INTERNATIONAL STANDARD

ISO 3183

Third edition
2012-11-01

Petroleum and natural gas industries — Steel pipe for pipeline transportation systems

Industries du pétrole et du gaz naturel — Tubes en acier pour les systèmes de transport par conduites

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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

ISO 3183 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 2, *Pipeline transportation systems*.

Working Group 16 of ISO/TC 67/SC 2 meets jointly with the Line Pipe Working Group (currently WG 4210) of the American Petroleum Institute (API) to ensure the harmonization of ISO 3183 with API Specification 5L.

This third edition of ISO 3183 cancels and replaces the second edition (ISO 3183:2007), on which it is based but with revisions to incorporate updating, clarification and additional technical requirements.

The second edition of ISO 3183 was harmonized to a great extent with the 44th edition of API 5L, published on 1 October 2007, and the revisions produced by the joint ISO and API Working Groups are intended to extend or complete harmonization with the new 45th edition of API 5L.

It is the intent of ISO/TC 67 that the second and third editions of ISO 3183 shall both be applicable, at the option of the purchaser (as defined in 4.49), for a period of six months from the first day of the calendar quarter immediately following the date of publication of this third edition, after which period, the second edition (ISO 3183:2007) will no longer be applicable.

Introduction

This International Standard is the result of harmonizing the requirements of the following standards:

— API Spec 5L; 44th edition published 1 October 2007;

— ISO 3183:2007; second edition published 15 March 2007.

In the preparation of this third edition of ISO 3183, the technical committee has maintained the concept of two basic levels of standard technical requirements for line pipe expressed as two product specification levels (PSL 1 and PSL 2). Level PSL 1 provides a standard quality level for line pipe. Level PSL 2 has additional mandatory requirements for chemical composition, notch toughness and strength properties and additional non-destructive testing (NDT). Requirements that apply only to PSL 1 or only to PSL 2 are so designated. Requirements that are not designated to a specific PSL designation apply to both PSL 1 and PSL 2 pipe.

The technical committee also recognized that the petroleum and natural gas industry often specifies additional requirements for particular applications. In order to accommodate such needs, optional additional requirements for special applications are available, as follows:

— PSL 2 pipe ordered with a qualified manufacturing procedure (Annex B), the requirements of which have been enhanced to include verification detail of critical processes in the production of feedstock material, line pipe manufacture and product testing and inspection;

— PSL 2 pipe ordered with resistance to ductile fracture propagation in gas pipelines (Annex G);

— PSL 2 pipe ordered for sour service (Annex H);

— pipe ordered as “Through the Flowline” (TFL) pipe (Annex I);

— PSL 2 pipe ordered for offshore service (Annex J);

The following two new annexes are added to the third edition of this International Standard.

— PSL 2 pipe ordered for European onshore natural gas transmission pipelines (Annex M).

— Equations for threaded and coupled pipe and background equations for guided bend and CVN test (Annex P).

The requirements of the annex(es) apply only when specified on the purchase order.

When pipe is ordered for dual or multiple applications, the requirements of more than one annex for special applications can be invoked. In such instances, if a technical conflict arises due to applying the requirements of more than one annex for special applications, the most stringent requirement applicable to the intended service applies.

This International Standard does not provide guidance on when it is necessary to specify the above supplementary requirements. Instead, it is the responsibility of the purchaser to specify, based upon the intended use and design requirements, which, if any, of the supplementary requirements apply for a particular purchase order.

This third edition of ISO 3183 is the result of a continuing process of harmonizing documents of different heritage. It has been necessary to give consideration to traditional symbols (denoting mechanical or physical properties or their values, dimensions or test parameters) and the format of equations that have been widely used and which (in their traditional format) maintain strong links with other widely used standards and specifications, and with the original scientific work that led to their derivation. Accordingly, although in some instances changes to established symbols and equations have been made to optimize alignment with the ISO/IEC Directives, Part 2, in other instances, some symbols and equations, most specifically those in 9.2, Table F.1 and Annex P, have been retained in their traditional form to avoid causing confusion in this post-harmonization stage. Where changes have been made, care has been taken to ensure that the new symbol replacing the traditional one has been fully and clearly defined.

