



BSI Standards Publication

Petroleum and natural gas industries – Steel drill pipe

National foreword

This British Standard is the UK implementation of EN ISO 11961:2018+A1:2020. It is identical to ISO 11961:2018, incorporating amendment 1:2020. It supersedes [BS EN ISO 11961:2018](#), which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PSE/17/-/5, Casing, tubing and drill pipe.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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© The British Standards Institution 2020
Published by BSI Standards Limited 2020

ISBN 978 0 539 05413 2

ICS 75.180.10; 77.140.75

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2018.

Amendments/corrigenda issued since publication

Date	Text affected
31 July 2020	Implementation of ISO amendment 1:2020 with CEN endorsement A1:2020: Figure B.14 c) replaced

English Version

Petroleum and natural gas industries - Steel drill pipe
(ISO 11961:2018)

Industries du pétrole et du gaz naturel - Tiges
de forage en acier (ISO 11961:2018)

Erdöl- und Erdgasindustrie - Stahl-
Bohrrohre (ISO 11961:2018)

This European Standard was approved by CEN on 3 October 2018.

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European foreword

This document (EN ISO 11961:2018) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" in collaboration with Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2019, and conflicting national standards shall be withdrawn at the latest by May 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of ISO 11961:2018 has been approved by CEN as EN ISO 11961:2018 without any modification.

Foreword to amendment A1

This document (EN ISO 11961:2018/A1:2020) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" in collaboration with Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" the secretariat of which is held by NEN.

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The text of ISO 11961:2018/Amd 1:2020 has been approved by CEN as EN ISO 11961:2018/A1:2020 without any modification.

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Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 11961:2008), which has been technically revised. It also incorporates the Technical Corrigendum ISO 11961:2008/Cor.1:2009.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Users of this document are advised that further or differing requirements might be needed for individual applications. This document is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the vendor can identify any variations from this document and provide details.

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Petroleum and natural gas industries – Steel drill pipe

1 Scope

This document specifies the technical delivery conditions for steel drill-pipes with upset pipe-body ends and weld-on tool joints for use in drilling and production operations in petroleum and natural gas industries for three product specification levels (PSL-1, PSL-2 and PSL-3). The requirements for PSL-1 form the basis of this document. The requirements that define different levels of standard technical requirements for PSL-2 and PSL-3 are in [Annex G](#).

This document covers the following grades of drill-pipe:

- grade E drill-pipe;
- high-strength grades of drill-pipe, grades X, G and S;
- enhanced H₂S resistance drill pipe, grades D and F.

A typical drill-pipe configuration is given, showing main elements and lengths (see [Figure B.1](#)). The main dimensions and masses of the grades of drill-pipe are given in both SI units (see [Table A.1](#)) and in USC units (see [Table C.1](#)).

This document can also be used for drill-pipe with tool joints not specified by ISO or API standards.

By agreement between purchaser and manufacturer, this document can also be applied to other drill-pipe body and/or tool-joint dimensions. This document lists supplementary requirements that can optionally be agreed between purchaser and manufacturer, for testing, performance verification and non-destructive examination (see [Annex E](#)).

This document does not consider performance properties, nor performance degradation of the product when in service.

NOTE 1 In this document, drill-pipe is designated by label 1, label 2, grade of material (E, X, G, S, D and F), upset type and type of rotary shouldered connection. Designations are used for the purpose of identification in ordering.

NOTE 2 Reference can be made to [ISO 10424-2](#) or API Spec 7-2 for the detailed requirements for the threading of drill-pipe tool joints.

NOTE 3 Reference can be made to API RP 7G for the performance properties of the drill-pipe.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[ISO 6506-1](#), *Metallic materials — Brinell hardness test — Part 1: Test method*

[ISO 6507-1](#), *Metallic materials — Vickers hardness test — Part 1: Test method*

[ISO 6508-1](#), *Metallic materials — Rockwell hardness test — Part 1: Test method*

[ISO 6892](#), *Metallic materials — Tensile testing*

[ISO 7500-1](#), *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

[ISO 9513](#), *Metallic materials — Calibration of extensometer systems used in uniaxial testing*

[ISO 10424-2](#), *Petroleum and natural gas industries — Rotary drilling equipment — Part 2: Threading and gauging of rotary shouldered thread connections*

[ISO 10893-2](#), *Non-destructive testing of steel tubes — Part 2: Automated eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections*

[ISO 10893-3](#), *Non-destructive testing of steel tubes — Part 3: Automated full peripheral flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal and/or transverse imperfections*

[ISO 10893-5](#), *Non-destructive testing of steel tubes — Part 5: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections*

[ISO 10893-10](#), *Non-destructive testing of steel tubes — Part 10: Automated full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal and/or transverse imperfections*

[ISO 11484](#), *Steel products — Employer's qualification system for non-destructive testing (NDT) personnel*

SPEC API 7-2, *Specification for Threading and Gauging of Rotary Shouldered Thread Connections*

ANSI/NACE TM0177, *Laboratory testing of metals for Resistance to Sulfide Stress Cracking and Stress Corrosion Cracking in H₂S Environments*

ASME. *Boiler and Pressure Vessel Code, Section IX*

ASNT SNT-TC-1A, *Recommended Practice, Personnel Qualification and Certification in Non-Destructive Testing*

ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM A751, *Standard Test Methods, Practices and Terminology for Chemical Analysis of Steel Products*

ASTM A941, *Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys*

ASTM E4, *Standard Practices for Force Verification of Testing Machines*

ASTM E10, *Standard Test Method for Brinell Hardness of Metallic Materials*

ASTM E18, *Standard Test Methods for Rockwell Hardness of Metallic Materials*

ASTM E23, *Standard Test Methods for Notched Bar Impact Testing of Metallic Materials*

ASTM E83, *Standard Practice for Verification and Classification of Extensometer Systems*

ASTM E92, *Standard Test Method for Vickers Hardness of Metallic Materials*

ASTM E213, *Standard Practice for Ultrasonic Examination of Metal Pipe and Tubing*

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

ASTM E570, *Standard Practice for Flux Leakage Examination of Ferromagnetic Steel Tubular Products*

ASTM E709, *Standard Guide for Magnetic Particle Testing*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ASTM A941 and the following apply:

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1.1

bevel diameter

outer diameter of the sealing shoulder of a rotary shouldered connection

3.1.2

defect

imperfection of sufficient magnitude to warrant rejection of the product based on criteria defined in this document

[SOURCE: ISO 11960:2014, definition 4.1.12]

3.1.3

drill-pipe

drill-pipe body with weld-on tool joints

3.1.4

drill-pipe body

seamless pipe with upset ends

Note 1 to entry: See [Figure B.1](#).

3.1.5

drill-pipe-body manufacturer

firm, company or corporation that operates facilities for making drill-pipe bodies and is responsible for compliance with the requirements of this document applicable to the drill-pipe body

Note 1 to entry: See [7.21](#).

