: there shall be no opening of the weld.
  - For pipe with a (D/T) > 10 - continue flattening to 1/3 of the original outside diameter: there shall be no cracks or breaks other than in weld.
  - For all D/T ratios - continue flattening until opposite walls of the pipe meet: there shall occur no evidence of lamination or burnt metal during the entire test.
- Grade L175 welded pipe.
  - Flatten to 3/4 of the original outside diameter without weld fracture: continue flattening to 60 % of the original outside diameter without cracks or breaks other than in the weld.

8.10.4 Bend test

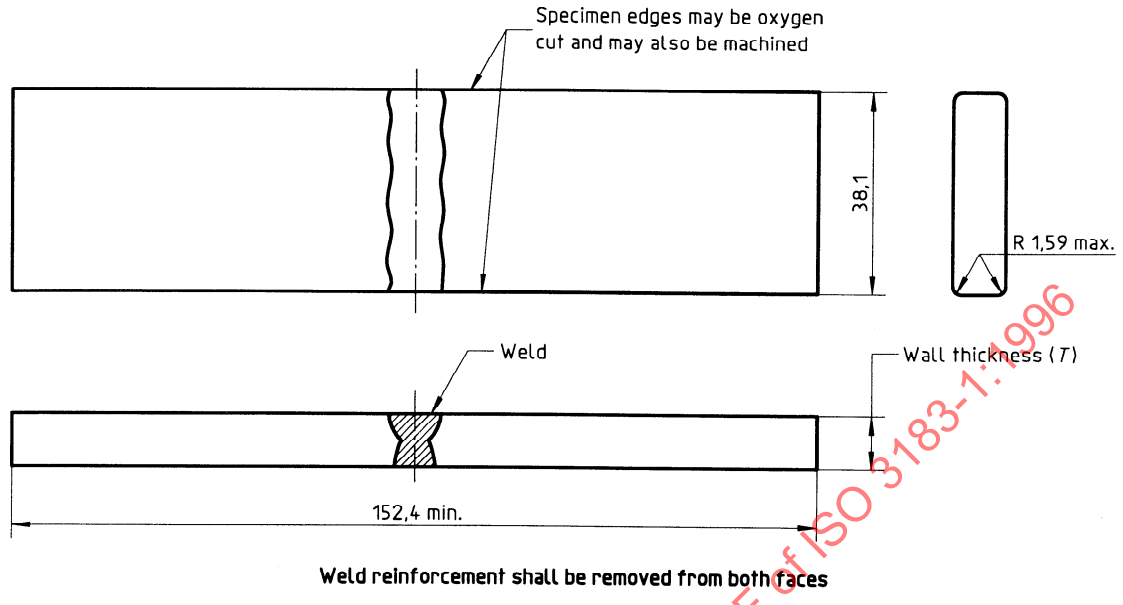
The bend test shall be carried out in accordance with ISO 8491. The full section specimen of appropriate length shall be bent cold through 90°, around a mandrel having a diameter not greater than twelve times the outside diameter of the pipe being tested, with the weld located approximately 45° from the point of contact of the specimen with the mandrel. No cracks shall occur in any portion of the pipe, and no opening shall occur in the weld.

NOTE 13 For the purpose of mechanical testing the weld of electric-welded pipe of nominal size 2 and larger, "the weld" extends to a distance of 12,7 mm on either side of the fusion line. For pipe smaller than nominal size 2, "the weld" extends to a distance of 6,35 mm on either side of the fusion line.

8.10.5 Manipulation tests for submerged arc- and gas metal arc-welds

For the guided-bend test the specimens, conforming to figure 5, shall be bent approximately 180° in a jig substantially in accordance with figure 6. For any combination of outside diameter, wall thickness and grade, the maximum value for jig dimension A may be calculated by the formula given in figure 6. The manufacturer shall use a jig based on this dimension, or a smaller dimension at his option; however, to minimize the number of jigs required, standard values for dimension A have been selected to pipe outside diameters ≥ 323,9 mm. These values are listed for each diameter, wall thickness and grade in annex E. For intermediate grades or wall thicknesses, the next smaller standard value for dimension A shall be used. When dimension A is greater than 228,6 mm, the length of the specimen required to contact the male die need not exceed 228,6 mm. For pipe with wall thicknesses over 19,1 mm, a reduced wall specimen, as shown in figure 5, may be used at the option of the manufacturer. Reduced wall specimens shall be tested in a jig with the A dimension calculated for 19,1 mm wall pipe of the appropriate size and grade. The specimen (a) shall not fracture completely, (b) shall not reveal any cracks or ruptures in the weld metal greater than 3,18 mm in length regardless of depth, and (c) shall not reveal any cracks or ruptures in the parent metal, the heat affected zone, or fusion line longer than 3,18 mm and deeper than 12,5 % of the specified wall thickness; except cracks which occur at the edges of the specimen and which are less than 6,35 mm long shall not be cause for rejection in (b) or (c) regardless of depth.

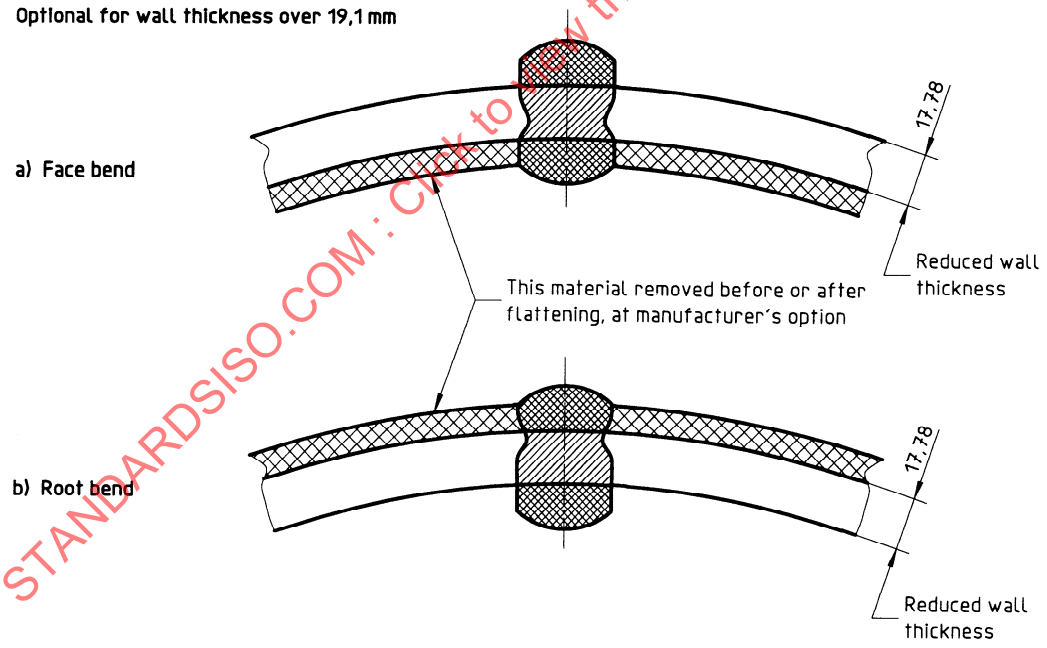
Dimensions in millimetres



Weld reinforcement shall be removed from both faces

Reduced wall specimens

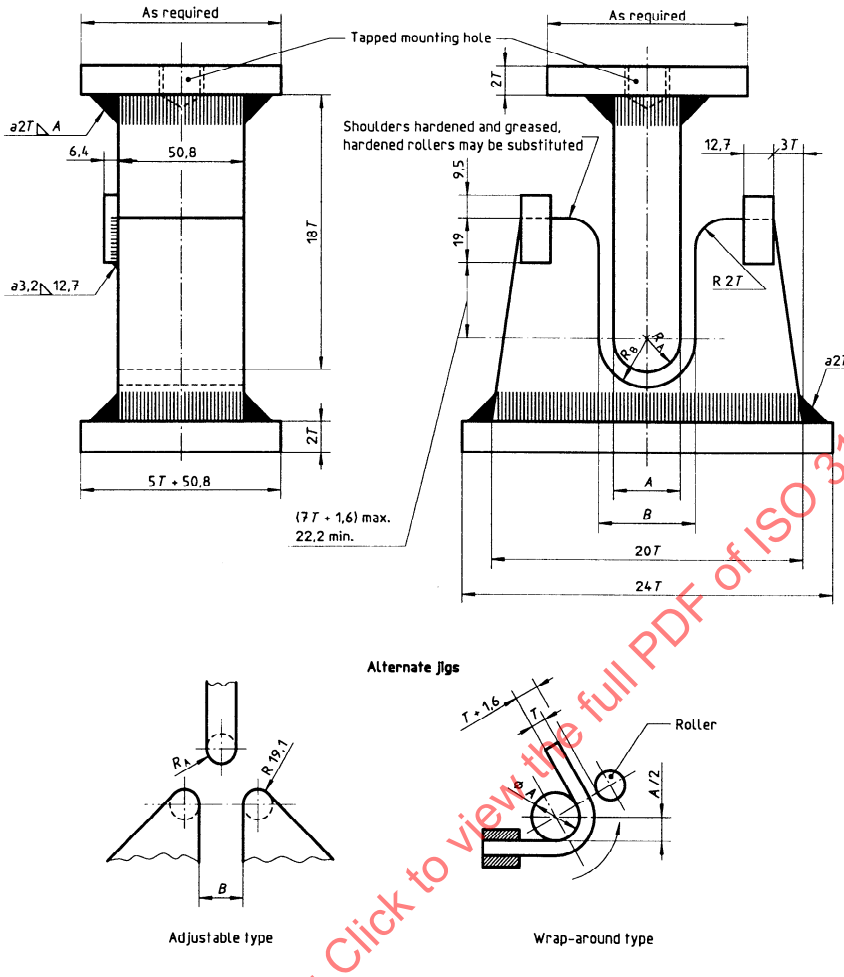
Optional for wall thickness over 19,1 mm



Note – Use jig dimensions for 19,1 mm wall when testing with reduced wall specimens.

Figure 5 – Guided bend test specimen

Dimensions in millimetres



$R_A = \frac{1}{2} A$

$B = A + 2T + 3{,}2$ mm

$R_B = \frac{1}{2} B$

$$A = \frac{1{,}15(D-2T)}{(e\frac{D}{T} - 2e - 1)} - T$$

where

1,15 = peaking factor

D = specified outside diameter in millimetres

T = specified wall thickness in millimetres

e = strain

Specified e values:

167,5 (L210)	112,5 (L415)
137,5 (L245, L290)	110,0 (L450)
132,5 (L320)	102,5 (L485)
125,0 (L360)	90,0 (L555)
117,5 (L385)	

Figure 6 – Jig for guided bend test

8.10.6 Weld ductility tests

The specimens shall be flattened cold between parallel platens. The weld shall be placed 90° from the direction of applied force (i.e. the weld at the point of maximum bending). No crack or breaks exceeding 3,18 mm in any direction in the weld or the parent metal shall occur on the outside surface until the distance between platens is less than the value of H calculated in accordance with a) or b) below:

a) Grades less than L360

$$H = \frac{3{,}07\ T}{0{,}07 + 3\ \frac{T}{D}}$$

b) Grades L360 and higher

$$H = \frac{3{,}05\ T}{0{,}05 + 3\ \frac{T}{D}}$$

where

H is the distance between flattening platens in millimetres;
T is the specified wall thickness of the pipe in millimetres;
D is the specified outside diameter of the pipe in millimetres.

Cracks which originate at the edge of the specimen and which are less than 6,35 mm long shall not be cause for rejection.

8.10.7 Fracture toughness test

For grade L555 the mandatory fracture toughness tests have to be performed at 0 °C in accordance with ASTM A 370.