Petroleum and natural gas industries — Steel pipe for pipeline transportation systems

1 Scope

This International Standard specifies requirements for the manufacture of two product specification levels (PSL 1 and PSL 2) of seamless and welded steel pipes for use in pipeline transportation systems in the petroleum and natural gas industries.

This International Standard is not applicable to cast pipe.

2 Conformance

2.1 Units of measurement

In this International Standard, data are expressed in both International System (SI) units and United States Customary (USC) units. For a specific order item, only one system of units shall be used, without combining data expressed in the other system. Data values expressed in SI and USC units shall not be combined on the same inspection document or in the same required pipe marking sequence.

Where product is tested and verified against requirements using one measurement system (USC or SI), and an inspection document is issued, with data reported in the alternate measurement system units, a statement shall appear on the inspection document indicating that the data presented was converted from the measurement system used for the original inspection.

The purchaser shall specify whether data, drawings, and maintenance dimensions of pipes shall be in the International System (SI) or US Customary (USC) system of measurements. Use of an SI data sheet indicates that the SI measurements shall be used. Use of a USC data sheet indicates that the USC system of measurements shall be used.

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

2.2 Rounding

Unless otherwise stated in this International Standard, to determine conformance with the specified requirements, observed or calculated values shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with ISO 80000-1:2009, Annex B, Rule A.

NOTE For the purposes of this provision, the rounding method of ASTM E29-08 [1] is equivalent to ISO 80000-1:2009, Annex B, Rule A.

2.3 Compliance to this International Standard

A documented quality system shall be applied to assist compliance with the requirements of this International Standard.

NOTE Documentation of a quality system does not require certification by a third party certification body. Only the creation or adoption of a written quality system is necessary to meet the requirement of this International Standard. ISO defers to the expertise of responsible quality management personnel to create or adopt the system which best reflects the need of each company. There are many existing quality management systems to which personnel can refer for guidance in the development of an appropriate quality system, including ISO/TS 29001[2] and API Spec Q1[3], which contain provisions specific to the oil and gas industry, or ISO 9001[4], which contains general requirements for quality management systems that are auditable. This list is not exhaustive and is provided for information only.

A contract may specify that the manufacturer shall be responsible for complying with all of the applicable requirements of this International Standard. It shall be permissible for the purchaser to make any investigation necessary in order to be assured of compliance by the manufacturer and to reject any material that does not comply.

3 Normative references

The following referenced documents are indispensable for the application 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 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 404, *Steel and steel products — General technical delivery requirements*

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

ISO 4885, *Ferrous products — Heat treatments — Vocabulary*

ISO 5173, *Destructive tests on welds in metallic materials – Bend tests*

ISO 6506 (all parts), *Metallic materials — Brinell hardness test*

ISO 6507 (all parts), *Metallic materials — Vickers hardness test*

ISO 6508 (all parts), *Metallic materials — Rockwell hardness test*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 6929, *Steel products — Vocabulary*

ISO 7438, *Metallic materials — Bend test*

ISO 7539-2, *Corrosion of metals and alloys — Stress corrosion testing — Part 2: Preparation and use of bent-beam specimens*

ISO 8491, *Metallic materials — Tube (in full section) — Bend test*

ISO 8492, *Metallic materials — Tube — Flattening test*

ISO 8501-1:2007, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*

ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

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

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

ISO 10893-2:2011, *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 10893-3:2011, *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 10893-4, *Non-destructive testing of steel tubes — Part 4: Liquid penetrant inspection of seamless and welded steel tubes for the detection of surface 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 10893-6, *Non-destructive testing of steel tubes — Part 6: Radiographic testing of the weld seam of welded steel tubes for the detection of imperfections*

ISO 10893-7:2011, *Non-destructive testing of steel tubes — Part 7: Digital radiographic testing of the weld seam of welded steel tubes for the detection of imperfections*

ISO 10893-8:2011, *Non-destructive testing of steel tubes — Part 8: Automated ultrasonic testing of seamless and welded steel tubes for the detection of laminar imperfections*

ISO 10893-9:2011, *Non-destructive testing of steel tubes — Part 9: Automated ultrasonic testing for the detection of laminar imperfections in strip/plate used for manufacture of welded steel tubes*