3.1.6

drill-pipe manufacturer

firm, company or corporation responsible for compliance with all the applicable requirements of this document

Note 1 to entry: See [6.16](#).

3.1.7

drill-pipe torsion-strength ratio

torsion strength of the tool-joint connection divided by the drill-pipe-body torsion strength

3.1.8

drill-pipe weld neck

machined part of the drill-pipe comprising the tool-joint weld neck, the weld and the drill-pipe-body upset

Note 1 to entry: See [Figure B.1](#).

3.1.9

elephant hide

wrinkled outside diameter surfaces of the drill-pipe body caused by the upsetting process

3.1.10

enhanced H₂S resistance

classification of drill pipe that includes Sulfide Stress Cracking testing as part of its qualification and quality control

3.1.11

essential variable

variable parameter in which a change affects the mechanical properties of the weld joint

3.1.12

gouge

elongated groove or cavity caused by mechanical removal of metal

3.1.13

hard banding

application of material onto tool joints to reduce external wear of the tool joint

Note 1 to entry: This is also known as hard facing.

3.1.14

hardness number

result from a single hardness impression

3.1.15

heat

heat of steel

metal produced by a single cycle of a batch-melting process

3.1.16

heat analysis

chemical analysis representative of a heat as reported by the metal producer

[SOURCE: ISO 11960:2014, definition 4.1.18]

3.1.17

imperfection

discontinuity in the product wall or on the product surface that can be detected by an NDE method included in this document

[SOURCE: ISO 11960:2014, definition 4.1.19, modified]

3.1.18

indication

evidence of a discontinuity that requires interpretation to determine its significance

3.1.19

inspection

process of measuring, examining, testing, gauging or otherwise comparing the product with the applicable requirements

3.1.20

label 1

dimensionless designation for the drill-pipe-body size that may be used when ordering

3.1.21

label 2

dimensionless designation for the drill-pipe-body mass per unit length that may be used when ordering

3.1.22

linear imperfection

imperfection that includes, but is not limited to, seams, laps, cracks, plug scores, cuts, gouges and elephant hide

Note 1 to entry: See API 5T1.

[SOURCE: ISO 11960:2004, definition 4.1.28, modified]

3.1.23

lot

definite quantity of product manufactured under conditions that are considered uniform for the attribute being inspected

3.1.24

lot size

number of units in a lot

3.1.25

manufacturer

maker of drill-pipe, drill-pipe body or tool joints

Note 1 to entry: The manufacturer can be the maker of one or more of the specified components, depending on context.

3.1.26

mean hardness number

result of averaging the hardness numbers for the single specimen or location being evaluated

3.1.27

non-essential variable

variable parameter in which a change may be made in the WPS without re-qualification

3.1.28

non-linear imperfection

imperfection that includes, but is not limited to, pits

Note 1 to entry: See API Std 5T1.

3.1.29

pipe body

seamless pipe excluding upset and upset-affected areas

Note 1 to entry: See [Figure B.1](#).

3.1.30

procedure qualification record

PQR

written documentation stating an assessment that a specific WPS produces welds in accordance with the requirements of this document.

3.1.31

product

drill-pipe, drill-pipe body or tool joint

3.1.32

purchaser

party responsible for both the definition of requirements for a product order and for payment for that order

[SOURCE: ISO 11960:2014, definition 4.1.39]

3.1.33

quench crack

crack in steel resulting from stresses produced during the transformation from austenite to martensite

Note 1 to entry: This transformation is accompanied by an increase in volume.

[SOURCE: ISO 11960:2014, definition 4.1.40]

3.1.34

rotary shouldered connection

connection used on drill string elements which has tapered threads and sealing shoulders

3.1.35

rotary friction welding

solid state welding under compressive-force contact of work-pieces rotating relative to one another along a common axis to increase temperature and plastically displace material from the faying surfaces

Note 1 to entry: Either direct drive or inertia friction welding is acceptable.

3.1.36

sample

one or more units of product selected from a lot to represent that lot

3.1.37

seamless pipe

wrought steel tubular product made without a weld seam

Note 1 to entry: It is manufactured by hot working and, if necessary, by subsequently cold-working or heat-treating, or a combination of these operations, to produce the desired shape, dimensions and properties.

[SOURCE: ISO 11960:2014, definition 4.1.41, modified]

3.1.38

tool joint

forged or rolled steel component for drill-pipe designed to be welded to the drill-pipe body and having a rotary shouldered connection

3.1.39

tool-joint box

threaded connection on tool joints that has internal threads

3.1.40

tool-joint manufacturer

firm, company or corporation that operates facilities for making tool joints and is responsible for compliance with the requirements of this document applicable to the tool joint

Note 1 to entry: See [8.14](#).

3.1.41

tool-joint pin

threaded connection on tool joints that has external threads

3.1.42

upset ovality

difference between the largest and smallest diameter in a plane perpendicular to the axis of the upset

3.1.43

weld zone

zone comprising the weld line and the heat-affected areas on either side of the weld line caused by the friction welding and subsequent heat-treatment processes

3.1.44

welding machine and welding operator performance qualification

WPQ

written procedure used to demonstrate that a welding machine and welding operator combination has the capability to use the WPS to produce a weld meeting the requirements of this document

Note 1 to entry: It includes records from the qualification tests.

3.1.45 welding procedure specification WPS

written procedure that provides instructions to the welding operator for making production welds in accordance with the requirements of this document

Note 1 to entry: It includes all essential variables and non-essential variables for friction welding of tool joints to drill-pipe body. A WPS applies to all those welds, of which each element has the same specified dimensions and chemistry, that are grouped according to a documented procedure that ensures a predictable response to weld-zone treatment for a particular grade.

3.2 Symbols and abbreviated terms

A_{dp}	cross-sectional area of the drill-pipe body based on the specified dimensions of the pipe body
A	cross-sectional area of the tensile specimen, expressed in square millimetres (square inches)
A	length of reduced section, expressed in millimetres
A_w	minimum cross-sectional area of the weld zone
D	tool-joint outside diameter (pin and box)
C_m	standard Charpy impact energy, expressed in Joules
C	standard Charpy impact energy, expressed in foot-pounds
D_{dp}	pipe-body outside diameter
D_f	bevel diameter (pin and box)
D_j	external diameter on the tool-joint neck, which becomes D_{te} after welding and final machining
D	diameter of round bar
D_{te}	outside diameter of the drill-pipe weld after machining
D_{0u}	drill-pipe-body upset outside diameter
d_{dp}	pipe-body inside diameter
d_j	internal diameter of the tool-joint neck, which becomes d_{te} after welding and final machining
d_p	tool-joint-pin inside diameter
d_{te}	inside diameter of the drill-pipe weld after machining
d_{0u}	drill-pipe-body upset inside diameter
EU	external upset
e	minimum extension in a gauge length of 50,8 mm (2.0 in)
e_m	minimum elongation
e_w	drill-pipe-body mass gain or loss due to end finishing. For plain-end non-upset pipe, e_w equals zero