Three 10 mm x 10 mm Charpy V-notch specimens shall be used if obtainable from the pipe diameter and wall thickness. Otherwise appropriate specimen thicknesses shall be used with the required energy levels reduced in proportion to the thickness.

For DWT-testing the test specimen, testing procedure, and rating of the specimens shall be in accordance with the latest edition of ANSI/API RP 5L3.

The test results shall comply with the requirements given in 7.3.3.

In case of grades lower than L555 - when so specified on the purchase order - the manufacturer shall conduct fracture toughness tests in accordance with SR3 or SR4 (annex D) or any combination of these, as specified by the purchaser. The testing temperature for SR3 and SR4 test, and also the Charpy V-notch energy value for SR3B, shall be selected by the purchaser.

8.10.8 Defective mechanical test specimen

For any of the mechanical tests in 8.5, any test specimen that shows defective preparation or material imperfections unrelated to the intent of the particular mechanical test, whether observed before or after testing, may be discarded and be replaced by another specimen from the same length of pipe.

8.10.9 Hydrostatic test

8.10.9.1 Testing conditions

Test pressures for all sizes of seamless pipe and for welded pipe with outside diameters < 508,0 mm, shall be held for not less than 5 s. Test pressures for welded pipe with outside diameters ≥ 508,0 mm shall be held for not less than 10 s. For threaded-and-coupled pipe, the test shall be applied with the couplings made up power-tight if this is specified on the purchase order, except that pipe with outside diameters > 323,9 mm may be tested in the plain-end condition. For threaded pipe furnished with couplings made up handling-tight, the hydrostatic test shall be made on the pipe in the plain-end or threads-only condition or with coupling applied, unless otherwise agreed upon by the interested parties.

8.10.9.2 Verification of hydrostatic test

In order to ensure that every length of pipe is tested to the required test pressure, each tester, except those on which continuous welded pipe is tested, shall be equipped with a recording gauge that will record the test pressure and the duration for each length of pipe, or be equipped with some positive and automatic or interlocking device to prevent pipe from being classified as tested until the test requirements (pressure and time) have been complied with. Such records or charts shall be available for examination at the manufacturer's facility by the purchaser's inspectors when the purchaser is so represented at the manufacturer's facility. The test pressure measuring device shall be calibrated by means of a dead weight tester, or equivalent, within four months prior to each use. Calibration records retention shall be per 8.3.

8.10.9.3 Test pressures

The minimum test pressures shall be the standard test pressures listed in tables 6, 7, 8 and 9 (or an alternative test pressure - see footnote 4 in table 9) or an intermediate or higher pressure at the discretion of the manufacturer unless specifically limited by the purchaser, or a higher pressure as agreed upon between the interested parties. The minimum test pressure for grades, outside diameters, and wall thicknesses not listed shall be computed by the formula given below. Where the unlisted wall is intermediate to walls whose test pressure has been arbitrarily assigned, the test pressure for the intermediate wall shall be equal to the test pressure specified for the next heavier wall thickness. When computed pressures are not an exact multiple of 100 kPa, they shall be rounded to the nearest 100 kPa.

The test pressures shall be computed by the following formula and rounded to the nearest 100 kPa.

$$p = \frac{2\,000\,ST}{D}$$

where

p is the hydrostatic test pressure, in kilopascals;

S is the fiber stress in megapascals, equal to a percentage of the specified minimum yield strength for the various sizes as shown in table 15;

T is the specified wall thickness, in millimetres;

D is the specified outside diameter, in millimetres.

Table 15 – Percentage of specified minimum yield strength (SMYS) for calculation of S

Grade	Outside diameter mm	% of SMYS for calculation of S	
		Standard test pressure	Alternative test pressure
L175	141,3[1)]	60	-
L210	≥ 60,3[2)]	60	75
L245	≥ 60,3[2)]	60	75
L290 to L555[3)]	≤ 141,3	60	75
	168,3 and 219,1	75	-
	273,1 to 457,0	85	-
	≥ 508,0	90	-

1) Test pressures established arbitrarily.
2) Test pressures were limited to 17 200 kPa for ≤ 88,9 mm outside diameter, and to 19 300 kPa for sizes > 88,9 mm outside diameter. Test pressures for other sizes established arbitrarily.
3) Test pressures for grades L290 to L555 were limited to 20 700 kPa to accommodate hydrostatic tester limitations.

When the purchase order specifies a hydrostatic test that will produce a hoop stress greater than 90 % of the specified minimum yield strength, and when SR5 (see annex D) is specified on the purchase order, the test pressure shall be determined in accordance with SR5.

NOTES

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

15 When hydrostatic testing in excess of 90 % of specified minimum yield strength, using the formula in 8.10.9.3, the applied forces for end sealing produce a compressive longitudinal stress which should be considered.

8.10.9.4 Supplementary hydrostatic test

For grades L290 and higher, the manufacturer, by agreement between the interested parties, shall make additional internal pressure tests, which may involve one or more of the following methods. In all supplementary hydrostatic tests, the formula shown in 8.10.9.3 shall be used for stress calculations. The conditions of test shall be as agreed upon.

a) Hydrostatic destructive tests in which the minimum length of the specimen is ten times the outside diameter of the pipe, but should not exceed 12,2 m.

b) Full-length destructive tests made by the "hydrostatic pressure water column" method.

c) Hydrostatic transverse yield strength tests using accurate strain gauges.

NOTE 16 Acceptable gauges are the roller-chain ring-expansion gauge, the "SR-4" (trade name) strain gauge, or other suitable gauges of a similar accuracy.

8.10.10 Dimensions, mass and length

The accuracy of all measuring instruments except ring and plug thread gauges used for acceptance/rejection shall be verified at least once every operating turn. Accuracy verification of rules, length measuring tapes and other non-adjustable measuring devices shall be defined as a visual check of markings legibility 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.

If measuring equipment, whose calibration or verification is required under the provisions of this part of ISO 3183, is subjected to such unusual or severe conditions that its accuracy would become questionable, recalibration or a new verification shall be performed before further use of the equipment.

8.10.10.1 Outside diameter

For pipe with outside diameters ≥ 114,3 mm, the outside diameter measurements on the body of the pipe shall be made at the mill with a diameter tape.

Measuring methods for the pipe ends and the out-of-roundness are defined in connection with tolerances in 7.6.8.2 and 7.6.8.3.

8.10.10.2 Wall thickness

Wall thickness measurements shall be made with a mechanical caliper or with a properly calibrated non-destructive inspection 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 with outside diameters ≥ 168,3 mm, a maximum radius of d/4 for pipe with outside diameters < 168,3 mm, with a minimum radius of 3,2 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.

8.10.10.3 Mass

Each length of pipe with outside diameters ≥ 141,3 mm, shall be weighed separately, and the carload masses determined. Lengths of pipe with outside diameters ≥ 114,3 mm shall be weighed either individually or in convenient lots, at the option of the manufacturer, and the carload masses determined. A carload is considered to be a minimum of 18 144 kg. Threaded-and-coupled pipe shall be weighed with the couplings screwed on, but without thread protectors except for carload weighings, for which proper allowance shall be made for the mass of thread protectors. Threaded-and-coupled pipe may be weighed without the couplings screwed on providing proper allowance is made for mass of the couplings.

8.10.10.4 Length

When pipe is furnished with threads and couplings, the length shall be measured to the outer face of the coupling. The length of threaded-and-coupled pipe may be determined without the couplings screwed on providing proper allowance is made for the length of the couplings. The accuracy of length measuring devices for length of pipe less than 30 m shall be ± 0,03 m.

8.10.10.5 Straightness

Measurements may be made using a taut string or wire from end to end along the side of the pipe measuring the greatest deviation.

8.10.11 Non-destructive testing

8.10.11.1 Methods of inspection

Submerged arc-welds shall be inspected by radiological methods in accordance with 8.10.11.2. Such inspection shall be full length, or for a minimum distance of 203 mm from each end if the balance of the weld length is inspected by ultrasonic methods in accordance with 8.10.11.3.1 to 8.10.11.3.4.

Electric-welds shall be inspected by ultrasonic or electromagnetic methods in accordance with 8.10.11.3.1 to 8.10.11.3.4. If necessary to meet the full length (100 %) inspection requirements of 8.9, pipe ends shall

be inspected by using hand-held ultrasonic shear wave equipment, or other NDT method agreed between the interested parties.

Gas metal arc-welds shall be inspected full length by ultrasonic methods in accordance with 8.10.11.3.1 to 8.10.11.3.4. In addition, the welds shall be inspected by radiological methods in accordance with 8.10.11.2 to 8.10.11.2.10 for a minimum distance of 203 mm from each end.

Strip end welds in finished helical seam pipe shall have been inspected in accordance with one or more of the methods specified above for the weld type. Radiological inspection shall include the junction of the strip end weld with the helical seam weld and, for cold expanded pipe, shall be performed after expansion.

8.10.11.2 Radiological inspection

8.10.11.2.1 Radiological inspection equipment

The homogeneity of weld seams examined by radiological methods shall be determined by means of X-rays directed through the weld material onto a suitable radiographic film or fluorescent screen, or a television screen provided adequate sensitivity can be obtained.

8.10.11.2.2 Fluoroscopic operator qualification

Operators of fluoroscopic equipment shall be trained, tested and certified by the pipe manufacturer.

Details of such training, testing and certification programmes shall be available to the purchaser. Included in these programmes shall be:

a) Classroom instructions in the fundamentals of radiological inspection techniques.

b) On the job training designed to familiarize the operator with specific installations including the appearance and interpretation of weld imperfections and defects. The length of time for such training shall be of sufficient duration to assure adequate assimilation of the knowledge required for conducting the inspection.

c) Knowledge of appropriate requirements of this specification.

d) A physical examination at least once per year to determine the operator's optical capability to perform the required inspection.

e) Upon completion of a) and b) above, an examination shall be given by the manufacturer to determine if the operator is qualified to properly perform fluoroscopic examinations.

8.10.11.2.3 Operator certification

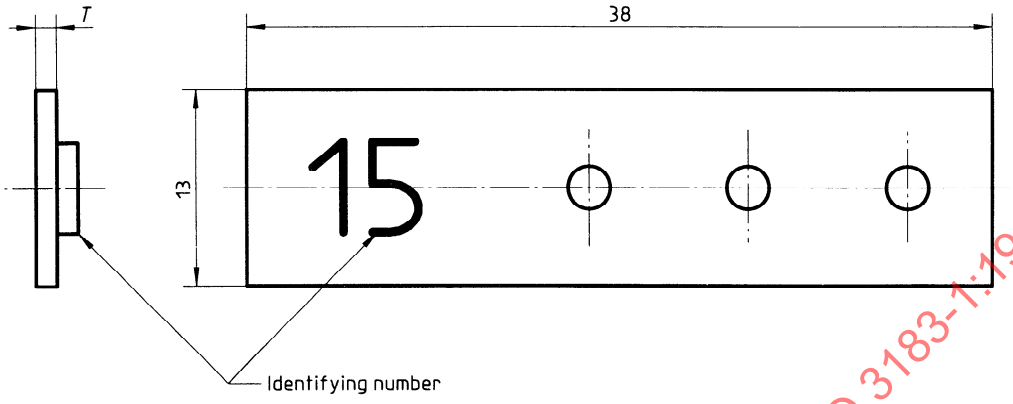
Certified operators whose work has not included fluoroscopic inspection for a period of one year or more shall be recertified by successfully completing the examination of e) above and also passing the physical examination of d) above. Substantial changes in procedure or equipment shall require recertification of the operators.

8.10.11.2.4 Radiological NDT reference standards

Unless otherwise specified, the reference standard shall be the API hole standard penetrameter described in a) below or, at the option of the manufacturer, the ISO wire penetrameter (wire type image quality indicator in accordance with ISO 1027) described in b) below. By agreement between the interested parties, other standard penetrameters may be used.

a) API hole standard penetrameter: The API hole standard penetrameter shall be as shown in figure 7 and made of a material with the same radiological characteristics as the pipe. The thickness of the penetrameter shall be a maximum of 4 % of the nominal wall thickness. Either 2 % or 4 % penetrameters may be used, the sizes of which are shown in tables 16 and 17.