ISO 10893-10:2011, *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 10893-11:2011, *Non-destructive testing of steel tubes — Part 11: Automated ultrasonic testing of the weld seam of welded steel tubes for the detection of longitudinal and/or transverse imperfections*

ISO 10893-12, *Non-destructive testing of steel tubes — Part 12: Automated full peripheral ultrasonic thickness testing of seamless and welded (except submerged arc-welded) steel tubes*

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

ISO 11699-1:2008, *Non-destructive testing — Industrial radiographic film — Part 1: Classification of film systems for industrial radiography*

ISO 12135, *Metallic materials — Unified method of test for the determination of quasistatic fracture toughness*

ISO 13678, *Petroleum and natural gas industries — Evaluation and testing of thread compounds for use with casing, tubing, line pipe and drill stem elements*

ISO 14284, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition*

ISO 19232-1:2004, *Non-destructive testing — Image quality of radiographs — Part 1: Image quality indicators (wire type) — Determination of image quality value*

ISO 80000-1:2009, *Quantities and units — Part 1: General*

API Spec 5B[1)], *Specification for Threading, Gauging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads*

API RP 5A3, *Recommended Practice on Thread Compounds for Casing, Tubing, Line Pipe, and Drill Stem Elements*

API RP 5L3, *Recommended Practice for Conducting Drop-Weight Tear Tests on Line Pipe*

API Std 5T1, *Standard on Imperfection Terminology*

ASNT SNT-TC-1A[2)], *Recommended Practice No. SNT-TC-1A — Non-Destructive Testing*

ASTM A370[3)], *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM A435, *Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates*

ASTM A578/A578M, *Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications*

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

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1) American Petroleum Institute, 1220 L Street, N.W., Washington, DC 20005, USA.

2) American Society for Nondestructive Testing, 1711 Arlingate Lane, Columbus, OH 43228-0518, USA.

3) ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA.

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

ASTM A956, *Standard Test Method for Leeb Hardness Testing of Steel Products*

ASTM A1038, *Standard Test Method for Portable Hardness Testing by the Ultrasonic Contact Impedance Method*

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

ASTM E94, *Standard Guide for Radiographic Examination*

ASTM E110, *Standard Test Method for Indentation Hardness of Metallic Materials by Portable Hardness Testers*

ASTM E114, *Standard Practice for Ultrasonic Pulse-Echo Straight-Beam Contact Testing*

ASTM E164, *Standard Practice for Contact Ultrasonic Testing of Weldments*

ASTM E165, *Standard Practice for Liquid Penetrant Examination for General Industry*

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

ASTM E273, *Standard Practice for Ultrasonic Testing of the Weld Zone of Welded Pipe and Tubing*

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

ASTM E384, *Standard Test Method for Knoop and Vickers Hardness of Materials*

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

ASTM E587, *Standard Practice for Ultrasonic Angle-Beam Contact Testing*

ASTM E709, *Standard Guide for Magnetic Particle Testing*

ASTM E747, *Standard Practice for Design, Manufacture and Material Grouping Classification of Wire Image Quality Indicators (IQI) Used for Radiology*

ASTM E1290, *Standard Test Method for Crack-Tip Opening Displacement (CTOD) Fracture Toughness Measurement*

ASTM E1806, *Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition*

ASTM E1815-08, *Standard Test Method for Classification of Film Systems for Industrial Radiography*

ASTM E2033, *Standard Practice for Computed Radiology (Photostimulable Luminescence Method)*

ASTM E2698, *Standard Practice for Radiological Examination Using Digital Detector Arrays*

ASTM G39, *Standard Practice for Preparation and Use of Bent-Beam Stress-Corrosion Test Specimens*

BS 7448-1, *Fracture mechanics toughness tests — Method for determination of KIc, critical CTOD and critical J values of metallic materials*

EN 10168[4)], *Steel products — Inspection documents — List of information and description*

EN 10204:2004, *Metallic products — Types of inspection documents*

NACE TM0177:2005 [5)], *Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking and Stress Corrosion Cracking in H_2S Environments*

NACE TM0284:2011, *Standard Test Method — Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking*

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4) CEN, European Committee for Standardization, Management Centre, Avenue Marnix 17, B-1000 Brussels, Belgium.