G	gauge length
ID	inside diameter
IEU	internal-external upset
IU	internal upset
L	length of drill-pipe with weld-on tool joint (from shoulder to shoulder)
L_b	length of box-tool joint outside diameter including connection bevel and hard band; see Figures B.1 and B.12
L_{eu}	drill-pipe-body external upset length
L_{iu}	drill-pipe-body internal upset length
L_{pb}	length of pin-tool-joint outside diameter, including connection bevel; see Figures B.1 and B.12
L_{pe}	length of drill-pipe body (without tool joint)
m_{eu}	drill-pipe-body external upset taper length
m_{iu}	drill-pipe-body internal upset taper length
N	fraction or number with a fraction
NDE	non-destructive examination
OD	outside diameter
PQR	procedure qualification record
PSL	product specification level
R	minimum radius of fillet
RSC	rotary shouldered connection
SSC	Sulfide Stress Cracking
T_S	tensile strength
t	pipe-body wall thickness
U	upset dimension
U_{dp}	minimum specified tensile strength
UT	ultrasonic testing
W	width
W_L	approximate calculated mass of a piece of drill-pipe body of length L_{pe}
WPQ	welder performance qualification
WPS	welding procedure specification
w_{dp}	approximate linear mass of the drill-pipe

w_{pe}	plain-end pipe-body unit mass (without upsets)
Y_{min}	specified minimum yield strength, see Table A.5 or Table C.5
Y_w	weld zone yield strength

4 Conformance

4.1 Dual citing of normative references

In the interests of world-wide application of this document, Technical Committee ISO/TC 67 has decided, after detailed technical analysis, that some of the normative documents listed in [Clause 2](#) and prepared by ISO/TC 67 or another ISO Technical Committee are interchangeable in the context of the relevant requirement with the relevant document prepared by the American Petroleum Institute (API), the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI). These latter documents are cited in the running text following the ISO reference and preceded by “or”, for example “ISO XXXX or API YYYY”. Application of an alternative normative document cited in this manner will lead to technical results different from the use of the preceding ISO reference. However, both results are acceptable and these documents are thus considered interchangeable in practice.

4.2 Units of measurement

In this document, data are expressed in both the International System (SI) of units and the United States Customary (USC) system of units. Separate tables for data expressed in SI units and USC units are in [Annex A](#) and [Annex C](#), respectively. Figures are in [Annex B](#) and express data in both SI and USC units. For a specific order item, it is intended that only one system of units be used, without combining data expressed in the other system.

Products manufactured to specifications expressed in either of these unit systems shall be considered equivalent and totally interchangeable. Consequently, compliance with the requirements of this document as expressed in one system provides compliance with requirements expressed in the other system.

For data expressed in the SI system, a comma is used as the decimal separator and a space as the thousands separator. For data expressed in the USC system, a dot (on the line) is used as the decimal separator and a space as the thousands separator.

In the text, data in SI units are followed by data in USC units in brackets.

NOTE The procedures used to convert from USC units to SI units are given in [Annex F](#).

5 Information to be supplied when placing orders for drill-pipe

5.1 Grades D95 and F105

Particular attention should be given to the application of Grades D95 and F105 in [ISO 15156-2](#) or ANSI- NACE MR0175/SSC Regions 1, 2 or 3, as this material is not suitable for all sour (hydrogen sulfide-containing) service applications.

Given the high strength often needed, drilling equipment may not comply with the requirements of the ISO 15156-2/ANSI-NACE MR0175. In such cases the primary means for avoiding SSC is control of the drilling or well-servicing environment. As service stresses and material hardness increase, drilling fluid control becomes increasingly important. The following precautions are suggested:

- maintain fluid density and integrity of hydrostatic column to minimize inflow of formation fluid;

- consider one or more of the following procedures:
 - maintain pH of water phase at 10 or higher to neutralize H₂S in the drilled formation and alkalinity of 1 or higher to maintain the pH;
 - use chemical sulfide scavengers
 - use a drilling fluid in which oil is the continuous phase.

NOTE The SSC test is for quality control purposes only and does not qualify the material for any specific sour service application. It is the product user's responsibility to ensure that the product is suitable for the intended application.

5.2 General information

When placing orders for drill-pipe to be manufactured in accordance with this document, the purchaser shall specify the following on the purchase agreement.

Requirements	Reference
Document number(s)	ISO 11961
Quantity	
Label 1	Table A.1 or Table C.1
Label 2	Table A.1 or Table C.1
Grade	Table A.1 or Table C.1
Upset type (internal, external or internal-external upset)	Table A.1 or Table C.1
RSC type or other special connection by agreement between purchaser and manufacturer	Table A.1 or Table C.1 , or 6.2.2
Range or special length and tolerance by agreement between purchaser and manufacturer	Table A.3 or Table C.3
Delivery date and shipping instructions	
Inspection by purchaser	Annex D
Documentation	6.17

5.3 Additional information

The purchaser shall also specify in the purchase agreement his requirements concerning the following stipulations, which are optional with the purchaser.

Requirements	Reference
Tool-joint outside diameter	6.2.2
Tool-joint inside diameter of the pin end	6.2.2
Length of pin-tool-joint outside diameter	6.2.6
Length of box-tool-joint outside diameter	6.2.6
Under-thickness tolerance if less than 12,5 %	7.2.6

Type of heat treatment for drill-pipe body: grade E only	7.4.3
SSC test method and solution for grades D and F	6.3.7
Hard banding: type, location, dimensions and acceptance criteria	8.4.7
NOTE Hard banding reduces the length of the tool-joint outside diameter available for tong placement.	
Pipe coatings: internal and/or external	6.4.5 , 6.4.6 and 7.4.4
Special threads on tool joints	8.2.5
Specific thread or storage compound	6.4.7
Thread-protector type	6.4.7 and 8.4.8
Marking requirements	6.15 , 7.20 and 8.13
Individual drill-pipe traceability	6.5

Supplementary requirements

Non-destructive examination for grades E, X, G, D and F	Clause E.2 , SR2
Test certificates	Clause E.3 , SR15
Charpy V-notch (CVN) impact toughness testing of grade E pipe body	Clause E.4 , SR19
Alternative low-temperature Charpy V-notch impact testing	Clause E.5 , SR20
Weld-zone testing frequency	Clause E.6 , SR23
Charpy V-notch: increased weld-zone requirements	Clause E.7 , SR24
For PSL-2 or PSL-3	Annex G

6 Requirements for drill-pipe

6.1 General

The drill-pipe shall be made from drill-pipe body manufactured in accordance with [Clause 7](#) and tool joints manufactured in accordance with [Clause 8](#). Areas of the drill-pipe body and tool joint affected by the welding and finishing processes are addressed in [Clause 6](#).

6.2 Dimensions, masses and connections

6.2.1 Standard configuration

The configuration of drill-pipe shall correspond to [Figure B.1](#). Drill-pipe shall be furnished with dimensions and tolerances as in [Tables A.1](#) and [A.2](#) or [Tables C.1](#) and [C.2](#) and/or in the purchase agreement. All dimensions shown without tolerances are related to the basis for design and are not subject to measurement to determine acceptance or rejection of product. Drill-pipe dimensions that are not in this document or in the purchase agreement are at the manufacturer's discretion.