Dimensions in millimetres



The diameter of each hole shall be 1,6 mm.
Holes shall be round and drilled perpendicular to the surface.
Holes shall be free of burrs, but edges shall not be bevelled.
Each penetrameter shall carry a lead identification number as given in tables 16 and 17.

Figure 7 – API standard penetrameter

Table 16 – API hole standard 4 % penetrameters

Identifying number	Wall thickness		Maximum penetrameter thickness
	above mm	up to mm	*l* mm
10	4,8	6,4	0,25
12	6,4	7,9	0,32
15	7,9	9,5	0,38
17	9,5	11,1	0,45
20	11,1	12,7	0,51
25	12,7	15,9	0,64
30	15,9	19,1	0,76
40	19,1	25,4	1,02
50	25,4	31,8	1,27
60	31,8	38,1	1,52

Table 17 – API hole standard 2 % penetrameters

Identifying number	Wall thickness		Maximum penetrameter thickness
	above mm	up to mm	*I* mm
5	5,1	6,4	0,13
6	6,4	7,9	0,15
7	7,9	9,5	0,19
10	9,5	12,7	0,25
12	12,7	15,9	0,32
15	15,9	19,1	0,38
17	19,1	22,2	0,45
20	22,2	25,4	0,51
25	25,4	31,8	0,64
30	31,8	38,1	0,76

b) ISO wire penetrameter: The ISO wire penetrameter shall be Fe 1/7, Fe 6/12 or Fe 10/16 in accordance with tables 18 and 19 for the appropriate wall thickness. When the wire penetrameter is placed across the weld, the diameter of the wire employed shall be based on the specified wall thickness plus the estimated thickness of the weld reinforcement (not to exceed the maximum allowed) at the penetrameter location. When the penetrameter is placed on the base metal, the diameter of the wire employed shall be based on the specified wall thickness.

Table 18 – ISO wire 4 % penetrameters

Wire number	Wall thickness		Wire diameter
	above mm	up to mm	mm
Fe 1/7			
1	63,5	82,6	3,20
2	50,8	63,5	2,50
3	41,1	50,8	2,00
4	31,8	41,1	1,60
5	25,4	31,8	1,25
6	20,3	25,4	1,00
7	15,9	20,3	0,80
Fe 6/12			
6	20,3	25,4	1,00
7	15,9	20,3	0,80
8	12,7	15,9	0,63
9	10,2	12,7	0,50
10	8,3	10,2	0,40
11	6,4	8,3	0,32
12	5,1	6,4	0,25
Fe 10/16			
10	8,3	10,2	0,40
11	6,4	8,3	0,32
12	5,1	6,4	0,25
13	4,1	5,1	0,20
14	3,2	4,1	0,16
15	2,5	3,2	0,13
16	2,0	2,5	0,10

Table 19 – ISO wire 2 % penetrameters

Wire number	Wall thickness above mm	Wall thickness up to mm	Wire diameter mm
Fe 1/7			
1	127,0	165,2	3,20
2	101,6	127,0	2,50
3	82,6	101,6	2,00
4	63,5	82,6	1,60
5	50,8	63,5	1,25
6	40,6	50,8	1,00
7	31,8	40,6	0,80
Fe 6/12			
6	40,6	50,8	1,00
7	31,8	40,6	0,80
8	25,4	31,8	0,63
9	20,3	25,4	0,50
10	16,5	20,3	0,40
11	12,7	16,5	0,32
12	10,1	12,7	0,25
Fe 10/16			
10	16,5	20,3	0,40
11	12,7	16,5	0,32
12	10,1	12,7	0,25
13	8,3	10,1	0,20
14	6,4	8,3	0,16
15	5,1	6,4	0,13
16	4,1	5,1	0,10

8.10.11.2.5 Frequency of calibration

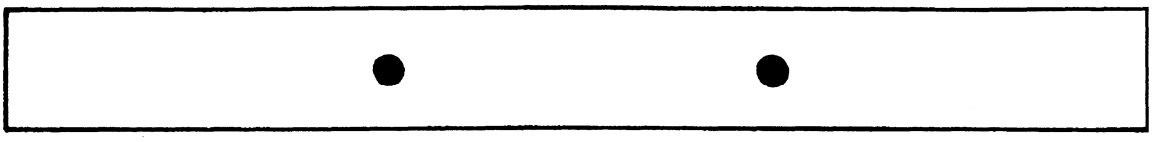
The penetrameter shall be used to check the sensitivity and adequacy of the radiographic technique on one pipe in every lot of 50 pipes, but not less than twice per 8-hour working shift, when the fluoroscopic method is used full length, and on each film when film is used. When film is used full length, one penetrameter shall be used for each length of pipe. The pipe shall be held in a stationary position during the adjustment of the radiographic technique by use of the penetrameter. Proper definition and sensitivity is attained when all three holes of the API standard penetrameter or individual wires of the ISO penetrameter are clearly discernible.

8.10.11.2.6 Procedure for evaluating in-motion operation of fluoroscope

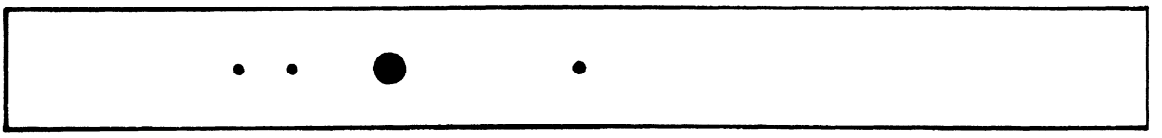
To evaluate the definition of defects at operational speeds, a pipe section having a minimum wall of 9,5 mm shall be used. Series of 0,8 mm holes, as shown in example 6, figure 8 shall be drilled into the centre of the weld to a depth of 100 percent of the total thickness. At least four such series shall be used, spaced 304,8 mm apart. As an alternative to the use of the pipe section described above, a penetrameter as described in 8.10.11.2.4 may be used at the option of the manufacturer. The speed of operation shall be adjusted so that the holes in the pipe section or API penetrameter or individual wires in the ISO penetrameter, are clearly visible to the operator.

8.10.11.2.7 Acceptance limits for radiological inspection

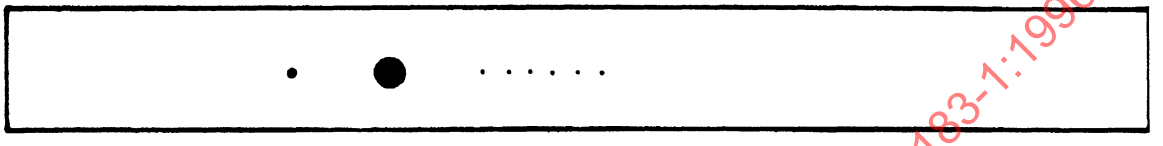
Radiological examination shall be capable of detecting weld imperfections and defects as described in 8.10.11.2.8 and 8.10.11.2.9.



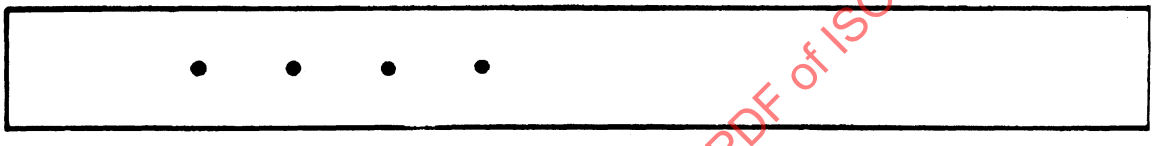
Example 1 : two 3,2 mm discontinuities



Example 2 : one 3,2 mm, one 1,6 mm, two 0,8 mm discontinuities

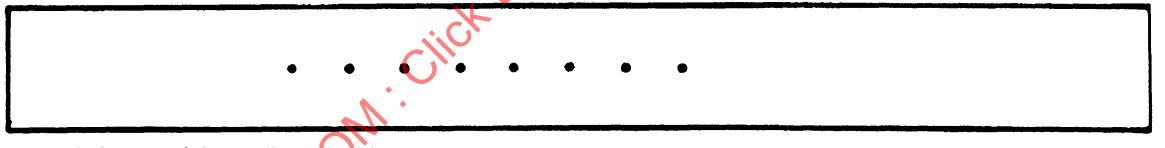


Example 3 : one 3,2 mm, one 0,8 mm, six 0,4 mm discontinuities

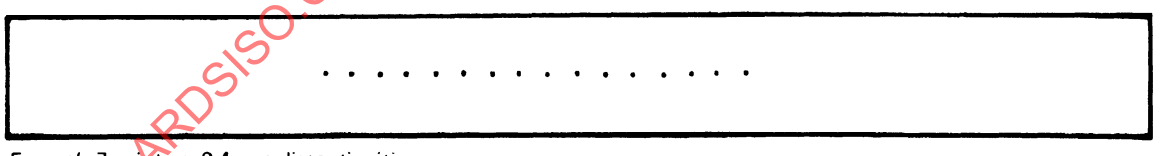


Example 4 : four 1,6 mm discontinuities

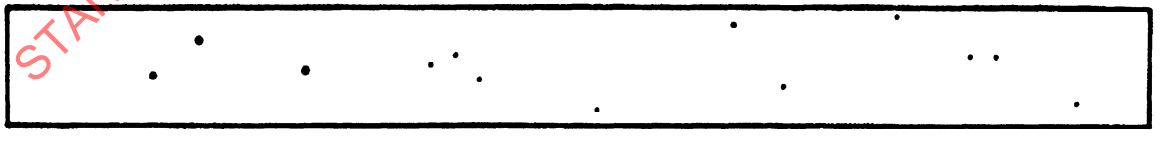
Example 5 : two 1,6 mm, four 0,8 mm discontinuities



Example 6 : eight 0,8 mm discontinuities



Example 7 : sixteen 0,4 mm discontinuities



Example 8 : scattered, three 0,8 mm, ten 0,4 mm discontinuities

Figure 8 – Examples of maximum distribution patterns of indicated circular slag-inclusion and gas-pocket-type discontinuities

8.10.11.2.8 Imperfections observed during radiological inspection

The maximum acceptance size and distribution of slag inclusion and/or gas pocket discontinuities are shown in tables 20 and 21 and figures 8 and 9.

NOTE 17 Unless the discontinuities are elongated, it cannot be determined with certainty whether the radiological indications represent slag inclusions or gas pockets. Therefore, the same limits apply to all circular-type discontinuities.

The important factors to be considered in determining rejection or acceptance limits are size and spacing of discontinuities and the sum of the diameters in an established distance. For simplicity, the distance is established as any 152,4 mm length. Discontinuities of this type usually occur in an aligned pattern, but no distinction is made between aligned or scattered patterns. Also, the distribution pattern may be of assorted sizes.

8.10.11.2.9 Defects observed during radiological inspection

Cracks, lack of complete penetration, or lack of complete fusion, and discontinuities greater in size and/or distribution than shown in tables 20 and 21 and figures 8 and 9, as indicated by radiological examination shall be considered defects. See G.4 for disposition of pipe containing defects.