5) NACE International, P.O. Box 201009, Houston, Texas 77216-1009, USA.

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply, as well as those given in

— ISO 6929 or ASTM A941 for steel products,

— ISO 4885 or ASTM A941 for heat treatment,

— API Std 5T1 for imperfection terminology,

— ISO 404, ISO 10474 or ASTM A370, whichever is applicable, for the types of sampling procedures, inspection and inspection documents,

4.1
as agreed
required to be as agreed upon by the manufacturer and the purchaser, and specified in the purchase order

NOTE Associated, for example, with items covered by 7.2 a).

4.2
as-rolled
delivery condition without any special rolling and/or heat-treatment

4.3
coil/plate end weld
weld that joins coil or plate ends together

4.4
cold-expanded pipe
pipe that, while at ambient mill temperature, has received a permanent increase in outside diameter or circumference throughout its length, by internal hydrostatic pressure in closed dies or by an internal expanding mechanical device

4.5
cold-sized pipe
pipe that, after forming (including sizing on electric welding) and while at ambient mill temperature, has received a permanent increase in outside diameter or circumference for all or part of its length, or a permanent decrease in outside diameter or circumference for all or part of its length

4.6
cold finishing
cold-working operation (normally cold drawing) with a permanent strain greater than 1,5 %

NOTE The amount of permanent strain generally differentiates it from cold expansion and cold sizing.

4.7
cold forming
process in which a strip or plate is formed into a pipe without heating

4.8
continuous welding
CW
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 strip for the welding mill

4.9
combination welded pipe
COW pipe
tubular product having one or two longitudinal seams or one helical seam, produced by a combination of gas metal-arc and submerged-arc welding wherein the gas-metal arc weld bead is not completely removed by the submerged-arc welding passes

4.10
COWH pipe
tubular product having one helical seam produced by a combination of gas metal-arc and submerged-arc welding wherein the gas-metal arc weld bead is not completely removed by the submerged-arc welding passes

4.11
COWL pipe
tubular product having one or two longitudinal seams produced by a combination of gas metal-arc and submerged-arc welding wherein the gas-metal arc weld bead is not completely removed by the submerged-arc welding passes

4.12
COW seam
longitudinal or helical seam produced by a combination of gas metal-arc and submerged-arc welding wherein the gas-metal arc weld bead is not completely removed by the submerged-arc welding passes

4.13
CW pipe
tubular product having one longitudinal seam produced by continuous welding

4.14
daughter coil
portion of steel removed via slitting, cutting or shearing from the mother coil, which is used to produce one or more pieces of pipe

4.15
daughter plate
portion of steel removed via slitting, cutting or shearing from the mother plate, which is used to produce one or more pieces of pipe

4.16
defect
imperfection of a size and/or population density greater than the acceptance criteria specified in this International Standard

4.17
electric welding
EW
process of forming a seam by electric-resistance 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 applied by induction or conduction

4.18
EW pipe
tubular product having one longitudinal seam produced by low- or high-frequency electric welding

4.19
EW seam
longitudinal seam produced by electric welding

4.20
flux core arc welding
welding process that produces melting and coalescence of metals by heating them with an arc between a continuous filler metal electrode and the workpiece, wherein the arc and molten metal are shielded by a flux contained within the tubular electrode

NOTE In some cases, additional shielding is obtained from an externally supplied gas or gas mixture.

4.21
gas metal-arc welding
welding process that produces melting and coalescence of metals by heating them with an arc or arcs between a continuous consumable electrode and the work, wherein the arc and molten metal are shielded by an externally supplied gas or gas mixture

NOTE Contact pressure is not used and the filler metal is obtained from the electrode.

4.22
heat
metal produced by a single cycle of a batch melting process

4.23
HFW pipe
high-frequency electric welded pipe
EW pipe produced with a welding current frequency equal to or greater than 70 kHz

4.24
if agreed
required to be as prescribed, or more stringent than is prescribed, if agreed upon by the manufacturer and the purchaser and specified in the purchase order

NOTE Associated, for example, with items covered by 7.2 c).