Rotary shouldered connections shall conform to the dimensions, together with the tolerances, in [ISO 10424-2](#) or API Spec 7-2. Right-hand thread connections shall be considered standard.

6.2.2 Alternative configurations

When specified in the purchase agreement, drill-pipe shall be furnished in dimensional configurations not defined in this document. In this case, dimensions, tolerances and markings shall be agreed between the purchaser and manufacturer. The drill-pipe body and tool joint shall be modified in accordance with this agreement but the drill-pipe shall otherwise be manufactured in accordance with the requirements of this document.

The outside diameter of the box tool joint, D , and inside diameter of the pin tool joint, d_p , dimensions in [Table A.1](#) or [Table C.1](#), result in a drill-pipe torsion-strength ratio 0,8 or greater. Changes in the OD and ID of the tool joints can result in a lower drill-pipe torsion-strength ratio, which should be determined by the purchaser to be suitable for the intended application.

6.2.3 Drill-pipe weld neck diameters

The drill-pipe weld diameters, D_{te} and d_{te} , as shown in [Figure B.1](#), apply to the finished product after the tool joint is welded to the drill-pipe body and machined and/or ground. The outside diameter, D_{te} , shall meet the requirements of [Table A.1](#) or [Table C.1](#), and [6.3.2](#). The inside diameter, d_{te} , shall meet the requirements of [6.3.2](#) and may be different on the pin and box weld zones.

6.2.4 Tool-joint inside diameters

The tool-joint-pin inside diameter, d_p , shall meet the requirements in [Table A.1](#) or [Table C.1](#). The tool-joint-box inside diameter is at the manufacturer's discretion but shall not be less than the tool-joint-pin internal diameter, d_p .

6.2.5 Length

Drill-pipe shall be furnished in length ranges conforming to [Table A.3](#) or [Table C.3](#) or other lengths and tolerances as specified in the purchase agreement.

The drill-pipe manufacturer shall specify the lengths and tolerances of the drill-pipe body and tool joints such that the required length of each drill-pipe is achieved.

6.2.6 Length of tool-joint outside diameter

The length of pin-tool-joint outside diameter, L_{pb} , and the length of box-tool-joint outside diameter, L_b , in [Table A.1](#) or [Table C.1](#), may be increased by agreement between purchaser and manufacturer.

6.2.7 End-drift

Each drill-pipe shall be end-drift tested throughout the length of the tool joints and upsets with a cylindrical mandrel having a minimum diameter of 3,2 mm (0.125 in) smaller than the specified inside diameter of the pin end, d_p . The drift mandrel shall be at least 100 mm (4 in) long.

NOTE Drift testing of the full length of the drill-pipe is not required.

6.2.8 Drill-pipe body and tool-joint alignment

The maximum misalignment between the longitudinal axis of the drill-pipe body and the longitudinal axis of the welded-on tool joint shall not exceed the following:

- for parallel misalignment: 4 mm (0,157 in) total indicator reading;
- for angular misalignment: 8 mm/m (0,008 in/in) for label 1: 4-1/2 and larger;
10 mm/m (0,010 in/in) for smaller than label 1: 4-1/2.

The axis of the tool joint shall be determined on the surface of the outside diameter, D , that is unaffected by markings or hard banding. The axis of the drill-pipe body shall be determined over a minimum length of 400 mm (15 in) on the outside surface of the pipe body.

6.2.9 Weld-zone profile

The weld zone shall have no sharp corners or drastic changes of section. The internal weld-zone profile shall not cause a 90° hook-type tool to hang up.

6.3 Material requirements

6.3.1 General

The material properties of the drill-pipe body and the tool joint shall be as in [Tables A.4](#) to [A.8](#) or [Tables C.4](#) to [C.8](#) inclusive.

6.3.2 Weld-zone yield strength

The yield load of the weld zone in tension shall be greater than the yield load of the drill-pipe body as given by [Formula \(1\)](#):

$$(Y_w \times A_w) > (Y_{\min} \times A_{dp}) \quad (1)$$

where

- A_{dp} is the cross-sectional area of the drill-pipe body based on the specified dimensions of the pipe body;
- A_w is the minimum cross-sectional area of the weld zone;
- $Y_{\min}$ is the specified minimum yield strength of the drill-pipe body;
- Y_w is the weld zone minimum yield strength (determined by the manufacturer based on the design).

The method for calculating the minimum cross-sectional area, A_w , of the weld zone shall be as given in [Formula \(2\)](#):

$$A_w = 0,7854 \times (D_{te,\min}^2 - d_{te,\max}^2) \quad (2)$$

where

- $d_{te,\max}$ is the maximum allowable inside diameter specified by the drill-pipe manufacturer;
- $D_{te,\min}$ is the minimum allowable outside diameter specified by the drill-pipe manufacturer.

6.3.3 Weld-zone hardness

6.3.3.1 Grades E, X, G and S

For surface hardness, no hardness number shall exceed 37.0 HRC or equivalent.

For the through-wall hardness test, the mean hardness number of the weld zone shall not exceed 37.0 HRC.

6.3.3.2 Grades D and F

For surface and through-wall hardness, no hardness number shall exceed 30.0 HRC (maximum average), and 32.0 HRC maximum single.

6.3.4 Weld-zone Charpy V-notch absorbed-energy requirements

The minimum absorbed energy requirements shall be as in [Table A.8](#) or [Table C.8](#). In addition, not more than one impact specimen shall exhibit an absorbed energy below the minimum average absorbed-energy requirement, and in no case shall an individual impact specimen exhibit an absorbed energy below the minimum specimen absorbed-energy requirement.

Additional requirements for PSL-3 are in [Annex G](#).

6.3.5 Weld-zone Charpy V-notch absorbed energy — Alternative requirements

When specified in the purchase agreement, the absorbed energy shall meet the SR20 and/or the SR24 requirements in [Clause E.5](#) and/or [Clause E.7](#) respectively (see also [Table A.8](#) or [Table C.8](#)).

6.3.6 Weld-zone transverse side bend properties

The guided-bend specimens shall have no open discontinuity in the weld zone exceeding 3 mm (0,125 in) measured in any direction on the convex surface of the specimen after bending. Open discontinuities occurring on the corner of the specimen during testing shall not be considered unless there is definite evidence that they result from lack of fusion, inclusions or other internal discontinuities.

6.3.7 Sulfide stress cracking test — Grades D and F

6.3.7.1 85 % SMYS all parts (default)

All parts (pipe body, tool joint and weld zone) shall have a demonstrated minimum threshold of 85% of the specified minimum yield strength for 720 hours as per NACE TM0177 (latest revision), Method A using Test solution D.