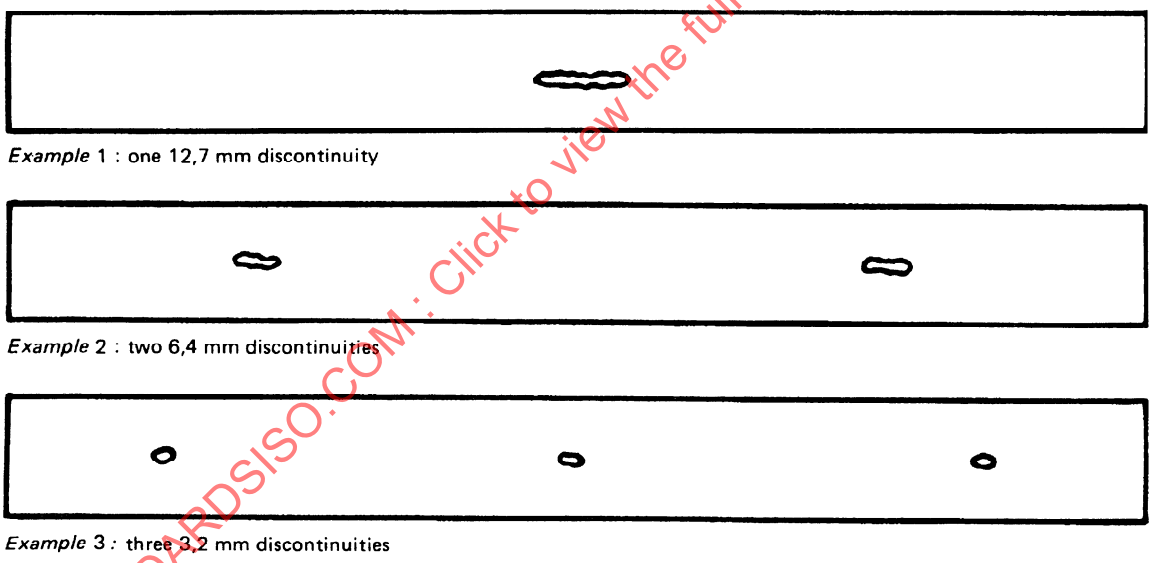


Figure 9 – Examples of maximum distribution patterns of indicated elongation slag-inclusion-type discontinuities

Table 20 – Elongated slag-inclusion-type discontinuities[1] (see figure 9)

Maximum dimensions mm	Minimum separation mm	Maximum number in any 152,4 mm
1,6 x 12,7	152,4	1
1,6 x 6,4	76,2	2
1,6 x 3,2	50,8	3
1) Maximum accumulated length of discontinuities in any 152,4 mm shall not exceed 12,7 mm.		

Table 21 – Circular slag-inclusion and gas-pocket-type discontinuities[1] (see figure 8)

Size mm	Adjacent size mm	Minimum separation mm	Maximum number in any 152,4 mm
3,2[2]	3,2	50,8	2
3,2[2]	1,6	25,4	varies
3,2[2]	0,8	12,7	varies
3,2[2]	0,4	9,5	varies
1,6	1,6	12,7	4
1,6	0,8	9,5	varies
1,6	0,4	6,4	varies
0,8	0,8	6,4[3]	8
0,8	0,4	4,8	varies
0,4	0,4	3,2	16
1) The sum of the diameters of all discontinuities in any 152,4 mm shall not exceed 6,4 mm. 2) Maximum size discontinuity for wall thickness ≤ 6,4 mm shall be 2,4 mm. 3) Two discontinuities ≤ 0,8 mm, may be as close as one diameter apart provided they are separated from any other discontinuity by at least 12,7 mm.			

8.10.11.2.10 Disposition of defects observed during radiological inspection

Any weld defect detected as a result of radiological examination shall be rejected. Disposition of the pipe containing the defect shall be in accordance with G.4.

8.10.11.3 Ultrasonic and electromagnetic inspection

8.10.11.3.1 Equipment

Any equipment utilizing the ultrasonic or electromagnetic principles and capable of continuous and interrupted inspection of the weld seam shall be used. The equipment shall be checked with an applicable reference standard as described in 8.10.11.3.2 at least once every working turn to demonstrate its effectiveness and the inspection procedures. The equipment shall be adjusted to produce well defined indications when the reference standard used by the manufacturer is scanned by the inspection unit in a manner simulating the inspection of the product, and shall be capable of inspection 1,6 mm on either side of the weld line for the entire wall thickness.

8.10.11.3.2 NDT reference standards

Reference standards shall have the same specified diameter and thickness as the product being inspected and may be of any convenient length as determined by the manufacturer. Reference standards shall contain machined notches, one on the inside surface and one on the outside surface, or a drilled hole as shown in figure 10 at the option of the manufacturer. The notches shall be parallel to the weld seam and shall be separated by a distance sufficient to produce two separate distinguishable signals. The 1,6 mm or

3,2 mm hole shall be drilled through the wall and perpendicular to the surface of the reference standard as shown in figure 10.

NOTE 18 The reference standard defined above are convenient standards for calibration of non-destructive testing equipment. The dimensions of these standards should not be construed as the minimum size imperfection detectable by such equipment.

8.10.11.3.3 Acceptance limits

Table 22 gives the height of acceptance limit signals produced by reference standards. An imperfection that produces a signal greater than the acceptance limit signal given in table 22 shall be considered a defect unless it can be demonstrated by the manufacturer that the imperfection does not exceed the provisions of G.3. Alternatively, indicated imperfections in submerged-arc welds may be reinspected by film radiological methods using 2 % penetrameters, in accordance with 8.10.11.2.

Table 22 – Acceptance limits

Weld type	Notch type	Size hole mm	Acceptance limit signal %
Submerged arc, gas metal arc and repair welds	N5	1,6	100
	All other	3,2	33 1/3
Electric-weld	N 10, V 10	3,2	100
	B, P		80

In addition, for gas metal arc-welds, continuous flaw signals greater than 25,4 mm length, regardless of signal height, but greater than the background signal (noise) shall be reinspected by radiological methods in accordance with 8.10.11.2 (as modified above) or by other techniques as agreed upon between the interested parties.

8.10.11.3.4 Weld repair

Defects in the weld, found by ultrasonic or electromagnetic methods of inspection, may be repaired by welding and non-destructively reexamined in accordance with G.5.

8.10.11.3.5 Reinspection of pipe ends

For cold expanded welded pipe non-destructively inspected only prior to cold expansion, the weld at each end of each length shall be non-destructively reinspected subsequent to cold expansion for a distance of at least 152,4 mm by any of the methods specified in 8.10.11.1 or by the magnetic particle method in accordance with 8.10.11.4.

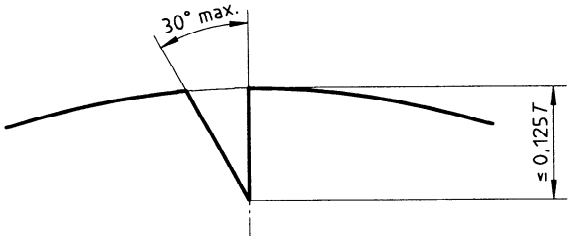
8.10.11.4 Magnetic particle inspection

(For pipe ends per 8.10.11.3.5 and for weld repairs to the pipe body.)

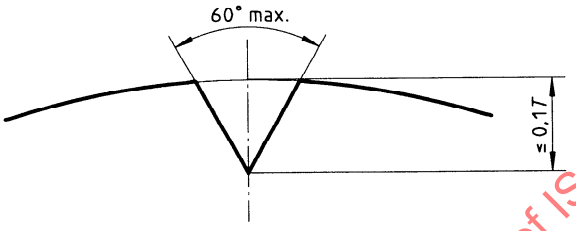
8.10.11.4.1 Equipment

The equipment used for magnetic particle inspection shall produce a magnetic field, transverse to the weld and of sufficient intensity to indicate weld area defects in the external surface of the pipe of the following character: open welds, partial or incomplete welds, intermittent welds, cracks, seams and slivers.

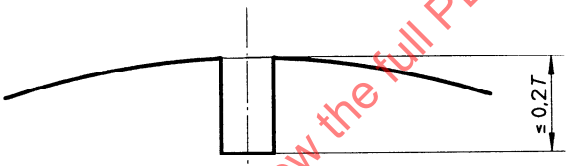
Dimensions in millimetres



B (buttress) notch

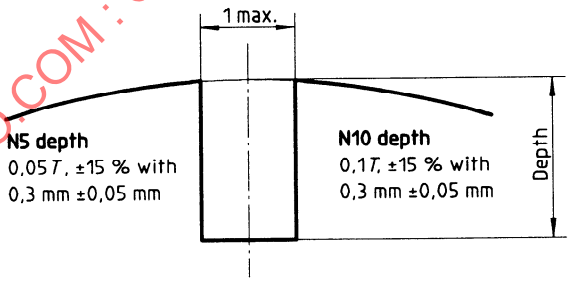


V10 notch



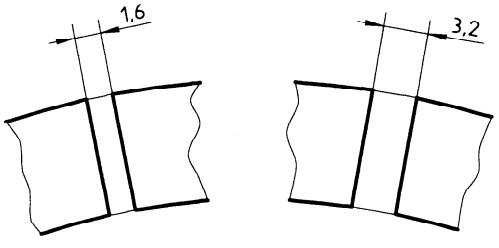
Area of each side, 3,87 mm² max.

P (parallel sided) notch



Length
For eddy current: 38 mm max. total length
For diverted flux and ultrasonic: 50 mm min. at full depth

N5 and N10 notches



Drilled hole

Figure 10 – Reference standards (see 8.10.11.3.2)

8.10.11.4.2 Reference standard

If requested by the purchaser, arrangements shall be made by the manufacturer to perform a demonstration for the purchaser or his representative during production of his order. Such demonstration shall be on basis of pipe in process or sample lengths of similar pipe retained by the manufacturer for that purpose and which exhibit natural or artificially produced defects of the character stated in 8.10.11.4.1.

8.10.11.4.3 Acceptance limits

The manufacturer shall mark each magnetic particle indication and subsequently explore each indication with respect to depth of the imperfection. Imperfections which require grinding or chipping to determine their depth shall be completely removed by grinding, or by cutting off, or may be repaired by welding in accordance with G.5 and reexamined non-destructively.

8.11 Invalidation of chemical, mechanical and technological tests

A test will be invalid (see also ISO 404, 8.4) if the results are unsatisfactory due to:

a) faulty production of the test piece not attributable to defects in the steel itself;

b) faulty mounting of the test piece;

c) faulty working of the test machine.

In each of these cases, the test shall be repeated.

8.12 Re-tests

8.12.1 Analyses

If the product analyses of both samples representing the cast fail to conform to the specified requirements, at the manufacturer's option either the cast shall be rejected or the remainder of the cast shall be tested individually for conformity to the specified requirements. If the product analysis of only one of the samples representing the cast fails to conform to the specified requirements, at the manufacturer's option either the cast shall be rejected or two recheck analyses shall be made using two additional samples from the cast. If both recheck analyses conform to the specified requirements, the cast shall be accepted, except for the pipe, plate or skelp, from which the initial sample that failed was taken. If one or both recheck analyses fail to conform to the specified requirements, at the manufacturer's option either the cast shall be rejected or the remainder of the cast shall be tested individually for conformance to the specified requirements.

For such individual testing, analyses for only the rejecting element or elements need to be determined.

Samples for recheck analyses shall be taken in the same location as specified for product analysis samples.

8.12.2 Tensile test

If the tensile test specimen representing a lot of pipe fails to conform to the specified requirements, the manufacturer may elect to make retests on two additional lengths from the same lot. If both retest specimens conform to the requirements, all the lengths in a lot shall be accepted, except the length from which the initial specimen was taken. If one or both of the retest specimens fail to conform to the specified requirements, the manufacturer may elect to test individually the remaining lengths in the lot, in which case determinations are required only for particular requirements with which the specimens failed to comply in the preceding tests. Specimen for retest shall be taken in the same manner as the specimen which failed to meet the minimum requirements.

8.12.2.1 Defective tensile test specimen

When the elongation of any tensile test specimen is less than that specified and if any part of the fracture is outside the middle third of the gauge length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

8.12.3 Flattening test

Flattening retest provisions are as follows.

Non-expanded electric-welded pipe produced in single length, higher than grade L175.