4.25
imperfection
discontinuity or irregularity in the product wall or on the product surface that is detectable by inspection methods outlined in this International Standard

4.26
indication
evidence obtained by non-destructive inspection

4.27
informative elements
elements that

a) identify the document, introduce its content and explain its background, development, and relationship with other documents, or

b) provide additional information intended to assist with the understanding or use of the document

NOTE See the ISO/IEC Directives, Part 2.

4.28
inspection
activities, such as measuring, examining, testing, weighing or gauging one or more characteristics of a product, and comparing the results of such activities with the specified requirements in order to determine conformity

NOTE Adapted from ISO 404.

4.29
instrument standardization
adjustment of a non-destructive inspection instrument to an arbitrary reference value

4.30
jointer
two or three lengths of pipe coupled or welded together by the manufacturer

4.31
ladle refining
post steelmaking secondary process, performed prior to casting to improve the steel quality, of which some examples may include degassing, desulfurization and various methods for the removal of non-metallic inclusions and for inclusion shape control

4.32
lamination
internal metal separation that creates layers, generally parallel to the pipe surface

4.33
laser welding
LW
process of forming a seam by using a laser-beam keyhole welding technique to produce melting and coalescence of the edges being welded, with or without preheating of the edges, wherein shielding is obtained from an externally supplied gas or gas mixture

4.34
low-frequency electric welded pipe
LFW pipe
EW pipe produced with a welding current frequency of less than 70 kHz

4.35
LW pipe
tubular product having one longitudinal seam produced by laser welding

4.36
manufacturer
firm, company or corporation responsible for making and marking the product in accordance with the requirements of this International Standard

NOTE 1 The manufacturer is, as applicable, a pipe mill, processor, maker of couplings or threader.

NOTE 2 Adapted from ISO 11961[5].

4.37
mother coil
hot-rolled coil of steel processed from a single reheated slab that is used to produce one or more pieces of pipe

4.38
mother plate
hot-rolled plate of steel processed from a single reheated slab that is used to produce one or more pieces of pipe

4.39
non-destructive inspection
non-destructive testing
NDT
inspection of pipe to reveal imperfections, using radiographic, ultrasonic or other methods specified in this International Standard that do not involve disturbance, stressing or breaking of the materials

4.40
normalizing formed
pipe delivery condition resulting from the forming process in which the final deformation is carried out within a certain temperature range, leading to a material condition equivalent to that obtained after normalizing, such that the specified mechanical properties would still be met in the event of any subsequent normalizing

4.41
normalizing rolled
pipe delivery condition resulting from the rolling process in which the final deformation is carried out within a certain temperature range, leading to a material condition equivalent to that obtained after normalizing, such that the specified mechanical properties would still be met in the event of any subsequent normalizing

4.42
normative elements
elements that describe the scope of the document, and which set out provisions that are required in order to implement the standard

NOTE See the ISO/IEC Directives, Part 2.

4.43
pipe body
⟨SMLS pipe⟩ entire pipe

4.44
pipe body
⟨welded pipe⟩ entire pipe, excluding the weld(s) and heat-affected zone (HAZ)

4.45
pipe grade
designation of pipe strength level

NOTE Chemical composition and/or heat treatment condition of a pipe grade can differ.

4.46
pipe mill
firm, company or corporation that operates pipe-making facilities

NOTE Adapted from ISO 11960[6].

4.47
processor
firm, company or corporation that operates facilities capable of heat treating pipe made by a pipe mill

NOTE Adapted from ISO 11960[6].

4.48
product analysis
chemical analysis of the pipe, plate or coil

4.49
purchaser
party responsible for both the definition of requirements for a product order and for payment of that order

4.50
quenching and tempering
heat treatment consisting of quench hardening followed by tempering

4.51
sample
quantity of material taken from the product to be tested for the purpose of producing one or more test pieces

4.52
submerged-arc welding
SAW
welding process that produces melting and coalescence of metals by heating them with an arc or arcs between a bare metal consumable electrode or electrodes and the workpiece, wherein the arc and molten metal are shielded by a blanket of granular flux

NOTE Contact pressure is not used and part or all of the filler metal is obtained from the electrodes.

4.53
SAW pipe
tubular product having one or two longitudinal seams, or one helical seam, produced by the submerged-arc welding process