Testing frequency shall be one specimen per heat, per heat treat lot, or every 200 tubes, whichever is the more frequent. If any heat has a failed specimen, two additional specimens from the same heat, heat treat lot are required as a retest. If either fail, the heat is unacceptable.

The SMYS of the weld zone is defined by calculation as described in [section 6.3.2](#).

An additional test shall be performed each time welding parameters change beyond the approved WPS/PQR.

6.3.7.2 Alternative testing (by agreement between purchaser and manufacturer)

The drill pipe tube shall have a demonstrated minimum threshold of 85 % of the specified minimum yield strength for 720 hours per NACE TM0177 (latest revision), Method A using Test solution A. Testing frequency shall be one specimen per heat, per heat treat lot, or every 200 tubes, whichever is the more frequent. If any heat has a failed specimen, two additional specimens from the same heat, heat treat lot are required as a retest. If either fail, the heat is unacceptable.

The drill pipe tool joint shall have a demonstrated minimum threshold of 65 % of the specified minimum yield strength for 720 hours per NACE TM0177 (latest revision), Method A using Test solution A. Testing frequency shall be one set per heat, per heat treat lot or every 200 tool joint box/pin set, whichever is the more frequent. To be acceptable, any heat, heat treat lot with a failed specimen requires two additional specimens with no failures.

The drill pipe weld zone shall have a demonstrated minimum threshold of 60 % of its calculated minimum yield strength (as per section [6.3.2](#)), for 720 hours per NACE TM0177 (latest revision), Method A using Test solution A. Testing frequency shall be every 200 drill pipe welded. If any heat has a failed specimen, two additional specimens from the same lot are required as a retest. If either fail, the heat is unacceptable. An additional test shall be performed each time the welding parameters are changed.

6.4 Process of manufacture for drill-pipe

6.4.1 Processes requiring validation

Final operations performed during drill-pipe manufacturing that affect compliance as required in this document (except chemical composition and dimensions) shall have their process validated.

Those processes requiring validation are welding and weld heat treatment.

6.4.2 Welding qualification

The manufacturer shall develop, qualify and use a welding procedure, including post-weld heat treatment (WPS and PQR), in accordance with the ASME Boiler and Pressure Vessel Code, Section IX. The procedure shall identify the essential variables and non-essential variables and address the permissible number of re-heat treatments.

The PQR shall include, as a minimum, the data of the specific variables (both essential and non-essential) used to weld a tool joint to a drill-pipe body and the results of all mechanical tests to verify the properties in [6.3](#) carried out on specimens taken from the test weld.

In addition, the manufacturer shall undertake macrostructural examination of the weld to verify that the weld exhibits complete bonding and freedom from cracks.

The manufacturer shall qualify the welding machines and welding operators to a specific WPQ for each WPS utilized by the operators.

6.4.3 Welding of tool joints to drill-pipe body and post-weld heat treatment

The welding of the tool joint to the drill-pipe body shall be by the rotary friction welding process.

A post-weld heat treatment shall be performed through the entire thickness and from the weld line to beyond where the flow lines of the tool joint and drill-pipe body material change direction as a result of the welding process. The weld shall be austenitized, cooled below the transformation temperature and tempered at a minimum temperature of 593 °C (1 100 °F).

6.4.4 Weld machining

The weld area shall be machined and/or ground, both externally and internally, to produce a flush surface (visually free from gouges or abrupt changes in section).

Tool marks from normal machining operations shall be acceptable.

6.4.5 Internal coating

When specified in the purchase agreement, drill-pipe shall be internally coated over the full length, except the thread. The type of coating shall be specified in the purchase agreement and the application and inspection shall be carried out in accordance with an agreed documented procedure.

6.4.6 External coating

Unless otherwise specified in the purchase agreement, the drill-pipe shall be given an external coating for protection from corrosion during transit. The coating shall be rated to protect the drill-pipe for at least three months and it should be smooth, hard to the touch and with minimum sags.

6.4.7 Thread protection

Threads and shoulders of rotary shouldered connections shall be equipped with thread protectors to protect them from damage during transportation and storage. Unless otherwise specified in the purchase agreement, the type of thread protector is at the manufacturer's discretion.

A thread compound, suitable for rotary shouldered connections, shall be applied over the clean threads and shoulders before protectors are installed. Unless otherwise specified in the purchase agreement, the type of thread compound is at the manufacturer's discretion.

When specified in the purchase agreement, a storage compound shall be applied instead of the thread compound.

6.5 Traceability

The drill-pipe manufacturer shall establish and follow procedures for maintaining traceability to any applicable supplementary requirement and/or PSL requirement, as well as to drill-pipe-body heat and tool-joint heat as in [Clauses 7](#) and [8](#), respectively.

Lot identity of all welds shall be maintained until all required tests are performed and conformance with specified requirements has been documented. The procedures shall provide means for tracing the welds to the lot and to mechanical and inspection test results.

When additional traceability is required, the details shall be agreed and be specified in the purchase agreement.

6.6 Testing — General

6.6.1 Test equipment calibration

The manufacturer shall determine and document the appropriate calibration frequency and procedures (including occurrences of out-of-calibration and the consequences on products) in order to know whether all products conform to the requirements of this document.

6.6.2 Dimensional inspection

The drill-pipe weld diameters, D_{te} and d_{te} , shall be verified, after final machining and/or grinding according to a documented procedure, to meet the requirements of [6.2.3](#).

6.6.3 Drill-pipe length

The drill-pipe length, L , (see [Figure B.1](#)) shall be measured from shoulder to shoulder unless otherwise specified in the purchase agreement. This length shall be recorded and reported to the purchaser. The accuracy of length-measuring devices shall be $\pm 0,03$ m (± 0.1 ft). Drill-pipe length determination shall be in metres and hundredths of a metre (feet and tenths of a foot).

6.6.4 Straightness

All drill-pipe shall be visually examined for straightness. The straightness of questionably bent pipes or crooked extremities shall be measured in accordance with [7.14](#).

6.6.5 End-drift test

End-drift testing shall be performed with a drift mandrel conforming to the requirements of [6.2.7](#). It is permissible for the ends of the drift mandrel, extending beyond the specified cylindrical portion, to be shaped to permit easy entry into the drill-pipe. The drift mandrel shall pass freely through the length of the drill-pipe tool joint and upset by the use of a manual or power drift procedure. In case of dispute, the manual drift procedure shall be used.

6.6.6 Internal profile

Each end of every drill-pipe shall be visually examined for compliance with the requirements of [6.2.9](#). Questionable ends shall be examined using the following method.

The weld-zone configuration inspection shall be made with a 90° hook-type tool (see [Figure B.2](#)). The contact pin shall be visually determined to be attached perpendicular to the handle. The contact-point radius shall not exceed the inside radius of the weld zone being inspected. Sharp edges on the contact point shall be removed (see contact point on [Figure B.2](#)). The 90° hook-type-tool contact point should be maintained perpendicular to the longitudinal axis of the weld zone while the contact point is passed axially throughout the weld-zone length. Pressure on the contact point shall be no greater than the pressure created by the weight of the 90° hook-type tool.