Manufacturer may elect to retest any failed end until the requirements are met providing the finished pipe is not less than 80 % of its length after initial cropping.

Non-expanded electric-welded pipe produced in multiple lengths, higher than grade L175.

Manufacturer may elect to retest each end of each individual length if any test fails. The retests for each end of each individual length shall be made with the weld alternately at 0° and 90°.

Cold-expanded electric-welded pipe higher than grade L175 and all welded L175 pipe with outside diameters ≤ 73,0 mm.

Manufacturer may elect to retest one end from each of two additional lengths of the same lot. If both retests are acceptable, all lengths in the lot shall be accepted, except the original failed length. If one or both retests fail, the manufacturer may elect to repeat the test on specimens cut from one end of each of the remaining individual lengths in the lot.

8.12.4 Bend test

If the specimen fails to conform to the specified requirements, the manufacturer may elect to make retests on specimens cut from two additional lengths from the same lot. If all retest specimens conform to the specified requirements, all lengths in the lot shall be accepted, except the length from which the initial specimen was taken. If one or more of the retest specimens fail to conform to the specified requirements, the manufacturer may elect to repeat the test on specimens cut from the individual lengths remaining in the lot.

8.12.5 Guided-bend test

If one or both of the guided-bend specimens fail to conform to the specified requirements, 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 lengths in the lot shall be accepted, except the length initially selected for test. If any of the retest specimens fail to pass the specified requirements, the manufacturer may elect to test specimens cut from the individual lengths remaining in the lot. The manufacturer may also elect to retest any length which has failed to pass the test by cropping back and cutting two additional specimens from the same end. If the requirements of the original test are met by both of these additional tests, that length shall be acceptable. No further cropping and retesting is permitted. Specimens for retests shall be taken in the same manner as specified in 8.5.2.4.

8.12.6 Weld ductility test

If the weld ductility test specimen representing a lot of pipe fails to conform to the specified requirements of 8.5.2.5, the manufacturer may elect to make retests on two additional lengths from the same lot. If both 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 one or both of the retest specimens fail to conform to the specified requirements, the manufacturer may elect to test specimens cut from one end of the

individual lengths remaining in the lot. Precaution shall be taken so that the specimens can be identified with respect to the length of pipe from which they were cut. The manufacturer may also elect to retest any length which has failed to pass the above test procedure by cropping back and cutting two additional specimens from the same end. If the weld ductility test requirements are met by both of these additional tests, that length shall be acceptable. No further cropping and retesting is permitted.

8.12.7 Fracture toughness test

For grade L555 retests shall not be made.

If the all-cast average of the order does not meet 68 J, the manufacturer shall be responsible for the replacement of casts as may be necessary to bring the average up to 68 J.

If the all-cast average of the order does not meet the required percent shear area, the manufacturer shall be responsible for replacement of such casts as may be necessary to bring the average to the required value.

For grades lower than L555 retests may be made in accordance with SR3 and SR4 (annex D).

9 Marking of pipes and pipe couplings

9.1 General

Pipes and pipe couplings manufactured in conformity with this part of ISO 3183 shall be marked by the manufacturer as specified hereinafter.

a) The required marking on pipe shall be paint stencilled as stipulated in 9.2.

b) The required marking on couplings shall be die stamped unless otherwise agreed between the interested parties, in which case they shall be paint stenciled.

c) Length and hydrostatic test pressure markings shall be in metric units.

9.2 Location of marking

The location of identification markings, shall be as follows:

Outside diameters ≤ 48,3 mm - The marking requirements of 9.2 shall be die stamped on a metal tag fixed to the bundle, or may be printed on the straps or banding clips used to tie the bundle.

Seamless pipe in all other sizes and welded pipe outside diameters up to 406,4 mm - Paint stencil on the outside surface starting at a point between 457,0 mm and 762 mm from the end of the pipe, and in the sequence shown below, except when agreed between the interested parties some or all of the markings may be placed on the inside surface in a sequence convenient to the manufacturer.

Welded pipe outside diameters ≥ 406,4 mm - Paint stencil on the inside surface starting at a point no less than 152,4 mm from the end of the pipe in a sequence convenient to the manufacturer, unless otherwise specified by the purchaser.

9.3 Sequence of markings

The sequence of identification markings shall be as follows:

a) **Manufacturer's name or mark (X)**

b) **Designation** of this part of ISO 3183 shall be marked when the product is in complete compliance with this International Standard.

c) **Compatible standards.** Products in compliance with multiple compatible standards may be marked with the name of each standard.

d) **Designations.** The size and mass designations are dimensionless quantities based on diameter and mass per metre. The size designation (see column 1, tables 6 to 9) shall be marked. For outside diameters ≥ 114,3 mm, the nominal mass for threaded-and-coupled pipe (see column 2, tables 6 and 7) and the tabulated mass for plain-end pipe (see M in column 1, tables 8 and 9) shall be marked.

e) **Grade and class**

The symbols to be used are as follows:

Grade L175 class I	L175
Grade L175 class II	L175 R
Grade L210	L210
Grade L245	L245
Grade L290	L290
Grade L320	L320
Grade L360	L360
Grade L390	L390
Grade L415	L415
Grade L450	L450
Grade L485	L485
Grade L555	L555

For grades intermediate to L290 and L390, the symbol shall be "L" followed by the first three digits of the specified minimum yield strength.

For all grades L320 and higher, including intermediate grades, containing niobium, vanadium and/or titanium, the grade symbol shall be followed by the letter(s) C, V, T or combination thereof.

By agreement between the interested parties and when so specified on the purchase order, the grade shall be identified by colour in accordance with SR3 (annex D).

NOTE 19 See 7.1 for limitations on downgrading.

f) **Process of manufacture**

The symbols to be used are as follows:

Seamless pipe	S
Welded pipe, except continuous welded	W
Continuous welded pipe	F

g) **Heat treatment**

The symbols to be used are as follows:

Normalized or normalized and tempered ..... N
Subcritical stress relieved ..... HS
Subcritical age hardened ..... HA
Quenched and tempered ..... Q

h) **Test pressure**

When the specified hydrostatic test pressure is higher than the tabulated pressure (see tables 6 to 9) the test pressure in kPa preceded by the word TESTED, shall be paint stencilled.

i) **Supplementary requirements**

See annex D.

EXAMPLES:

1. Size 14, mass 54,57, grade L245 seamless, regular-mass, plain-end pipe should be paint stencilled as follows:

X 3183-1, 14 54,57 L245 S

2. Size 6 5/8, mass 18,97, grade L245, electric-welded, regular mass, plain-end pipe should be paint stencilled as follows:

X 3183-1, 6 5/8 18,97 L245 W

3. Nominal size 4, grade L175, continuous welded, class 1, standard-mass, threaded line pipe should be paint stencilled as follows:

X 3183-1, 4 11,00 L175 F

4. Size 14, mass 54,57, grade L290, seamless, steel pipe should be paint stencilled as follows:

X 3183-1, 14 54,57 L290 S

5. Size 12 3/4, mass 43,77, grade L290, seamless plain-end pipe should be paint stencilled as follows:

X 3183-1, 12 3/4 43,77 L290 S

6. Size 6 5/8, mass 14,97, grade L290, electric-welded plain-end pipe should be paint stencilled as follows:

X 3183-1, 6 5/8 14,97 L290 W

7. Size 12 3/4, mass 43,77, grade L290, helical seam submerged arc-welded plain-end pipe should be paint stencilled as follows:

X 3183-1, 12 3/4 43,77 L290 W

9.4 Bundle identification

For pipe with outside diameter ≤ 48,3 mm, the identification markings specified in 9.2 shall be placed on the tag, strap, or clip used to tie the bundle.

9.5 Length

In addition to the identification markings stipulated in 9.1, 9.2 and 9.3 the length shall be marked as follows:

a) For pipe with outside diameter > 48,3 mm, the length in metres and hundredths of metre, unless otherwise specified on the purchase order, as measured on the finished pipe shall be paint stencilled on the outside surface at a place convenient to the manufacturer, except by agreement between the interested parties the length marking may be placed inside the pipe at convenient location.

b) For pipe with outside diameter ≤ 48,3 mm, the total length of pipe in the bundle in metres and hundredths of metre unless otherwise specified on the purchase order, shall be marked on the tag, band or clip.

9.6 Couplings

All couplings in nominal size 2 and larger shall be identified with the manufacturer's name or mark and "3183-1".

9.7 Die stamping

Cold die-stamping of grades higher than L175 plate or pipe not subsequently heat treated, and all pipe with wall thickness ≤ 4,0 mm is prohibited, except that by agreement between the interested parties and when so specified on the purchase order, pipe or plate may be cold die stamped. The manufacturer, at his option, may hot die stamp (93 °C or higher) plate or pipe, cold die stamp plate or pipe if it is subsequently heat treated and cold die stamp couplings. Cold die-stamping shall be done with rounded or blunt dies. All die-stamping shall be at least 25,4 mm from the weld for all grades except grade L175.

9.8 Thread identification

At the manufacturer's option, any pipe threads which conform to the threading and gauging stipulation given in the latest edition of ISO 10422 may be identified by stamping or stencilling the product adjacent to such thread, with the manufacturer's name or mark, the size and the letters LP to indicate the type of thread.

For example, nominal size 6 ISO line pipe threads may be marked:

X 10422 6 LP

If the product is clearly marked elsewhere with the manufacturer's identification, his name or mark may be omitted.

9.9 Thread certification

The use of the letters as provided in 9.7 shall constitute a certification by the manufacturer that the threads so marked comply with the requirements stipulated in the latest edition of ISO 10422, but should not be construed by the purchaser as a representation that the product so marked is, in its entirety, in accordance with any ISO Standard.

9.10 Pipe processor markings

Pipe heat treated by a processor other than the original pipe manufacturer shall be marked as stipulated in 9.1 to 9.7. 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 Protective coatings

Unless otherwise ordered, pipe shall be given an external coating to protect it from rusting in transit. An attempt should be made to make these coatings smooth, hard to the touch, and with minimum sags.

NOTE 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 specified 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.

Annex A
(normative)

Specification for welded jointers

A.1 Method

Welding of any type that uses deposited filler metal and is generally recognized as sound practice shall be permitted unless the purchaser specifies a particular method. Welding procedures, and welders and welding machine operators (hereafter operators) shall be qualified in accordance with API Standard 1104. Copies of the welding procedure specification and procedure qualification record shall be provided to the purchaser upon request.

A.2 Workmanship

The ends of the pipe to be welded together shall be prepared in accordance with the requirements of the procedure used. Pipe weld seams (straight, helical or strip) shall be staggered between 51 mm and 203 mm unless specified otherwise by the purchaser. The completed jointers shall be straight within the limits specified in 7.6.6. Each weld shall have a substantially uniform cross section around the entire circumference of the pipe. At no point shall its crowned surface be below the outside surface of the parent metal nor shall it rise above the latter by more than 3,18 mm if submerged arc-welded, or by more than 1,59 mm if welded by another process.

A.3 Marking

Each jointer shall be marked to identify the welder or operator, using paint stencil.

A.4 Non-destructive testing

The girth welds of jointers shall be 100 % radiographed in accordance with the procedures and standards of acceptability in API Standard 1104. Jointer welds failing to pass this radiographic examination may be repaired and re-radiographed in accordance with the procedures and acceptance criteria of API Standard 1104.

NOTE 21 See also 7.6.7 for length requirements on jointers.

Annex B
(normative)

Repair welding procedure

B.1 General

All repair welds shall be made in the flat position according to a qualified procedure and by a welding machine operator (hereafter operator) or repair welder qualified in a flat position, as specified in B.2. Repair welds may be made by one of the following methods:

- automatic submerged arc;
- automatic or semi-automatic gas metal arc;
- manual shielded metal arc using low hydrogen electrodes.

All welding materials shall be properly handled and stored in accordance with the manufacturer's recommendations so as to preclude moisture or other contamination. Test welds may be made on either plate stock or pipe stock at the option of the manufacturer.

The manufacturer shall maintain a record of the welding procedure and procedure qualification test results; copies of the welding procedure specification and procedure qualification record shall be provided to the purchaser upon request.

B.2 Repair welding procedure qualification

Welding procedures shall be qualified by preparing and testing welds in accordance with this annex B. At the option of the manufacturer, the tests specified in the latest issue of the ASME Boiler and Pressure Vessel Code, Section IX may be substituted therein. For the purpose of this annex, the term automatic welding includes both machine welding and automatic welding as defined in the ASME Boiler and Pressure Vessel Code, Section IX.

B.2.1 Essential variables

An existing procedure shall not be applicable and new procedure shall be qualified when any of the following essential variables is changed beyond the stated limits.

B.2.1.1 Welding process

a) A change in the welding procedure (i.e. submerged arc to gas metal arc).

b) A change in the method (i.e. manual to semi-automatic).

B.2.1.2 Pipe material

a) A change in grade category. When different alloying systems are used within one grade category, each alloying composition shall be separately qualified. Grade categories are as follows:

   - SMYS $\leq$ 290 N/mm^2;
   - SMYS > 290 N/mm^2, but < 450 N/mm^2;
   - each grade with SMYS $\geq$ 450 N/mm^2.

b) Within each grade category, a thicker material than the material qualified.

c) Within the grade category and thickness range, a carbon equivalent (CE) based on product analysis for the material to be repaired which is more than 0,04 % greater than the CE of the material qualified, where

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

B.2.1.3 Welding materials

a) A change in filler metal classification.

b) A change in electrode diameter.

c) A change of more than 5 % in the composition of shielding gas.

d) A change of more than 10 % in the flow rate of shielding gas.

e) A change in submerged arc-welding flux from one designation to another.

B.2.1.4 Welding parameters

a) A change in the type of current (i.e. AC instead of DC).

b) A change in polarity.

c) For automatic and semi-automatic welding, schedules of welding current, voltage and speed may be established to cover ranges of wall thicknesses. Within the schedule, appropriately selected points shall be tested to qualify the entire schedule. Thereafter, a new qualification is required if there is a deviation from the qualified schedule greater than:

   1) 10 % in amperage;

   2) 7 % in voltage;

   3) 10 % in travel speed for automatic welding.

B.2.1.5 Weld bead

For manual and semi-automatic welding, a change in bead width greater than 50 %.

B.2.1.6 Preheat and post weld heat treat

a) Repair welding at a pipe temperature lower than the pipe temperature of the qualification test.

b) The addition of deletion of post weld heat treatment.

B.2.2 Mechanical testing

B.2.2.1 Number of tests

Two specimens of each type are required from each test.

B.2.2.2 Transverse tensile test

The transverse tensile test specimen shall be approximately 38 mm wide and shall have the transverse butt weld perpendicular to the longitudinal axis at the centre of the test specimen (see figure B.1). The weld reinforcement shall be removed from both faces. The ultimate tensile strength shall be at least equal to the minimum specified for the pipe grade.

Dimensions in millimetres

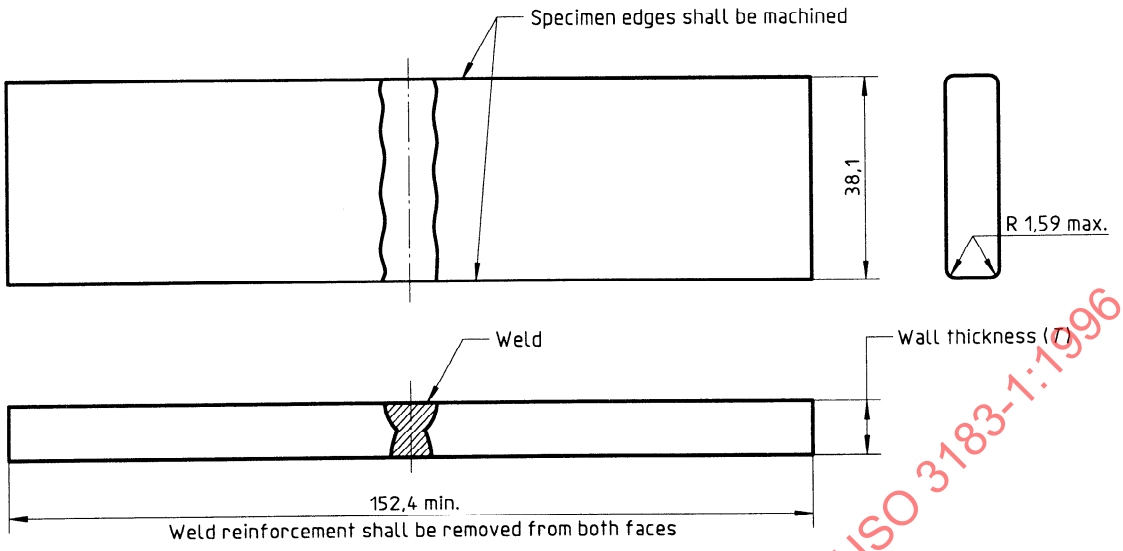


Figure B.1 – Transverse tensile test specimen

B.2.2.3 Transverse guided bend test

The transverse guided bend test specimens shall conform to figure B.2. The weld shall be made in a groove as shown. Each specimen shall be placed on the die with the weld at mid-span, and shall be bent approximately 180° in a jig substantially in accordance with figure 6 in 8.10.5 and table B.1, with the exposed surface of the weld in tension. The bend test shall be considered acceptable if no crack or other defect exceeding 3,18 mm in any direction is present in the weld metal or base metal after bending. Cracks which both originate along the edges of the specimen during testing and measure less than 6,35 mm in all directions shall not be considered.

Dimensions in millimetres

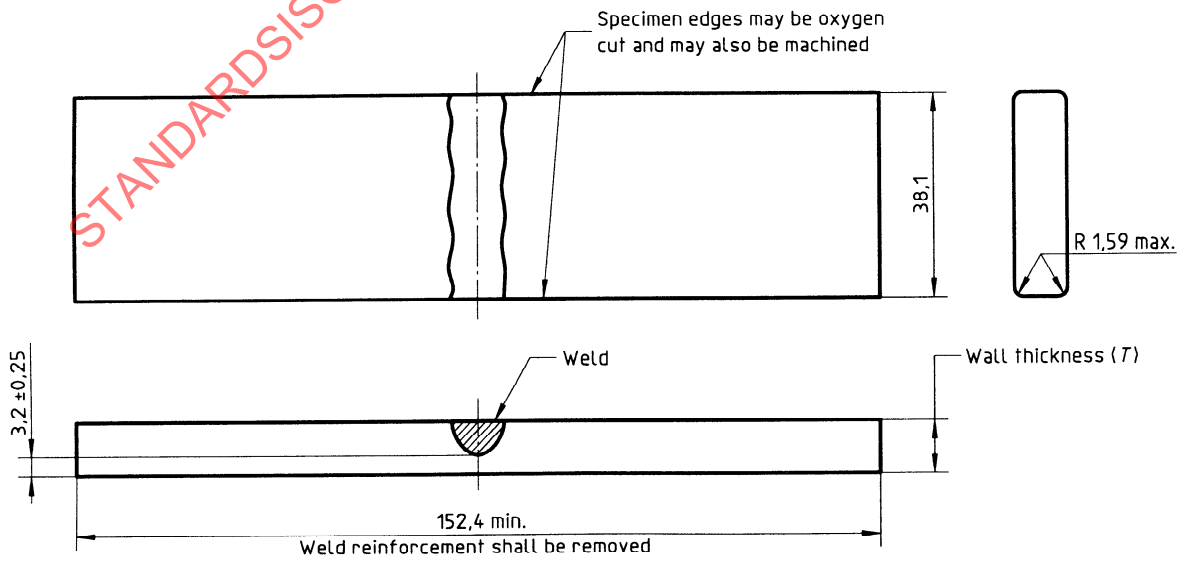


Figure B.2 - Transverse guided-bend test specimen

Table B.1 – Guided-bend test jig dimension (see figure 6 and 8.10.5)

	Pipe grade[1)]				
	L210, L275, L290	L320	L360, L390	L415, L450	L485, L555
Radius of male member, R_A	3 T	3 1/2 T	4 T	4 1/2 T	5 T
Radius of female member, R_B	4 T + 1,6 mm	4 1/2 T + 1,6 mm	5 T + 1,6 mm	5 1/2 T + 1,6 mm	6 T + 1,6 mm
Width of male member, A	6 T	7 T	8 T	9 T	10 T
Width of groove in female member, B	8 T + 3,2 mm	9 T + 3,2 mm	10 T + 3,2 mm	11 T + 3,2 mm	12 T + 3,2 mm
T = specified wall thickness of the pipe					

1) For intermediate grades of pipe, the above dimensions of the bending jig shall conform to those shown for the next lower grade or shall be proportional thereto.

B.2.2.4 Nick-break test

The nick-break specimens shall conform to figure B.3. The weld shall be made in a groove as shown. Each specimen shall be saw-notched from both edges at the centre of the weld and shall be broken by pulling or hammer blows at the centre of one end. The exposed surface of the specimen shall be visually examined, and shall be considered acceptable if it meets the following criteria.

a) No gas pockets exceeding 1,59 mm in any direction.

b) Not more than one gas pocket of any size for specified wall thickness ≤ 6,35 mm.

c) Not more than two gas pockets of any size for specified wall thicknesses ≤ 12,7 mm, but > 6,35 mm.

d) Not more than three gas pockets of any size for specified wall thickness > 12,7 mm.

e) To be acceptable, slag inclusions shall be separated by at least 12,7 mm of sound metal and shall not appear > 1,59 mm in width or > 4,76 mm in length.

Dimensions in millimetres

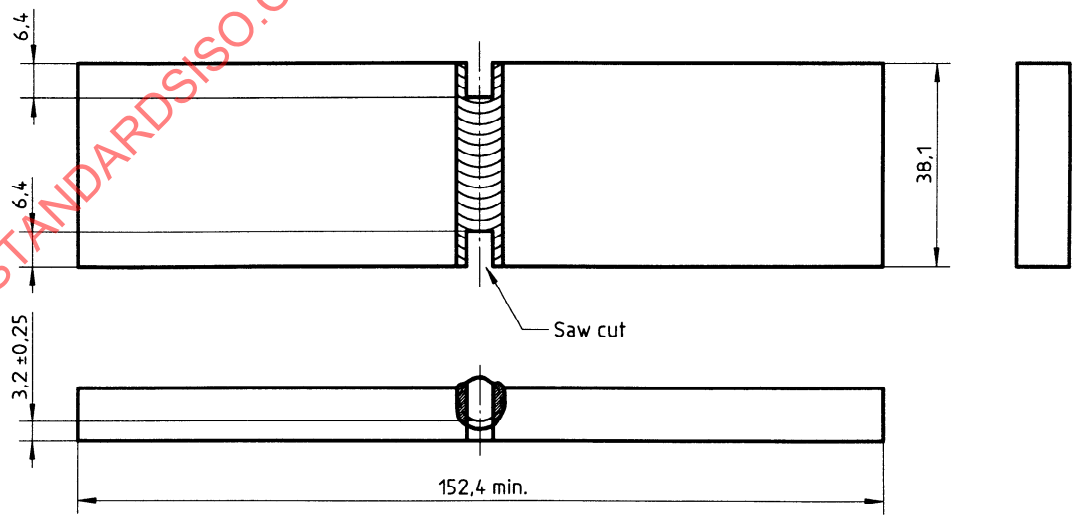


Figure B.3 – Nick-break test specimen

B.3 Welding personnel performance qualification

B.3.1 Qualification

B.3.1.1 Each repair welder and operator is required to qualify. A repair welder or operator qualified on one grade category is qualified for any lower grade category provided the same welding process is used.