6.6.7 Drill-pipe body and tool-joint alignment

Drill-pipe body and tool-joint alignment shall conform to the requirements in [6.2.8](#) and shall be verified according to a documented procedure.

6.7 Testing of welds

6.7.1 Lot size

A lot shall consist of all those welds that are produced in a single production run (either continuous or interrupted) on the same welding machine (without any modification of the set-up parameters) using the same qualified procedures (WPS and WPQ).

6.7.2 Test specimens

All initial test specimens for the weld zone, where size allows, shall be taken from the same sample.

6.8 Tensile test

6.8.1 Procedures

The tensile test shall be performed at room temperature in accordance with ISO 6892 or ASTM A370.

Tests may be carried out on semi-finished products, that is, before final machining operations but after final heat treatment.

The fracture shall not occur at the weld line.

6.8.2 Test equipment calibration

Tensile test machines shall have been calibrated within a period of 15 months preceding any test, in accordance with the procedures in [ISO 7500-1](#) or ASTM E4. Extensometers shall have been calibrated within a period of 15 months preceding any test, in accordance with the procedures in [ISO 9513](#) or ASTM E83. Retention of records shall be in accordance with [6.17.4](#) and [Table A.9](#) or [Table C.9](#).

6.8.3 Specimens

A longitudinal section of sufficient length to include the entire weld zone shall be suitably prepared and etched to determine the location of the weld zone relative to the weld line and transverse grain flow. This etched section shall be used to ensure that the tensile specimen includes the full weld zone within the reduced section as shown in [Figure B.3](#).

The largest possible round-bar tensile specimens, in accordance with the requirements of ISO 6892 or ASTM A370, 0,2 % offset method, shall be taken from the longitudinal section location as shown in [Figure B.3](#). Specimens with a diameter of 12,7 mm (0.500 in) are preferred. Specimens with a diameter of 8,9 mm (0.350 in) or 6,4 mm (0.250 in) are suitable alternatives for thin sections.

6.8.4 Frequency

The tensile-test frequency for the weld shall be as in [Table A.10](#) or [Table C.10](#).

Additional requirements for PSL-2 and PSL-3 are in [Annex G](#).

For an alternative test frequency, see [Clause E.6](#), SR23.

6.8.5 Defective specimen

Specimens showing material imperfections or defective preparation, whether observed before or after testing, may be discarded, and replacements shall be considered as original specimens.

6.8.6 Re-tests

If the initial tensile test fails to conform to the specified requirements, the manufacturer may elect to test two additional specimens from the same weld. If both of the additional specimens pass, the lot shall be accepted.

If one or more of the additional specimens fail to conform to the requirements, the lot shall be rejected. Rejected lots may be re-heat-treated and tested as new lots.

If insufficient material remains for the re-test specimens to be obtained from the original sample, then it is permitted to obtain specimens from another weld within the same lot.

6.9 Hardness test

6.9.1 Procedures

Hardness tests shall be made in accordance with the appropriate standards as follows:

- [ISO 6506-1](#) or ASTM E10;
- [ISO 6507-1](#) or ASTM E92;
- [ISO 6508-1](#) or ASTM E18.

Hardness indentations shall not be closer than three indentation diameters from other indentations measured centre-to-centre.

6.9.2 Surface hardness test

Each weld zone shall be hardness tested on the outside surface at three places, $120^\circ \pm 15^\circ$ apart. Selection of the hardness testing method is at the manufacturer's discretion, including the use of an alternative test method. In such a case, the manufacturer shall demonstrate the equivalence of the test result to those of one of the standards mentioned in [6.9.1](#).

6.9.3 Surface hardness — Re-test

All welds with a hardness number that exceeds the maximum single value listed in [6.3.3](#) shall be re-tested or rejected. For any hardness number that exceeds the maximum single value, two more hardness tests shall be made in the immediate area. If both of the new hardness numbers do not exceed the maximum single value, the weld shall be accepted. If either of the new hardness number exceeds the maximum single value, the weld shall be rejected. The manufacturer may elect to re-heat-treat the weld in accordance with the same qualified procedure and perform the surface hardness test again.

6.9.4 Through-wall hardness test

The through-wall hardness test frequency of the weld zone shall be as in [Table A.10](#) or [Table C.10](#).

A Rockwell mean hardness number is the average of three Rockwell C-scale numbers taken at 2,5 mm to 6,4 mm (0.10 in to 0.25 in) from the outside surface and from the inside surface on the

pipe and tool-joint sides of the weld line (that is 12 hardness numbers and 4 Rockwell mean hardness numbers on each weld, as shown in [Figure B.3](#)).

6.9.5 Through-wall hardness — Re-tests

All weld test pieces with a mean hardness number or single value that exceeds the maximum value listed in [section 6.3.3](#) shall be re-tested or the lot represented by the test shall be rejected. Before re-testing, the test surface may be re-ground.

For any single hardness number that exceeds the maximum single value, one more hardness test shall be made in the immediate area.

If the re-test mean and single hardness numbers do not exceed the maximum value, the lot shall be accepted. If any re-test mean or single hardness number exceeds the maximum value, the lot of welds represented by the test piece shall be rejected. Rejected lots may be re-heat-treated and tested as new lots.

6.10 Charpy V-notch impact test

6.10.1 Procedures

A test shall consist of a set of three longitudinal specimens taken from one weld. Charpy V-notch impact tests as in ASTM A370 and ASTM E23 shall be conducted at a temperature of $21\text{ °C} \pm 3\text{ °C}$ ($70\text{ °F} \pm 5\text{ °F}$). For alternative standardized test temperatures, see [Clause E.5](#), SR20, and PSL-3 in [Table A.8](#) or [Table C.8](#).

Tests conducted at any temperature lower than the specified temperature are acceptable provided the absorbed-energy requirements at the specified temperature are achieved.

Additional requirements for PSL-2 and PSL-3 are in [Annex G](#).

6.10.2 Specimen size and orientation

The impact test specimen shall not be smaller than the largest size shown in [Table A.11](#) or [Table C.11](#) based on the specified drill-pipe weld neck diameter (and rounded to the next smaller specified outside diameter if required) and the calculated weld neck thickness (based on specified dimensions).

Specimens shall be removed from the weld longitudinally with respect to the axis of the pipe with the notch oriented in a radial direction as shown in [Figure B.3](#). The centre of the notch in the specimen shall be located on the weld line.

6.10.3 Test frequency

The impact test frequency for the weld shall be as in [Table A.10](#) or [Table C.10](#).

Additional requirements for PSL-2 and PSL-3 are in [Annex G](#).

For an alternative test frequency, see [Clause E.6](#), SR23.

6.10.4 Re-tests

If the requirements of [6.3.4](#) are not met and not more than one specimen is below the minimum specimen absorbed-energy requirement, the manufacturer may elect either to reject the lot or to re-test a set of three additional specimens from the same weld test piece. For all three of these specimens, the absorbed energy shall be equal to or greater than the minimum average absorbed energy in [Table A.8](#) or [Table C.8](#) or the lot shall be rejected. If insufficient material remains for the re-test specimens to be obtained from the original sample, then it is permitted to obtain specimens from another weld from the same lot.