B.3.1.2 Testing

For qualification, a repair welder or operator shall produce welds which are acceptable in the following tests:

B.3.1.2.1 Film radiographic examination per 8.10.11.

B.3.1.2.2 Two transverse guided bend tests per B.2.2.3.

B.3.1.2.3 Two nick-break tests per B.2.2.4.

B.3.1.3 Test failures

If one or more of the tests in B.3.1.2 fail to meet the specified requirements, the welder or operator may make one additional qualification weld. If that weld fails one or more of the tests in B.3.1.2, the welder or operator is disqualified. No further retests shall be permitted until the welder has completed additional training.

B.3.2 Requalification

Requalification in accordance with B.3.1 is required under the following circumstances:

B.3.2.1 One year has elapsed since the last prior applicable qualification.

B.3.2.2 The individual has not been welding using qualified procedures for a period of three months.

B.3.2.3 There is reason to question the individual's ability.

Annex C
(normative)

Couplings

C.1 Material

Couplings for grades L210 and L240 pipe shall be seamless and shall be made of a grade of material at least equal in mechanical properties to that of the pipe. Couplings for grade L175 pipe shall be seamless or welded, and shall be made of steel. By agreement between the interested parties, welded couplings may be supplied on pipe outside diameters ≥ 355,6 mm, if the couplings are properly marked.

C.2 Tensile test

A tensile test shall be made on each cast of steel from which couplings are produced, and the coupling manufacturer shall maintain a record of such tests. This record shall be open to inspection by the purchaser. If such test is made on finished couplings, either round specimens or strip specimens in accordance with ISO 6892, shall be used, at the option of the manufacturer.

C.3 Dimensions

Couplings shall conform to the dimensions and tolerances shown in table C.1 and figure 1.

NOTE 22 Couplings covered by table C.1 are applicable to either threaded or extra-strong threaded pipe.

C.4 Threading

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

C.5 Inspection

Couplings shall be free from blisters, pits, cinder marks and other defects which would impair the efficiency of the coupling or break the continuity of the thread.

Table C.1 - Coupling dimensions, masses and tolerances
(see figure 1)

Nominal size designation	Outside diameter of coupling W [1] mm	Minimum length N_L mm	Diameter of recess Q m	Width of bearing face b mm	Calculated coupling mass kg
1/8	14,3	27,0	11,9	0,8	0,02
1/4	18,3	41,3	15,3	0,8	0,04
3/8	22,2	41,3	18,8	0,8	0,06
1/2	27,0	54,0	22,9	1,6	0,11
3/4	33,4	54,0	28,3	1,6	0,15
1	40,0	66,7	35,0	2,4	0,25
1 1/4	52,2	69,8	43,8	2,4	0,47
1 1/2	55,9	69,8	49,9	2,4	0,41
2	73,0	73,0	62,7	3,2	0,84
2 1/2	85,7	104,8	75,4	4,8	1,48
3	101,6	108,0	91,3	4,8	1,86
3 1/2	117,5	111,1	104,0	4,8	2,69
4	132,1	114,3	116,7	6,4	3,45
5	159,9	117,5	143,7	6,4	4,53
6	187,7	123,8	170,7	6,4	5,87
8	244,5	133,4	221,5	6,4	10,52
10	298,4	146,0	275,4	9,5	14,32
12	355,6	155,6	326,2	9,5	22,37
14D	381,0	161,9	358,0	9,5	20,81
16D	431,8	171,4	408,8	9,5	23,35
18D	482,6	181,0	459,6	9,5	30,20
20D	533,4	193,7	510,4	9,5	36,03

1) Tolerance on outside diameter W : ± 1 %

Annex D
(normative)

Supplementary requirements

By agreement between the interested parties and when specified on the purchase order the following supplementary requirements shall apply.

Supplementary requirement 1 (SR1)

Colour identification

SR1.1 Grade L320 and higher, pipe outside diameters ≥ 114,3 mm shall be identified by colour in accordance with the colour code given in SR1.3.

SR1.2 The manufacturer shall apply a spot of paint of (approximately) 50 mm of the appropriate colour on the inside surface at one end of each length of pipe.

SR1.3 The grade identification colours are as follows:

Grade	Colour
L320	Black
L360	Green
L390	Blue
L415	Red
L450	White
L485	Purple
L555	Yellow

Supplementary requirement 2 (SR2)

Non-destructive testing of seamless line pipe

SR2.1 Supplementary non-destructive testing

Seamless pipe shall be inspected full length for longitudinal defects by either magnetic particle inspection or by ultrasonic or electromagnetic methods. The location of the equipment in the mill shall be at the discretion of the manufacturer; however, the non-destructive testing must take place after all heat treating and expansion operations, if performed, but may take place before cropping, bevelling, and end sizing.

SR2.2 Magnetic particle inspection

When magnetic particle inspection is employed to inspect for longitudinal defects, the entire outside surface shall be inspected. The depth of all imperfections revealed by magnetic particle inspection shall be determined and when found to be greater than 12,5 % of the specified wall thickness the imperfection shall be considered a defect. Pipe containing defects shall be disposed of in accordance with G.4.

SR2.3 Ultrasonic or electromagnetic inspection

a) Equipment

Any equipment utilizing the ultrasonic or electromagnetic principles and capable of continuous and uninterrupted inspection of the entire outer surface of the pipe or tube may be used. The equipment shall be of sufficient sensitivity to indicate defects and shall be checked as prescribed in SR2.3 b).

b) Reference standards

A reference standard having the same nominal diameter and thickness as the product being inspected shall be used to demonstrate the effectiveness of the inspection equipment and procedures at least once every working turn. The reference standard may be of any convenient length as determined by the manufacturer. It shall be scanned by the inspection unit in a manner simulating the inspection of the product. For ultrasonic inspection, the reference standard shall contain a machined notch as specified in figure D.1 a). For electromagnetic inspection, the reference standard shall contain either a machined notch [see figure D.1 a)] or a 3,2 mm drilled hole [see figure D.1 b)].

Dimensions in millimetres

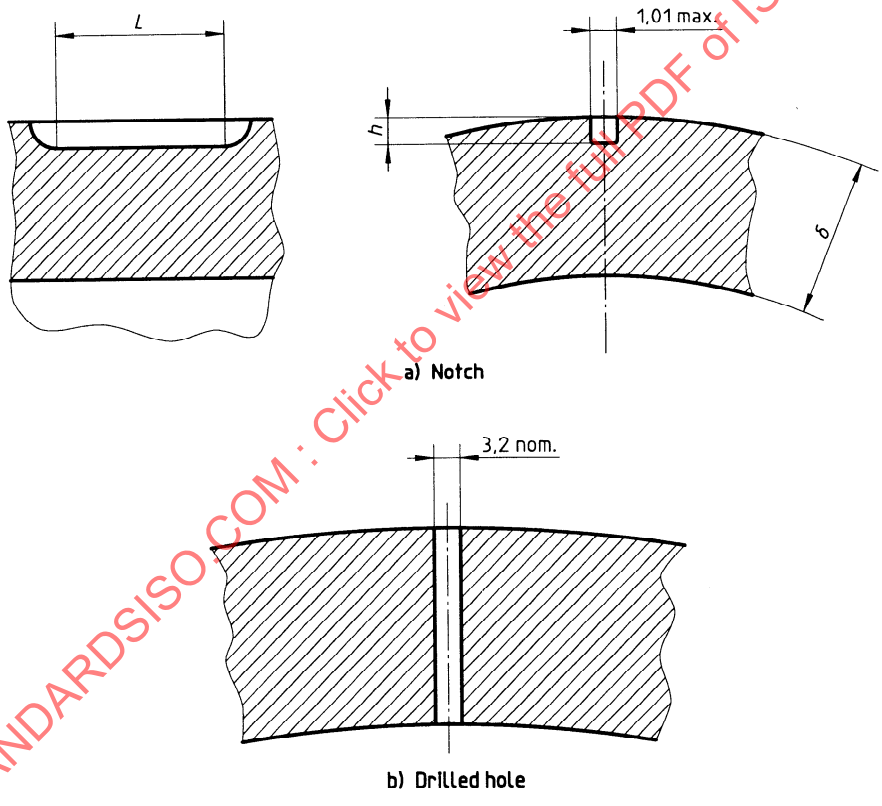


Figure D.1 – Reference standards

The notch shall be in the outer surface of the reference standard and parallel to the longitudinal axis of the pipe or, at the option of the manufacturer, may be oriented at such an angle as to optimize the detection of anticipated defects.

The depth of notch, h, shall be 12,5 % of the nominal wall thickness of the pipe being inspected, but not less than 0,30 mm.

For ultrasonic and eddy current test the length of notch at full depth, L, shall be at least twice the width of the scanning head.

For diverted flux the length of notch shall be as required by the equipment design to provide a reproducible signal when the reference standard is passed through the equipment at the inspection line speed for the pipe being inspected. Three passes through the equipment shall be required to insure reproducibility.

The 3,2 mm hole shall be drilled radially through the wall of the reference standard. The inspection equipment shall be adjusted to produce a well-defined indication when the reference standard is scanned by the inspection unit.

c) Acceptance limits

Any imperfection that produces a signal greater than the signal received from the reference standard shall be considered a defect unless it can be demonstrated by the manufacturer that the imperfection does not exceed the provisions of G.3. Pipe containing defects shall be given one of the dispositions specified in G.4.

NOTES

23 The reference standards defined above are convenient standards for calibration of non-destructive testing equipment. The dimensions of these standards should not be construed as the minimum size imperfection detectable by such equipment.

24 Reference standards other than the specific notch described above may be used by agreement between the interested parties.

SR2.4 Marking

Pipe non-destructively inspected in accordance with this supplementary requirement shall be marked SR2.

Supplementary requirement 3 (SR3)

Fracture toughness testing (Charpy) of pipe outside diameters ≥ 114,3 mm

SR3.1 The manufacturer is responsible for the performance of Charpy-V-notch tests in accordance with ASTM A 370. Either one or both toughness criteria (A-shear area or B-absorbed energy) may be specified under this supplementary requirement.

SR3.2 The following applies to all specified limits and observed values to be used in connection with this SR3.

For purposes of determining conformity with this SR3, an observed value shall be rounded off to the nearest whole number in accordance with the rounding off method of ASTM A 29. Further, limiting values as specified or calculated under this SR3 shall be expressed as whole numbers rounded, if necessary.

SR3.3 Flattening of the pipe wall is not permitted.

SR3.4 When the wall thickness does not permit machining full size 10 mm by 10 mm specimens the largest size possible, of either 2/3 size or 1/2 size shall be substituted (see table D.1). The selection of subsize specimens for pipe whose size permits full size specimens is permissible by agreement between the interested parties.

A. Shear area

SR3A.1 Three transverse specimens shall be taken from one length of pipe from each lot of 100 lengths per cast produced.

The requirements of this SR3 are limited to pipe sizes and thickness from which a 1/2 size specimen may be secured.

The specimen shall be oriented circumferentially from a location 90° from the weld, with the axis of the notch oriented through the pipe wall thickness as shown in figure D.2.

SR3A.2 The specimens shall be tested at 10 °C or at a lower temperature as specified by the purchaser. The average shear value of the fracture appearance of the three specimens shall not be less than 60 % and the all-cast average for each order per diameter size and grade shall not be less than 80 %.

Table D.1 – Minimum wall thickness for transverse Charpy V-notch specimens

Outside diameter	Minimum wall thickness for		
	full size specimen	2/3 size specimen	1/2 size specimen
mm	mm	mm	mm
114,3	17,06	13,74	12,05
141,3	15,60	12,27	10,59
168,3	14,68	11,30	9,60
219,1	13,51	10,19	8,51
273,1	12,80	9,47	7,80
323,9	12,37	8,94	7,37
355,6	12,14	8,81	7,14
406,4	11,89	8,56	6,88
457,0	11,66	8,33	6,65
508,0	11,51	8,20	6,50
559,0	11,35	8,03	6,35
610,0	11,25	7,92	6,25
660,0	11,15	7,82	6,15
711,0	11,07	7,75	6,07
762,0	11,00	7,67	5,99
813,0	10,95	7,62	5,94
864,0	10,90	7,57	5,89
914,0	10,85	7,52	5,84
965,0	10,80	7,47	5,79
1016,0	10,74	7,42	5,74
1067,0	10,72	7,39	5,72
1118,0	10,70	7,37	5,69
1168,0	10,64	7,32	5,64
1219,0	10,62	7,30	5,61
1321,0	10,59	7,26	5,59
1422,0	10,54	7,21	5,54
1524,0	10,52	7,19	5,51
1626,0	10,46	7,14	5,46

SR3A.3 If the average of the three specimens from one cast does not meet the requirement of 60 % shear, the manufacturer may elect to repeat the tests on specimens cut from two additional lengths of pipe from the same cast. If such specimens conform to the specified requirements, all the lengths in the cast shall be accepted except the length initially selected for test. If any of the re-test specimens fail to pass this specified re-test requirement, the manufacturer may elect to test specimens cut from the individual lengths remaining in the cast.

SR3A.4 The average shear value for a cast shall be the average of the original three specimens if this is 60 % or more; the combined average of the re-test specimens, provided the average of each group of three

specimens is 60 % or more; or, in the event individual lengths are tested, the combined average of all groups of three specimens that meet 60 %. The all-cast average value is the combined average of the value established for each cast.

SR3A.5 If the all-cast average of the order does not meet the requirement of 80 % shear, the manufacturer shall be responsible for replacement of such casts as may be necessary to bring the average shear area up to 80 %.

SR3A.6 Alternatively, the manufacturer may elect to test two or more additional lengths from one or more of the casts. In determining the new cast average, the original test values may be discarded if the pipe length represented is rejected or the three or more individual values averaged. In any case, the new test values shall be incorporated into the value for the cast.

SR3A.7 Specimens showing material defects or defective preparation, whether observed before or after breaking, may be discarded and replacements shall be considered as original specimens.

SR3A.8 Marking Pipe tested in accordance with this supplementary requirement shall be marked to indicate the type of test and the test temperature. Temperatures below 0 °C shall be preceded by the letter M (see note 25).

Example at 0 °C: **SR3A-0C**

Example at - 40 °C: **SR3A-M40C**

B. Absorbed energy

SR3B.1 The fracture toughness of the pipe shall be determined using Charpy V-notch impact test specimens in accordance with the latest edition of ASTM A 370 and the requirements of SR3A.1, except that test frequency shall be as indicated in SR3B.2. Purchaser shall specify, in whole numbers, both the test temperature and the minimum average absorbed energy for full size specimens.

Specimens used for shear area determination according to SR3A, may be additionally used for the determination of absorbed energy.

SR3B.2 Three transverse specimens shall be taken from one length of pipe from each lot of at maximum 100 lengths. In no case a lot shall contain more than one cast.

SR3B.3 For acceptance, the average absorbed energy of the 3 individual specimens from a length shall not be less than the full size value specified by the purchaser. In addition, the lowest individual reading of the three specimens shall not be less than 75 % of the specified value. When subsize specimens are used, the individual readings and the average of the three readings are divided by the fractional specimen size and compared with the full size acceptance criteria.

SR3B.4 Specimens showing material defects or defective preparations, whether observed before or after breaking, may be discarded and replacements shall be considered original specimens.

In the event a set of test specimens fails to meet the acceptance criteria, the manufacturer may elect to replace the lot of material involved or alternatively to test two or more lengths from the same lot. If both of the new tests meet the acceptance criteria, then all pipe in that lot with the exception of the original selected length shall be considered to meet the requirement. Failure of either of the two additional tests shall require testing of each length in the lot for acceptance.

SR3B.5 Pipe complying with this supplementary requirement shall be marked to indicate the type of test, the specified (full size) minimum average absorbed energy and the test temperature.

Example for 40 J at 0 °C: **SR3B-40J-OC**

Example for 27 J at - 40 °C: **SR3B-27J-M40C**

Example for both SR3A and SR3B 27 J at - 40 °C: **SR3AB-27J-M40C**

NOTE 25 M signifies a minus temperature (see SR3A.8 Marking).

Supplementary requirement 4 (SR4)

Drop weight tear (DWT) testing on welded pipe with outside diameters ≥ 508 mm, grade L360 or higher

SR4.1 Fracture toughness of pipe with outside diameters ≥ 508 mm, grade L360 and higher, shall be determined by the manufacturer using drop weight tear test in accordance with the following requirements:

SR4.2 Two transverse specimen shall be taken from one length of pipe from each cast supplied in the order. The specimens shall be oriented circumferentially from a location 90° from the weld with the axis of the notch oriented through the pipe wall thickness as shown in figure D.2. The specimens shall be tested at 10 °C or at a lower temperature as specified by the purchaser.

SR4.3 The test specimens, testing procedures, and rating of the specimens shall be in accordance with the latest edition of API RP 5L3.

SR4.4 At least 80 % of the casts shall exhibit a fracture appearance shear area of 40 % or more for the specified test temperature.

NOTE 26 Due to manufacturing difficulties encountered with thicker materials, pipe producers may not be able to offer materials in all grades that meet this requirement.

SR4.5 In the event the average value of the two specimens from the length selected to represent the cast is less than 40 %, the manufacturer may elect to establish the cast average by testing two specimens from each of two or more additional lengths of pipe in the cast. In establishing the new cast average, the manufacturer may elect to employ the combined average of the three or more tests; or to discard the first test, reject the pipe from which it was taken, and employ the combined average of the two or more additional tests. Alternatively, the manufacturer may elect to test all the pipe in the cast, in which case 80 % or more of the lengths tested and applied to the order must exhibit an average of 40 % or more shear.

SR4.6 Specimens showing material defects or defective preparation, whether observed before or after breaking, may be discarded and replacements shall be considered as original specimens.

SR4.7 The manufacturer shall be responsible for replacement of such casts as may be necessary to meet the above requirements.

SR4.8 Marking

Pipe tested in accordance with this supplementary requirements shall be marked to indicate the type of test and the testing temperature.

Example: **SR4OC**

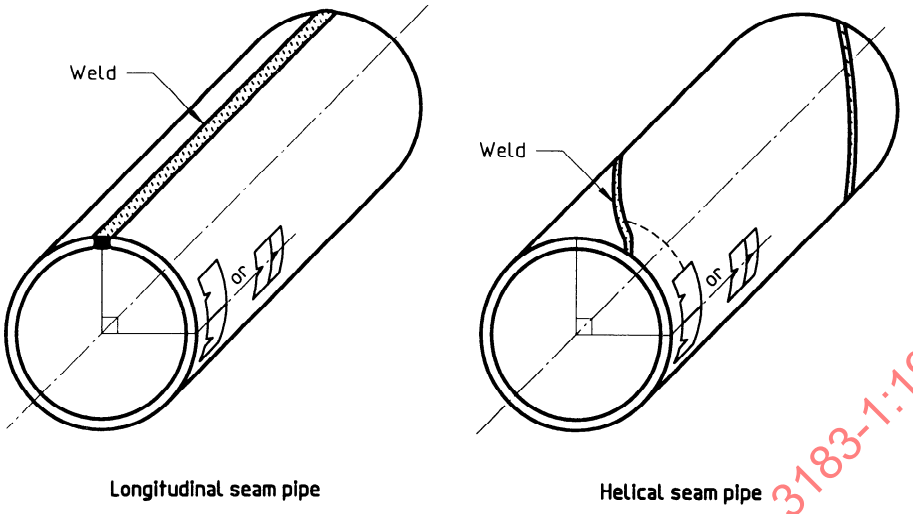


Figure D.2 - Drop weight tear (DWT) test specimen

Supplementary requirement 5 (SR5)

End load compensation for hydrostatic test pressures in excess of 90 % of specified minimum yield strength

SR5.1 As a measure to prevent distortion when testing at pressures equivalent to stresses in excess of 90 % of specified minimum yield strength, the manufacturer may apply a calculation to compensate for the forces applied to the pipe end which produce a compressive longitudinal stress. The calculation described below is based on Barlow's formula (see 8.10.9.3) modified by a factor based on the maximum shear theory. The calculation may be applied only when testing in excess of 90 % of the specified minimum yield strength. The gauge pressure for testing may in no case be less than that calculated using Barlow's formula at 90 % of specified minimum yield strength.

NOTE 27 This calculation is an approximation of the effective hoop stress (S_E) which is practical for application under mill pipe testing conditions. Other calculations provide closer approximations of effective hoop stress, but are complex and therefore impractical for application.

SR5.2 The test pressure calculated shall be rounded to the nearest 100 kPa.

SR5.3 The hydrostatic test pressure compensated for pipe end loading shall be calculated according to the following metric formula:

$$p_1 = 1\,000\,\frac{S_E - \dfrac{p_R A_R}{A_p}}{\dfrac{D}{2T} - \dfrac{A_I}{A_p}}$$

where

A_I is the internal cross-sectional area of pipe, in square millimetres;
A_p is the cross-sectional area of pipe wall, in square millimetres;
A_R is the cross-sectional area of ram, in square millimetres;
p_I is the hydrostatic test pressure, in kilopascals;
p_R is the internal pressure on end sealing ram, in kilopascals;
S_E is the effective hoop stress, in megapascals, equal to a percentage of the specified minimum yield strength;
D is the specified outside diameter, in millimetres;
T is the specified wall thickness, in millimetres.

SR5.4 The above formula may be manipulated algebraically to provide calculation in other terms appropriate to the manufacturer's testing facility.

SR5.5 Appropriate techniques for the control of effective hoop stress based on measurements of internal pipe and ram pressures vary according to hydrotester system design. The manufacturer shall provide a control technique appropriate to his installation.

Supplementary requirement 6 (SR6)

Test certificates for line pipe

SR6.1 The manufacturer shall deliver a certificate (in accordance with ISO 10474 - 3.1B) where this part of ISO 3183 is stated and where the following data, as applicable for each item for which this SR6 is specified on the purchase order are given.

a) Specified diameter, wall thickness, grade, process of manufacture, and type of heat treatment

b) Chemical analyses (cast, product, control, and recheck) showing the weight percent of all elements whose limits or reporting requirements are set in this specification

c) Test data for all tensile tests required by this specification, including yield strength, ultimate tensile strength, elongation. The type, size and orientation of specimens shall be shown.

d) Fracture toughness test results (including test type and criteria, and the size, location and orientation of specimen) where such testing is specified by the purchaser.

e) Minimum hydrostatic test pressure and duration.

f) For welded pipe for which non-destructive inspection of the weld seam is required by this part of ISO 3183, the method of non-destructive inspection employed (radiological, ultrasonic, electromagnetic, and/or magnetic particle) and the type and size of all penetrameters and/or reference standards used.

g) For seamless pipe for which non-destructive inspection (see SR2) is specified by the purchaser, the method of inspection employed (ultrasonic, electromagnetic, or magnetic particle) and the type and size of the reference standard used.

h) For electric-welded pipe, the minimum temperature for heat treatment of the weld seam. Where such heat treatment is not performed, "No seam heat treatment" shall be stated on the certificate.

i) Results of any supplemental testing required by the purchaser.

SR6.2 The manufacturer shall establish and follow procedures for maintaining cast and lot identity of all pipes covered by this SR6. The procedures shall provide means for tracing any length of pipe or coupling to the proper cast and lot, and to all applicable chemical and mechanical test results.