If more than one specimen in the initial test is below the minimum specimen absorbed-energy requirement, then the manufacturer may elect either to reject the lot or to re-test an additional set of three specimens from each of three additional welds from the same lot. If these additional sets of specimens do not meet the initial test requirements, then the lot shall be rejected.

Rejected lots may be re-heat-treated and tested as new lots.

6.10.5 Defective specimens

Specimens showing material imperfections or defective preparation, whether observed before or after testing, may be discarded, and replacements shall be considered as original specimens. Specimens shall not be judged defective simply because they fail to exhibit the minimum absorbed energy requirements.

6.11 Transverse side-bend test

6.11.1 Procedure

The guided bend test shall be carried out in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, paragraphs QW-161.1 and QW-162.1. The specimen shall be bent until the two branches of the specimen form an angle of not greater than 40° under load, as shown in [Figure B.3](#). The weld zone shall be completely within the bend portion of the specimen after bending. A test shall consist of one specimen bent in the clockwise direction and another specimen bent in the counter-clockwise direction relative to the pipe axis.

6.11.2 Specimens

One set of two specimens shall be removed from the weld zone of the test piece. The weld zone shall be in the centre of longitudinal specimens. The test specimens shall be of full wall thickness, approximately 9,5 mm ($3/8$ in) wide, and the length shall be 150 mm (6 in) minimum.

6.11.3 Test frequency

The transverse side-bend test frequency shall be as in [Table A.10](#) or [Table C.10](#).

For an alternative test frequency, see [Clause E.6](#), SR23.

6.11.4 Re-tests

If only one of the guided-bend specimens fail to conform to the specified requirements, the manufacturer may elect to reject the lot or to test an additional set of two specimens from the same weld test piece. If both of the re-test specimens meet the specified requirements, the lot shall be accepted. If one or both of the re-test specimens fail to meet the specified requirements, the lot shall be rejected.

It is preferred that re-test specimens be obtained from the same sample as the original test specimen(s). However, if the re-test specimens cannot be obtained from the original sample, it is permissible to obtain specimens from another weld within the same lot.

Rejected lots may be re-heat-treated and tested as a new lot.

6.12 Imperfections and defects in drill-pipe

6.12.1 General

Drill-pipe shall be free from defects as defined in this document.

6.12.2 Weld zone defects

Any weld-zone imperfection detected by visual inspection, as in [6.13](#), or wet fluorescent magnetic-particle inspection, as in [6.14.2](#), shall be considered to be a defect.

Any imperfection detected by ultrasonic inspection that produces a signal equal to or greater than the signal produced by the reference standard described in [6.14.4](#) shall be considered a defect.

Quench cracks shall be considered defects and shall be cause for rejection of the product.

6.12.3 Process control plan

The manufacturer, based on knowledge of the production process and the requirements of [6.13](#) and [6.14](#), shall apply a process control plan that ensures compliance with the requirements of [6.12.2](#).

6.13 Visual inspection of the drill-pipe weld zone

6.13.1 General

Each weld zone shall be visually inspected over the entire outside surface for the detection of defects.

This inspection shall be carried out by trained personnel. Visual acuity requirements shall be documented by the manufacturer. Personnel compliance with these requirements shall be documented.

NOTE Examples of visual acuity requirements are in [ISO 11484](#) or ASNT SNT-TC-1A.

Documented lighting standards for visual inspection shall be established by the manufacturer. The minimum illumination level at the inspection surface shall be 500 lux (50 foot-candles).

The visual inspection for defects may be at any appropriate point in the manufacturing process after machining.

6.13.2 Disposition of defects

Defects shall be completely removed by grinding or machining. All grinding shall be blended smooth. The dimensions after grinding shall comply with the requirements of [6.2](#).

6.14 Non-destructive examination of the weld zone

6.14.1 General

All NDE operations (except visual inspection) referred to in this document shall be conducted by NDE personnel qualified in accordance with [ISO 11484](#) or ASNT SNT-TC-1A.

Surfaces to be inspected shall be machined and/or ground before inspection.

When specified in the purchase agreement, the provisions for purchaser inspection of the weld zone and/or witnessing of NDE operations shall be in accordance with [Annex D](#).

The inspections performed in accordance with [6.14](#), with the equipment calibrated to the specified reference indicators, should not be construed as assuring that the material requirements in [6.12](#) have been met.

The manufacturer shall determine the appropriate NDE equipment verification frequency in order to know whether all products conform to the requirements of this document.

6.14.2 Wet fluorescent magnetic-particle inspection

The entire outside surface of the weld zone shall be wet-fluorescent-magnetic-particle inspected for the detection of transverse imperfections in accordance with [ISO 10893-5](#) or ASTM E709.

concentration shall be checked every 8 h or each shift change. The minimum black-light intensity at the examination surface shall not be less than 1 000 $\mu\text{W}/\text{cm}^2$.

6.14.3 Ultrasonic inspection — Procedure

Each weld zone shall be ultrasonically inspected from the pipe side around the circumference with the beam directed toward the weld. Shear wave/angle beam ultrasonic equipment capable of inspection of the entire weld zone shall be used. The inspection shall be applied in accordance with the manufacturer's documented procedure. The instrument gain setting during inspection shall not be set lower than the gain setting when checked against the reference standard. In case of dispute, the transducer used shall generate a square 2,25 MHz frequency attached to a $45^\circ \pm 5^\circ$ Lucite¹⁾ wedge (the angle refers to the entry angle in the material).

6.14.4 Ultrasonic inspection — Reference standard

A reference standard shall be used to demonstrate the effectiveness of the inspection equipment and procedures at least once every working shift. The equipment shall be adjusted to produce a well defined indication when the reference standard is scanned in a manner simulating the inspection of the product. The reference standard shall have the same specified diameter and wall thickness and the same acoustic properties and surface finish as the weld zone being inspected and may be of any convenient length as determined by the manufacturer. The reference standard shall contain a through-drilled hole as in [Figure B.4](#).

The manufacturer shall use a documented procedure to establish the reject threshold for ultrasonic inspection. The through-drilled hole described in [Figure B.4](#) shall be detected under normal operating conditions.

6.14.5 Ultrasonic inspection — System capability records

The manufacturer shall maintain NDE system records verifying the capabilities of the system(s) in detecting the reference indicators used to establish the equipment test sensitivity.

The verification shall cover, as a minimum, the following criteria:

- a) coverage calculation (i.e. scan plan);
- b) capability for the intended wall thickness;
- c) repeatability;
- d) transducer orientation that provides detection of defects typical of the manufacturing process (see [6.14.3](#));
- e) documentation demonstrating that defects typical of the manufacturing process are detected;
- f) threshold-setting parameters;

In addition, the manufacturer shall maintain documentation relating to:

- NDE system operating procedures;
- NDE equipment description;
- NDE personnel qualification information;
- dynamic test data demonstrating the NDE system/operation capabilities under production test conditions (not applicable to manual operations).

1) Lucite is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

6.14.6 Disposition of defects

Defects detected by either wet fluorescent magnetic-particle inspection or ultrasonic inspection shall be completely removed by grinding or machining, or the weld shall be rejected. All grinding shall be blended smooth. The dimensions after grinding shall comply with the requirements of [6.2](#). The weld zone shall be re-inspected after grinding using the same inspection method originally used to detect the defect in order to verify complete removal of the defect.

6.15 Marking of drill-pipe

6.15.1 General

Drill-pipe manufactured in conformance with this document shall be marked by the drill-pipe manufacturer as in [6.15](#). Additional markings may be applied, including those for applicable compatible standards, at the discretion of the manufacturer or as specified in the purchase agreement. Markings shall not overlap and shall be applied in such a manner as to not damage the drill-pipe.

The drill-pipe final marking shall be the responsibility of the drill-pipe manufacturer and shall include traceability (see [6.5](#)).

6.15.2 Drill-pipe marking

The final marking of the drill-pipe shall consist of:

- a) the traceability marking according to [6.15.3](#);
- b) marking on the drill-pipe body according to [6.15.4](#);
- c) marking on the tool joint according to [6.15.5](#).

6.15.3 Traceability marking

This marking (for traceability requirements, see [6.5](#)) shall be die stamped on the pin taper, as shown in [Figure B.1](#), unless otherwise specified in the purchase agreement.

6.15.4 Drill-pipe marking on the pipe body

Drill-pipe-body paint stencil markings shall start approximately 1 m (40 in) from the box shoulder and shall include, in the following sequence, as a minimum:

- a) drill-pipe manufacturer's name or mark;
- b) "ISO 11961";
- c) date of drill-pipe manufacture (month and year of welding).

The date of manufacture shall be a three- or four-digit number consisting of a one- or two-digit number indicating the month followed by the last two digits of the year in which the markings of [Clause 6](#) are completed. This marking may be waived at the manufacturer's discretion (it is also marked on the base of the tool-joint pin; see [Figure B.5](#)). Products manufactured in accordance with this edition of ISO 11961 during the period of overlap of application with the previous edition (see Foreword) may be identified by "00" as the overlap period designation rather than the month:

- size designation (label 1);
- mass designation (label 2);
- grade of the drill-pipe body;
- SR information applicable to the drill-pipe;

— L2 or L3 (indicating, respectively, PSL-2 or PSL-3) applicable to the drill-pipe.

EXAMPLE Paint-stencilled marking for a label 1: 2-3/8, label 2: 6.65, grade E PSL-2 drill-pipe manufactured by company ZZ in July 2007:

ZZ ISO 11961 707 2-3/8 6.65 E L2.

At the drill-pipe manufacturer's discretion or as specified in the purchase agreement, the drill-pipe-body manufacturer's marking may remain on the drill-pipe body or be obliterated by the drill-pipe manufacturer.

The paint-stencilled marking may be adversely affected when the drill-pipe is internally coated.

6.15.5 Drill-pipe marking on the tool joint

Unless otherwise specified in the purchase agreement, the tool joint shall be die stamped (the size of the die stamping shall be at the manufacturer's discretion) at the base of the pin as shown in [Figure B.5](#) and include the following:

- a) drill-pipe manufacturer's name or mark;
- b) month welded: for example, "6" designates "June";
- c) year welded: for example, "07" designates "2007";
- d) drill-pipe-body manufacturer's name or mark, at the manufacturer's discretion;
- e) drill-pipe-body grade: for example, "E" designates "grade E" pipe body;
- f) product drill-pipe-body mass code number (See [Table A.12](#) or [Table C.12](#)): for example, "2" designates a standard mass product; for designations not in [Table A.12](#) or [Table C.12](#), the mass code shall be by agreement between the purchaser and the manufacturer;
- g) tool-joint designation, at the manufacturer's discretion: for example, "NC50" designates an NC50 rotary-shouldered connection; for connections not in [Table A.1](#) or [Table C.1](#) the designation shall be as specified by the manufacturer.

Marking of the tool joint with grooves and flats shall be as specified in the purchase agreement.

Marking made by the tool-joint manufacturer on the outside surface of the tool joint may remain.

6.16 Minimum facility requirements for drill-pipe manufacturers

The drill-pipe manufacturer shall operate facilities for welding tool joints to drill-pipe body, for post-weld heat treatment and for machining the weld area.

Either the drill-pipe manufacturer shall have facilities for conducting all required tests and inspections or any of these tests or inspections may be provided by a subcontractor and may be located offsite. In the event that a subcontractor performs any of these services, the conduct of such inspections and tests shall be controlled and monitored by the drill-pipe manufacturer in accordance with a documented procedure.

6.17 Documentation requirements of drill-pipe

6.17.1 Standard documentation

The drill-pipe manufacturer shall provide the purchaser with the following:

- a) a certificate of conformance giving the product description and a statement that the drill-pipe has been manufactured, inspected and tested in accordance with, and is in conformance with, this document and the purchase agreement; product description shall include as a minimum

label 1, label 2, grade, range, RSC type and any other special requirements specified in the purchase agreement;

- b) a tally list giving the length, L , of each drill-pipe (see [Figure B.1](#) and [6.6.3](#)).

6.17.2 Supplementary documents

When specified in the purchase agreement, the requirements of [Clause E.3](#), SR15, shall apply.

Additional requirements for PSL-2 and PSL-3 are in [Annex G](#).

6.17.3 Electronic data interchange

The standard and/or supplementary documents (see [6.17.1](#) and [6.17.2](#)) printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the drill-pipe manufacturer's facility. The content of the EDI-transmitted document shall meet the requirements of this document and conform to any existing EDI agreement between the purchaser and the drill-pipe manufacturer.

6.17.4 Retention of records

[Table A.9](#) or [Table C.9](#) specifies records that shall be retained. Such records shall be retained by the drill-pipe manufacturer and shall be available to the purchaser on request for a period of five years after the date of purchase from the drill-pipe manufacturer.

7 Requirements for drill-pipe body

7.1 Information to be supplied when placing orders for drill-pipe bodies

7.1.1 When placing orders for drill-pipe bodies to be manufactured in accordance with this document, the purchaser shall specify the following in the purchase agreement:

Requirements	Reference
Document number(s)	ISO 11961
Quantity	
Label 1 or specified outside diameter	Table A.1 or Table C.1
Label 2 or specified wall thickness	Table A.1 or Table C.1
Grade	Table A.1 or Table C.1
Type of pipe upset (internal, external or internal-external upset)	Table A.1 or Table C.1
Length and tolerance	
Delivery date and shipping instructions	
Inspection by purchaser	Annex D
Documentation	7.22

7.1.2 The purchaser shall also specify in the purchase agreement his requirements concerning the following stipulations, which are optional with the purchaser: