Welded steel tubes for pressure purposes - Technical delivery)
conditions - Part 7: Stainless steel tubes

This European Standard was approved by CEN on 14 October 2004.

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Foreword

This document (EN 10217-7:2005) has been prepared by Technical Committee ECISS /TC 29, "Steel tubes and fittings for steel tubes", the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by August 2005, and conflicting national standards shall be withdrawn at the latest by August 2005.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 97/23/EC.

For relationship with EU Directive 97/23/EC, see informative Annex ZA, which is an integral part of this document.

Other parts of EN 10217 are:

— Part 1: Non-alloy steel tubes with specified room temperature properties;
— Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties;
— Part 3: Alloy fine grain steel tubes;
— Part 4: Electric welded non-alloy steel tubes with specified low temperature properties;
— Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties;
— Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties

Another European Standard series covering tubes for pressure purposes is:

— EN 10216: Seamless steel tubes for pressure purposes.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.
1 Scope

This Part of EN 10217 specifies the technical delivery conditions in two test categories for welded tubes of circular cross-section made of austenitic and austenitic-ferritic stainless steel which are applied for pressure and corrosion resisting purposes at room temperature, at low temperatures or at elevated temperatures.

2 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.

EN 473, Non destructive testing - Qualification and certification of NDT personnel - General principles.
EN 910, Destructive tests on weld in metallic materials - Bend tests.
EN 10002-1, Metallic materials - Tensile testing - Part 1: Method of test at ambient temperature.
EN 10002-5, Metallic materials - Tensile testing - Part 5: Method of test at elevated temperature.
EN 10020:2000, Definition and classification of grades of steel.
EN 10021:1993, General technical delivery requirements for steel and iron products.
EN 10027-1, Designation systems for steels - Part 1: Steel names, principal symbols.
EN 10027-2, Designation systems for steels - Part 2: Numerical system.
EN 10028-7, Flat products made of steels for pressure purposes – Part 7: Stainless steels.
EN 10045-1, Metallic materials - Charpy impact test - Part 1: Test method.
EN 10088-1, Stainless steels - Part 1: List of stainless steels.
EN 10088-2, Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strip for general purposes.
EN 10168, Steel products - Inspection documents - List of information and description.
EN 10204, Metallic products - Types of inspection documents.
EN 10233, Metallic materials - Tube - Flattening test.
EN 10234, Metallic materials - Tube - Drift expanding test.
EN 10236, Metallic materials - Tube - Ring expanding test.
EN 10237, Metallic materials - Tube - Ring tensile test.
EN 10246-2, Non destructive testing of steel tubes - Part 2: Automatic eddy current testing of seamless and welded (except submerged arc-welded) austenitic and austenitic-ferritic steel tubes for verification of hydraulic leak-tightness.
EN 10246-3, Non-destructive testing of steel tubes - Part 3: Automatic eddy current testing of seamless and welded (except submerged arc welded) steel tubes for the detection of imperfections.
EN 10246-7, Non destructive testing of steel tubes - Part 7: Automatic full peripheral ultrasonic testing of seamless and welded (except submerged arc welded) steel tubes for the detection of longitudinal imperfections.
3  Terms and definitions

For the purpose of this Part of EN 10217, the terms and definitions given in EN 10020:2000, EN 10021:1993, EN 10052:1993 and EN 10266:2003 and the following apply.

3.1  test category
classification that indicates the extent and level of inspection and testing

3.2  employer
organization for which a person works on a regular basis

NOTE The employer may be either the tube manufacturer or supplier or a third party organization providing Non-Destructive Testing (NDT) services.

4  Symbols

For the purpose of this Part of EN 10217, the symbols given in EN 10266:2003 and the following apply.

—  C1 and C2 category conformity indicators (see Clauses 7.2.1 and 7.2.3.);

—  TC test category.

NOTE See also Table 2 for symbols of the delivery condition.
5 Classification and designation

5.1 Classification

According to the classification system in EN 10020, the steel grades are classified as:

- austenitic steels (corrosion resisting);
- austenitic-ferritic steels.

For more details see EN 10088-1.

5.2 Designation

For the tubes covered by this Part of EN 10217 the steel designation consists of:

- the number of this Part of EN 10217 (EN 10217-7);

plus either:

- the steel name according to EN 10027-1 and CR 10260;

or:

- the steel number allocated according to EN 10027-2.

6 Information to be supplied by the purchaser

6.1 Mandatory information

The following information shall be supplied by the purchaser at the time of enquiry and order:

a) the quantity (mass or total length or number);

b) the term "tube";

c) the dimensions (outside diameter D and wall thickness T) (see 8.8.1);

d) the designation of the steel grade according to this Part of EN 10217 (see 5.2);

e) the test category (see 9.3).

6.2 Options

A number of options are specified in this Part of EN 10217 and these are listed below. In the event that the purchaser does not indicate a wish to implement any of these options at the time of enquiry and order, the tube shall be supplied in accordance with the basic specification (see 6.1).

a) Information about steelmaking process (see 7.1);

b) Tube manufacturing process and/or route (see 7.2.2);

c) The inside weld is remelted (see Table 1);

d) The inside weld is worked by rolling or remelting (see Table 1);

e) Delivery condition (see 7.2.4);

f) Product analysis (see 8.2.2);
g) Additional mechanical tests on samples that have undergone a different or additional heat treatment (see 8.3.1);

h) Verification of impact energy at room temperature (see 8.3.1);

i) Agreed mechanical properties at room temperature for austenitic steel tubes with wall thicknesses greater than 60 mm (see Table 6, footnote a);

j) Agreed proof strength at elevated temperatures for austenitic steel tubes with wall thicknesses greater than 60 mm (see Table 8, footnote a);

k) Verification of proof strength $R_{p0.2}$ or $R_{p1.0}$ at elevated temperatures (see 8.3.2);

l) Verification of impact energy at low temperature (see 8.3.3);

m) Intergranular corrosion test (see 8.4);

n) Repair welding (see 8.5.1.5);

o) Selection of leak-tightness test method (see 8.5.2.2);

p) Non-destructive testing of tube ends for detection of laminar imperfections (see 8.5.2.3);

q) Non-destructive testing of strip and plate edges for detection of laminar imperfections (see 8.5.2.3);

r) Special ends preparation (see 8.7);

s) Exact lengths (see 8.8.3);

t) Tolerance class D 4 for $D \leq 168.3$ mm (see Table 10);

u) The type of inspection document other than the standard document (see 9.2.1);

v) Transverse tensile test on the weld (see 10.2.2.2);

w) Test pressure for hydrostatic leak-tightness test (see 11.8.1);

x) Wall thickness measurement away from the ends (see 11.9);

y) Selection of non-destructive testing method for the inspection of the weld seam (see Table 16);

z) Image quality class R1 of EN 10246-10 for the radiographic inspection of the weld seam (see Table 16);

aa) Additional marking (see 12.2);

bb) Special protection (see 13).

6.3 Examples of an order

6.3.1 Example 1

2000 m of welded tube W1 (see Table 2) with an outside diameter of 168.3 mm, a wall thickness of 4.5 mm, tolerance classes D 3 and T 3, in accordance with this Part of EN 10217, made of steel grade X2CrNi19-11, test category 1, with a 3.1 B inspection certificate according to EN 10204:

2000 m - Tube – 168.3 X 4.5 - EN 10217-7- X2CrNi19-11 – TC 1 – Option 5: W1

6.3.2 Example 2

300 m of cold finished welded tube WCA (see Table 2) with an outside diameter of 42.4 mm, a wall thickness of 2.6 mm, tolerance classes D 3 and T 3, in accordance with this Part of EN 10217, made of steel grade 1.4301, test category 2, with intergranular corrosion test (EN ISO 3651-2, method A), verification of proof strength at 300 °C,
non-destructive testing of strip edges for detection of laminar imperfections, with a 3.2 inspection certificate according to EN 10204 issued by the manufacturer:

300 m - Tube – 42,4 X 2,6 - EN 10217-7 - 1.4301 – TC 2 – Option 5: WCA - Option 11: 300 ° C - Option 13: A – Option 17 - Option 21: 3.2 (to be issued by the manufacturer)

7  Manufacturing process

7.1  Steelmaking process

The steelmaking process is at the discretion of the manufacturer, but see Option 1.

Option 1: The purchaser shall be informed about the steelmaking process used. The process shall be reported in the inspection document.

7.2  Tube manufacture and delivery conditions

7.2.1  All NDT activities shall be carried out by qualified and competent level 1,2 and/or 3 personnel authorised to operate by the employer.

The qualification shall be according to EN 10256 or, at least, an equivalent to it.

It is recommended that the level 3 personnel be certified according to EN 473 or, at least, an equivalent to it.

The operating authorisation issued by the employer shall be according to a written procedure.

NDT operations shall be authorised by a level 3 NDT individual approved by employer.

NOTE   The definition of level 1,2 and 3 can be found in appropriate standards, e.g. EN 473 and EN 10256.

For pressure equipment in categories III and IV (of Directive 97/23/EC) the personnel shall be approved by a recognised third-party organisation. Tubes not conforming to this requirement shall be marked "C 2", unless a requirement to mark "C 1" (see 7.2.3) applies.

7.2.2  The tubes shall be manufactured from hot or cold rolled plate, sheet or strip in accordance with EN 10028-7, longitudinally arc or laser welded by fusion across the abutting edges, with or without the addition of filler metal in accordance with one of the routes as specified in Table 1.

Unless Option 2 is specified, the manufacturing process and/or route are at the discretion of the manufacturer.

Option 2: The tube manufacturing process and/or route is specified by the purchaser.

The finished tubes shall not include welds used for joining together lengths of the hot or cold rolled strip prior to forming.

Option 3: (see Table 1).

Option 4: (see Table 1).

7.2.3  Welding shall be carried out by suitably qualified personnel in accordance with suitable operating procedures.

For pressure equipment in categories II, III, and IV, (of Directive 97/23/EC) the operating procedures and the personnel shall be approved by a competent third-party. Tubes not conforming to this requirement shall be marked "C 1".
<table>
<thead>
<tr>
<th>Route</th>
<th>Manufacturing process</th>
<th>Starting material</th>
<th>Forming operation</th>
<th>Weld condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>As welded</td>
<td>Hot or cold rolled strip</td>
<td>Continuous forming from strip</td>
<td>As welded</td>
</tr>
<tr>
<td>02</td>
<td>Welded, outside ground</td>
<td>Hot or cold rolled strip</td>
<td>Welded, bead worked</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>Automatic arc welding</td>
<td>Hot or cold rolled plate or sheet</td>
<td>Single forming from plate or sheet</td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>Laser welding</td>
<td>Hot or cold rolled strip</td>
<td>Continuous forming from strip</td>
<td>Welded, outside ground or bead worked</td>
</tr>
</tbody>
</table>

a Tubes with outside diameter not exceeding 168.3 mm may additionally be brought to the required tube dimensions by cold working (see type of condition WCA and WCR in Table 2).

b The terms "as-welded", "welded, outside ground", "bead worked" and "cold working" apply to the condition of the tube before heat treatment if required in accordance with Table 2.

c On request, the inside weld can be remelted. **Option 3: The inside weld is remelted.**

d On request, the inside weld can be worked by rolling or remelting. **Option 4: The inside weld is worked by rolling or remelting.**

e The weld seam can be welded using one or more separate layers.
7.2.4 The types of delivery condition of the tubes are shown in Table 2. Unless Option 5 is specified, the selection of type of delivery condition is at the discretion of the manufacturer.

**Option 5:** The type of delivery condition is specified by the purchaser.

### Table 2 - Delivery conditions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Type of delivery condition a</th>
<th>Surface condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0 b</td>
<td>Welded from hot or cold rolled plate, sheet or strip 1D, 2D, 2E, 2B</td>
<td>As welded</td>
</tr>
<tr>
<td>W1 b</td>
<td>Welded from hot rolled plate, sheet or strip 1D, descaled</td>
<td>Metallically clean</td>
</tr>
<tr>
<td>W1A b</td>
<td>Welded from hot rolled plate, sheet or strip 1D, heat treated, descaled</td>
<td>Metallically clean</td>
</tr>
<tr>
<td>W1R b</td>
<td>Welded from hot rolled plate, sheet or strip 1D, bright annealed.</td>
<td>Metallically bright</td>
</tr>
<tr>
<td>W2 b</td>
<td>Welded from cold rolled plate, sheet or strip 2D, 2E, 2B, descaled</td>
<td>Metallically clean</td>
</tr>
<tr>
<td>W2A b</td>
<td>Welded from cold rolled plate, sheet or strip 2D, 2E, 2B, heat treated, descaled</td>
<td>Except for the weld, essentially smoother than for types W1 and W1A</td>
</tr>
<tr>
<td>W2R b</td>
<td>Welded from cold rolled plate, sheet or strip 2D, 2E, 2B, bright annealed</td>
<td>Metallically bright</td>
</tr>
<tr>
<td>WCA</td>
<td>Welded from hot rolled or cold rolled plate, sheet or strip 1D, 2D, 2E, 2B, heat treated if appropriate, at least 20 % cold formed, heat treated, with re-crystallized weld metal, descaled</td>
<td>Metallically clean, weld scarcely recognizable</td>
</tr>
<tr>
<td>WCR</td>
<td>Welded from hot rolled or cold rolled plate, sheet or strip 1D, 2D, 2E, 2B, heat treated if appropriate, at least 20 % cold formed, bright annealed, with re-crystallized weld metal</td>
<td>Metallically bright, weld scarcely recognizable</td>
</tr>
<tr>
<td>WG</td>
<td>Ground c</td>
<td>Metallically bright-ground, the type and degree of grinding shall be agreed at the time of enquiry and order d</td>
</tr>
<tr>
<td>WP</td>
<td>Polished c</td>
<td>Metallically bright-polished, the type and degree of polishing shall be agreed at the time of enquiry and order d</td>
</tr>
</tbody>
</table>

a  Symbols of flat products according to EN 10088-2.
b  For tubes ordered with smoothed welds ("bead worked") letter "b" shall be appended to the symbol of the type of the condition (e. g. W2Ab).
c  Conditions W2, W2A, W2R, WCA or WCR are usually used as the starting condition.
d  It should be indicated in the enquiry and order whether grinding or polishing is to be performed internally or externally, or internally and externally.

### 8 Requirements

#### 8.1 General

When supplied in a delivery condition indicated in Clause 7.2.4 and inspected according to Clauses 9, 10 and 11, the tubes shall conform to the requirements of this Part of EN 10217.

In addition, the general technical delivery requirements specified in EN 10021 shall apply.
8.2 Chemical composition

8.2.1 Cast analysis

The cast analysis reported by the steel manufacturer shall apply and conform to the requirements of Table 3 for austenitic steel and of Table 4 for austenitic-ferritic steel.

NOTE When welding tubes produced according to this Part of EN 10217, account should be taken of the fact that the behaviour of the steel during and after welding is dependent not only on the steel, but also on the applied heat treatment and the conditions of preparing for and carrying out the welding.

8.2.2 Product analysis

Option 6: Product analysis for the tubes shall be supplied.

Table 5 specifies the permissible deviation of the product analysis from the specified limits on cast analysis given in Tables 3 and 4.
### Table 3 - Chemical composition (cast analysis)\(^a\) of austenitic steels, in % by mass (concluded)

<table>
<thead>
<tr>
<th>Steel grade</th>
<th>Steel number</th>
<th>C max</th>
<th>Si max</th>
<th>Mn max</th>
<th>P max</th>
<th>S max</th>
<th>N</th>
<th>Cr</th>
<th>Cu</th>
<th>Mo</th>
<th>Ni</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2CrNi18-9</td>
<td>1.4307</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>≤0.11</td>
<td>17.50 to 19.50</td>
<td>–</td>
<td>–</td>
<td>8.00 to 10.00</td>
<td>–</td>
</tr>
<tr>
<td>X2CrNi19-11</td>
<td>1.4306</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>≤0.11</td>
<td>18.00 to 20.00</td>
<td>–</td>
<td>–</td>
<td>10.00 to 12.00</td>
<td>–</td>
</tr>
<tr>
<td>X2CrNiN18-10</td>
<td>1.4311</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>0.12 to 0.22</td>
<td>17.00 to 19.50</td>
<td>–</td>
<td>–</td>
<td>8.50 to 11.50</td>
<td>–</td>
</tr>
<tr>
<td>X5CrNi18-10</td>
<td>1.4301</td>
<td>0.07</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>≤0.11</td>
<td>17.00 to 19.50</td>
<td>–</td>
<td>–</td>
<td>8.00 to 10.50</td>
<td>–</td>
</tr>
<tr>
<td>X6CrNiTi18-10</td>
<td>1.4541</td>
<td>0.08</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>–</td>
<td>17.00 to 19.00</td>
<td>–</td>
<td>–</td>
<td>9.00 to 12.00</td>
<td>Ti 5xC to 0.70</td>
</tr>
<tr>
<td>X6CrNiNb18-10</td>
<td>1.4550</td>
<td>0.08</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>–</td>
<td>17.00 to 19.00</td>
<td>–</td>
<td>–</td>
<td>9.00 to 12.00</td>
<td>Nb 10xC to 1.00</td>
</tr>
<tr>
<td>X2CrNiMo17-12-2</td>
<td>1.4404</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>≤0.11</td>
<td>18.50 to 18.50</td>
<td>–</td>
<td>–</td>
<td>2.50 to 2.50</td>
<td>10.00 to 13.00</td>
</tr>
<tr>
<td>X5CrNiMo17-12-2</td>
<td>1.4401</td>
<td>0.07</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>≤0.11</td>
<td>18.50 to 18.50</td>
<td>–</td>
<td>–</td>
<td>2.50 to 2.50</td>
<td>10.00 to 13.00</td>
</tr>
<tr>
<td>X6CrNiMoTi17-12-2</td>
<td>1.4571</td>
<td>0.08</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>–</td>
<td>18.50 to 18.50</td>
<td>–</td>
<td>–</td>
<td>2.50 to 2.50</td>
<td>10.50 to 13.50</td>
</tr>
<tr>
<td>X2 CrNiMo17-12-3</td>
<td>1.4432</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>≤0.11</td>
<td>16.50 to 18.50</td>
<td>–</td>
<td>–</td>
<td>2.50 to 3.00</td>
<td>10.50 to 13.00</td>
</tr>
<tr>
<td>X2CrNiMoN17-13-3</td>
<td>1.4429</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>0.12 to 0.22</td>
<td>16.50 to 18.50</td>
<td>–</td>
<td>–</td>
<td>2.50 to 3.00</td>
<td>11.00 to 14.00</td>
</tr>
<tr>
<td>X3CrNiMo17-13-3</td>
<td>1.4436</td>
<td>0.05</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>≤0.11</td>
<td>16.50 to 18.50</td>
<td>–</td>
<td>–</td>
<td>2.50 to 3.00</td>
<td>10.50 to 13.00</td>
</tr>
<tr>
<td>X2CrNiMo18-14-3</td>
<td>1.4435</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>≤0.11</td>
<td>17.00 to 19.00</td>
<td>–</td>
<td>–</td>
<td>2.50 to 3.00</td>
<td>12.50 to 15.00</td>
</tr>
<tr>
<td>X2CrNiMo17-13-5</td>
<td>1.4439</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>0.12 to 0.22</td>
<td>16.50 to 18.50</td>
<td>–</td>
<td>–</td>
<td>4.00 to 5.00</td>
<td>12.50 to 14.50</td>
</tr>
<tr>
<td>X2CrNiMo18-15-4</td>
<td>1.4438</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.049</td>
<td>0.015</td>
<td>≤0.11</td>
<td>17.50 to 19.50</td>
<td>–</td>
<td>–</td>
<td>3.30 to 4.00</td>
<td>13.00 to 16.00</td>
</tr>
<tr>
<td>X1NiCrMoCu31-27-4</td>
<td>1.4563</td>
<td>0.020</td>
<td>0.70</td>
<td>2.00</td>
<td>0.030</td>
<td>0.010</td>
<td>≤0.11</td>
<td>26.00 to 28.00</td>
<td>1.70 to 1.50</td>
<td>–</td>
<td>3.30 to 4.00</td>
<td>30.00 to 32.00</td>
</tr>
</tbody>
</table>

\(^a\) Unless otherwise specified, all the values relate to cast analysis.
<table>
<thead>
<tr>
<th>Steel grade</th>
<th>C max</th>
<th>Si max</th>
<th>Mn max</th>
<th>P max</th>
<th>S max</th>
<th>N</th>
<th>Cr</th>
<th>Cu</th>
<th>Mo</th>
<th>Ni</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1NiCrMoCu25-20-5</td>
<td>1.4539</td>
<td>0.020</td>
<td>0.70</td>
<td>2.00</td>
<td>0.030</td>
<td>0.010</td>
<td>0.15</td>
<td>19.00</td>
<td>21.00</td>
<td>4.00</td>
<td>24.00 to 26.00</td>
</tr>
<tr>
<td>X1CrNiMoCuN20-10-7</td>
<td>1.4547</td>
<td>0.020</td>
<td>0.70</td>
<td>1.00</td>
<td>0.030</td>
<td>0.010</td>
<td>0.16 to 0.25</td>
<td>18.50</td>
<td>20.50</td>
<td>6.00</td>
<td>17.50 to 18.50</td>
</tr>
<tr>
<td>X1NiCrMoCuN25-20-7</td>
<td>1.4529</td>
<td>0.020</td>
<td>0.50</td>
<td>1.00</td>
<td>0.030</td>
<td>0.010</td>
<td>0.15 to 0.25</td>
<td>18.00</td>
<td>21.00</td>
<td>6.00</td>
<td>24.00 to 26.00</td>
</tr>
</tbody>
</table>

a. Elements not listed in this Table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

b. For tubes welded without filler material the sum of sulphur and phosphorus shall be maximum 0.040 %.
Table 4 - Chemical composition (cast analysis)\(^{a}\) of austenitic-ferritic steels, in % by mass

<table>
<thead>
<tr>
<th>Steel grade</th>
<th>C max</th>
<th>Si max</th>
<th>Mn max</th>
<th>P max</th>
<th>S max</th>
<th>N</th>
<th>Cr</th>
<th>Cu</th>
<th>Mo</th>
<th>Ni</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2CrNiMoN22-5-3</td>
<td>1.4462</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.035</td>
<td>0.015</td>
<td>0.10 to 0.22</td>
<td>21.00 to 23.00</td>
<td>_</td>
<td>2.50 to 3.50</td>
<td>4.50 to 6.50</td>
</tr>
<tr>
<td>X2CrNiN23-4(^{c})</td>
<td>1.4362</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.035</td>
<td>0.015</td>
<td>0.05 to 0.20</td>
<td>22.00 to 24.00</td>
<td>0.10 to 0.60</td>
<td>0.10 to 0.60</td>
<td>3.50 to 5.50</td>
</tr>
<tr>
<td>X2CrNiMoN25-7-4(^{c})</td>
<td>1.4410</td>
<td>0.030</td>
<td>1.00</td>
<td>2.00</td>
<td>0.035</td>
<td>0.015</td>
<td>0.20 to 0.35</td>
<td>24.00 to 26.00</td>
<td>_</td>
<td>3.00 to 4.50</td>
<td>6.00 to 8.00</td>
</tr>
<tr>
<td>X2CrNiMoCuWN25-7-4</td>
<td>1.4501</td>
<td>0.030</td>
<td>1.00</td>
<td>1.00</td>
<td>0.035</td>
<td>0.015</td>
<td>0.20 to 0.30</td>
<td>24.00 to 26.00</td>
<td>0.50 to 1.00</td>
<td>3.00 to 4.00</td>
<td>6.00 to 8.00</td>
</tr>
</tbody>
</table>

\(^{a}\) Elements not listed in this Table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

\(^{b}\) For tubes welded without filler material the sum of sulphur and phosphorus shall be maximum 0.040 %.

\(^{c}\) Patented steel grade
### Table 5 - Permissible deviations of the product analysis from specified limits on cast analysis given in Tables 3 and 4

<table>
<thead>
<tr>
<th>Element</th>
<th>Limiting value for the cast analysis according to Tables 3 and 4</th>
<th>Permissible deviation of the product analysis&lt;sup&gt;a&lt;/sup&gt;</th>
<th>% by mass</th>
<th>% by mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>≤ 0,030</td>
<td>+ 0,005</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 0,030 ≤ 0,08</td>
<td>± 0,01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silicon</td>
<td>≤ 1,00</td>
<td>+ 0,05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manganese</td>
<td>≤ 1,00</td>
<td>+ 0,03</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 1,00 ≤ 2,00</td>
<td>+0,04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphorus</td>
<td>≤ 0,030</td>
<td>+ 0,003</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 0,030 to ≤ 0,045</td>
<td>+ 0,005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphur</td>
<td>≤ 0,015</td>
<td>+ 0,003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen</td>
<td>≤ 0,35</td>
<td>± 0,01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td>≥ 16,50 ≤ 20,00</td>
<td>± 0,20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 20,00 ≤ 28,00</td>
<td>± 0,25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>≤ 1,00</td>
<td>± 0,07</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 1,00 ≤ 2,00</td>
<td>± 0,10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molybdenum</td>
<td>≤ 0,60</td>
<td>± 0,03</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥ 2,00 ≤ 7,00</td>
<td>± 0,10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niobium</td>
<td>≤ 1,00</td>
<td>± 0,05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td>≤ 5,00</td>
<td>± 0,07</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 5,00 ≤ 10,00</td>
<td>± 0,10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 10,00 ≤ 20,00</td>
<td>± 0,15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 20,00 ≤ 32,00</td>
<td>± 0,20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Titanium</td>
<td>≤ 0,70</td>
<td>± 0,05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tungsten</td>
<td>≤ 1,00</td>
<td>± 0,05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> If several product analyses are carried out on one cast, and the contents of an individual element determined lie outside the permissible range of the chemical composition specified for the cast analysis, then it is only allowed to exceed the permissible maximum value or to fall short of the permissible minimum value, but not both for one cast.
8.3 Mechanical properties

8.3.1 At room temperature

The mechanical properties of the tubes shall conform to the requirements in Tables 6 and 7 and in Clause 11.

If heat treatments different from, or additional to, the reference heat treatment, are to be carried out after the delivery of the tubes, the purchaser may request, at the time of enquiry and order, additional mechanical tests on samples, that have been given heat treatments different from or additional to, those given in Tables 6 and 7. The heat treatment of the samples and the mechanical properties to be obtained from tests on them shall be agreed between the purchaser and the manufacturer at the time of enquiry and order.

Option 7: Additional mechanical tests on samples, which have undergone a different or additional heat treatment, shall be carried out.

Option 8: Impact test shall be carried out at room temperature (see Tables 6 and 7). The location of the test pieces, either from the weld or opposite to the weld, shall be agreed at the time of enquiry and order.

Option 9: (see Table 6, footnote a).

8.3.2 At elevated temperature

The minimum proof strength \(R_{p0.2}\) and \(R_{p1.0}\) values at elevated temperatures are specified in Tables 8 and 9.

Option 10: (see Table 8, footnote a).

Option 11: Proof strength \(R_{p0.2}\) or \(R_{p1.0}\) shall be verified (for austenitic-ferritic steels in Table 9 only \(R_{p0.2}\) apply). The test temperature shall be agreed at the time of enquiry and order.

8.3.3 At low temperature

Impact energy values at specified low temperature shall conform to the requirements in Tables 6 and 7.

Option 12: Impact test at low temperature shall be carried out. The location of the test pieces, either from the weld or opposite to the weld, shall be agreed at the time of enquiry and order.
Table 6 - Mechanical properties for wall thicknesses up to 60 mm\(^a\) of austenitic steels in the solution annealed condition (+AT) and information about intergranular corrosion (continued)

<table>
<thead>
<tr>
<th>Steel grade</th>
<th>Steel number</th>
<th>Tensile properties at room temperature(b)</th>
<th>Impact properties(b)</th>
<th>Reference heat treatment conditions</th>
<th>Resistance to intergranular corrosion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(R_{e0.2}) min</td>
<td>(R_{pt0}) min</td>
<td>(R_m) C</td>
<td>A min (%)</td>
</tr>
<tr>
<td>X2CrNi18-9</td>
<td>1.4307</td>
<td>180</td>
<td>215</td>
<td>470-670</td>
<td>40</td>
</tr>
<tr>
<td>X2CrNi19-11</td>
<td>1.4306</td>
<td>180</td>
<td>215</td>
<td>460-680</td>
<td>40</td>
</tr>
<tr>
<td>X2CrNi18-10</td>
<td>1.4111</td>
<td>270</td>
<td>305</td>
<td>550-760</td>
<td>35</td>
</tr>
<tr>
<td>X5CrNi18-10</td>
<td>1.4301</td>
<td>95</td>
<td>230</td>
<td>500-700</td>
<td>40</td>
</tr>
<tr>
<td>X6CrNiTi18-10</td>
<td>1.4541</td>
<td>200</td>
<td>235</td>
<td>500-730</td>
<td>35</td>
</tr>
<tr>
<td>X6CrNiNb18-10</td>
<td>1.4550</td>
<td>205</td>
<td>240</td>
<td>510-740</td>
<td>35</td>
</tr>
<tr>
<td>X2CrNiMo17-12-2</td>
<td>1.4404</td>
<td>190</td>
<td>225</td>
<td>490-690</td>
<td>40</td>
</tr>
<tr>
<td>X5CrNiMo17-12-2</td>
<td>1.4401</td>
<td>205</td>
<td>240</td>
<td>510-710</td>
<td>40</td>
</tr>
<tr>
<td>X6CrNiMoTi17-12-2</td>
<td>1.4571</td>
<td>210</td>
<td>245</td>
<td>500-730</td>
<td>35</td>
</tr>
<tr>
<td>X2 CrNiMo 17-12-3</td>
<td>1.4432</td>
<td>190</td>
<td>225</td>
<td>490-690</td>
<td>40</td>
</tr>
<tr>
<td>X2CrNiMoN17-13-3</td>
<td>1.4429</td>
<td>265</td>
<td>330</td>
<td>580-800</td>
<td>35</td>
</tr>
<tr>
<td>X3CrNiMo17-13-3</td>
<td>1.4436</td>
<td>205</td>
<td>240</td>
<td>510-710</td>
<td>40</td>
</tr>
<tr>
<td>X2CrNMo18-14-3</td>
<td>1.4435</td>
<td>190</td>
<td>225</td>
<td>490-690</td>
<td>40</td>
</tr>
<tr>
<td>X2CrNiMoN17-13-5</td>
<td>1.4439</td>
<td>285</td>
<td>315</td>
<td>580-800</td>
<td>35</td>
</tr>
<tr>
<td>X2CrNiMo18-15-4</td>
<td>1.4438</td>
<td>220</td>
<td>250</td>
<td>490-890</td>
<td>35</td>
</tr>
</tbody>
</table>
Table 6 - Mechanical properties for wall thicknesses up to 60 mm\(^a\) of austenitic steels in the solution annealed condition (+AT) and information about intergranular corrosion (concluded)

<table>
<thead>
<tr>
<th>Steel grade</th>
<th>Tensile properties at room temperature(^b)</th>
<th>Impact properties(^b)</th>
<th>Reference heat treatment conditions</th>
<th>Resistance to intergranular corrosion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proof strength</td>
<td>Tensile strength</td>
<td>Elongation</td>
<td>Minimum average absorbed energy KV</td>
</tr>
<tr>
<td>Steel name</td>
<td>Steel number</td>
<td>MPa</td>
<td>MPa</td>
<td>MPa</td>
</tr>
<tr>
<td>X1CrMoCu31-27-4</td>
<td>1.4563</td>
<td>215</td>
<td>245</td>
<td>500-750</td>
</tr>
<tr>
<td>X1NiCrMoCu25-20-5</td>
<td>1.4539</td>
<td>220</td>
<td>250</td>
<td>520-720</td>
</tr>
<tr>
<td>X1CrNiMoCuN20-18-7</td>
<td>1.4547</td>
<td>300</td>
<td>340</td>
<td>650-850</td>
</tr>
<tr>
<td>X1NiCrMoCuN25-20-7</td>
<td>1.4529</td>
<td>300</td>
<td>340</td>
<td>600-800</td>
</tr>
</tbody>
</table>

\(^a\) For wall thicknesses greater than 60 mm the mechanical properties are subject to agreement at the time of enquiry and order. **Option 9:** Agreed mechanical properties for wall thicknesses greater than 60 mm apply.

\(^b\) l = longitudinal; t = transverse.

\(^c\) For the delivery conditions W 0, W 1 and W 2 which do not include solution annealing, the upper \(R_m\) limit may be exceeded by 70 MPa.

\(^d\) The maximum temperatures are for guidance only.

\(^e\) w = water, a = air; cooling sufficiently rapid.

\(^f\) When tested according to EN ISO 3651-2 (Appropriate method, A or B or C, as indicated) up to the limit temperatures indicated in the last column of Table 8.

\(^g\) In delivery condition. (Normally not fulfilled in the sensitized condition.)
Table 7 - Mechanical properties for wall thicknesses up to 30 mm of austenitic-ferritic steels in the solution annealed condition (+AT) and information about intergranular corrosion

<table>
<thead>
<tr>
<th>Steel grade</th>
<th>Proof strength</th>
<th>Tensile strength</th>
<th>Elongation</th>
<th>Minimum average absorbed energy KV</th>
<th>Reference heat treatment</th>
<th>Resistance to intergranular corrosion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$R_{e,2}$, min.</td>
<td>$R_m$</td>
<td>$%$</td>
<td>at RT</td>
<td>at -40 °C</td>
<td>Solution temperature$^b$</td>
</tr>
<tr>
<td>Steel name</td>
<td>$R_{e,2}$, min.</td>
<td>$R_m$</td>
<td>$%$</td>
<td>at RT</td>
<td>at -40 °C</td>
<td>Solution temperature$^b$</td>
</tr>
<tr>
<td>X2CrNiMoN22-5-3</td>
<td>1.4462</td>
<td>450</td>
<td>700-920</td>
<td>25</td>
<td>20</td>
<td>120</td>
</tr>
<tr>
<td>X2CrNiN23-4</td>
<td>1.4362</td>
<td>400</td>
<td>600-820</td>
<td>25</td>
<td>25</td>
<td>120</td>
</tr>
<tr>
<td>X2CrNiMoN25-7-4</td>
<td>1.4410</td>
<td>550</td>
<td>800-1000</td>
<td>20</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>X2CrNiMoCuWN25-7-4</td>
<td>1.4501</td>
<td>550</td>
<td>800-1000</td>
<td>20</td>
<td>20</td>
<td>100</td>
</tr>
</tbody>
</table>

- $R_{e,2}$: proof strength
- $R_m$: tensile strength
- $\%$: elongation
- KV: minimum average absorbed energy
- Solution temperature: temperature for solution treatment
- Cooling: method of cooling after solution treatment
- d: method of testing for resistance to intergranular corrosion

$a$ $I =$ longitudinal; $t =$ transverse.

$b$ The maximum temperatures are for guidance only.

$c$ $w =$ water; $a =$ air; cooling sufficiently rapid.

$d$ When tested according to EN ISO 3651-2 (Appropriate method, A or B or C, as indicated) up to 250 °C.
### Table 8 - Minimum proof strength $R_{p0.2}$ and $R_{p0.1}$ at elevated temperatures for wall thicknesses up to 60 mm\(^a\) of austenitic steels in the solution annealed condition (+AT) and guideline for the limit temperature for intergranular corrosion

<table>
<thead>
<tr>
<th>Steel grade</th>
<th>Steel number</th>
<th>$R_{p0.2}$, min MPa at a temperature (°C) of</th>
<th>$R_{p0.1}$, min MPa at a temperature (°C) of</th>
<th>Limit temp.(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2CrNi18-9</td>
<td>1.4307</td>
<td>165 147 132 118 108 100 94 89 85 81 80</td>
<td>100 100 150 200 250 300 350 400 450 500 550</td>
<td>50 100 150 200 250 300 350 400 450 500 550</td>
</tr>
<tr>
<td>X2CrNi19-11</td>
<td>1.4306</td>
<td>165 147 132 118 108 100 94 89 85 81 80</td>
<td>100 100 150 200 250 300 350 400 450 500 550</td>
<td>50 100 150 200 250 300 350 400 450 500 550</td>
</tr>
<tr>
<td>X2CrNi18-10</td>
<td>1.4311</td>
<td>255 205 175 157 145 136 130 125 121 119 118</td>
<td>200 181 162 147 137 127 121 116 112 109 108 350</td>
<td></td>
</tr>
<tr>
<td>X5CrNi18-10</td>
<td>1.4301</td>
<td>180 157 142 127 118 110 104 98 95 92 90</td>
<td>218 191 172 157 145 135 129 125 122 120 120 300</td>
<td></td>
</tr>
<tr>
<td>X5CrNi18-10</td>
<td>1.4301</td>
<td>150 176 167 157 147 136 130 125 121 119 118</td>
<td>222 208 196 186 177 167 161 156 152 149 147 400</td>
<td></td>
</tr>
<tr>
<td>X6CrNiN18-10</td>
<td>1.4550</td>
<td>195 177 167 157 147 136 130 125 121 119 118</td>
<td>232 211 196 186 177 167 161 156 152 149 147 400</td>
<td></td>
</tr>
<tr>
<td>X2CrNiMo17-12</td>
<td>1.1104</td>
<td>162 166 152 137 127 118 113 108 103 100 98</td>
<td>217 199 181 167 157 145 139 135 130 128 127 100</td>
<td></td>
</tr>
<tr>
<td>X5CrNiMo17-12</td>
<td>1.4401</td>
<td>162 177 162 147 137 127 120 116 112 110 108</td>
<td>230 211 191 177 167 156 150 144 141 130 137 300</td>
<td></td>
</tr>
<tr>
<td>X6CrNiMo17-12</td>
<td>1.4571</td>
<td>202 185 177 167 157 145 140 135 131 129 127</td>
<td>232 218 206 196 186 175 169 164 160 158 157 400</td>
<td></td>
</tr>
<tr>
<td>X2 CrNiMo 17-12-3</td>
<td>1.4432</td>
<td>162 166 152 137 127 118 113 108 103 100 98</td>
<td>217 199 181 167 157 145 139 135 130 128 127 400</td>
<td></td>
</tr>
<tr>
<td>X2 CrNiMo17-13-3</td>
<td>1.4429</td>
<td>260 211 185 167 155 145 140 135 131 129 127</td>
<td>290 246 218 198 183 175 169 164 160 158 157 400</td>
<td></td>
</tr>
<tr>
<td>X3 CrNiMo17-13-3</td>
<td>1.4436</td>
<td>185 177 162 147 137 127 120 115 112 110 108</td>
<td>226 211 191 177 167 156 150 144 141 139 137 300</td>
<td></td>
</tr>
<tr>
<td>X2 CrNiMo18-14-3</td>
<td>1.4435</td>
<td>180 165 150 137 127 119 113 108 103 100 98</td>
<td>217 200 180 165 153 145 139 135 130 128 127 400</td>
<td></td>
</tr>
<tr>
<td>X2 CrNiMo17-13-5</td>
<td>1.4439</td>
<td>260 225 200 185 175 165 155 150 - - -</td>
<td>290 255 230 210 200 190 180 175 - - -</td>
<td>400</td>
</tr>
<tr>
<td>X2 CrNiMo18-15-4</td>
<td>1.4431</td>
<td>200 172 157 147 137 127 120 115 112 110 108</td>
<td>232 206 188 177 167 156 150 144 140 138 136 400</td>
<td></td>
</tr>
<tr>
<td>X1 NiCrMoCu31-27-24</td>
<td>1.4563</td>
<td>210 190 175 160 155 150 145 135 125 120 115</td>
<td>240 220 205 190 185 180 175 165 155 150 145 400</td>
<td></td>
</tr>
<tr>
<td>X1 NiCrMoCu25-20-5</td>
<td>1.4539</td>
<td>216 205 190 175 160 145 135 125 115 110 105</td>
<td>244 235 220 205 190 175 165 155 145 140 135 400</td>
<td></td>
</tr>
<tr>
<td>X1 NiCrMoCuNi20-18-7</td>
<td>1.4547</td>
<td>267 230 205 190 180 170 165 160 153 148 -</td>
<td>306 270 245 225 212 200 195 190 184 180 - - 400</td>
<td></td>
</tr>
<tr>
<td>X1 NiCrMoCuNi25-20-7</td>
<td>1.4529</td>
<td>270 230 210 190 180 170 165 160 150 120 105</td>
<td>310 270 245 225 215 205 195 190 180 150 150 400</td>
<td></td>
</tr>
</tbody>
</table>

---

\(^a\) For wall thicknesses greater than 60 mm the proof strength values are subject to agreement at the time of enquiry and order. **Option 10**: Agreed proof strength values at elevated temperature for wall thicknesses greater than 60 mm apply.

\(^b\) Up to these temperatures, the material should, within 100 000 h, not have changed so as to show susceptibility to intergranular corrosion, when tested in conformity with EN ISO 3551-2. See also Table 6.
Table 9 – Minimum proof strength \(R_{p0.2}\) at elevated temperatures for wall thicknesses up to 30 mm of austenitic-ferritic steels in the solution annealed condition (+AT) and guideline for the limit temperature for intergranular corrosion

<table>
<thead>
<tr>
<th>Steel grade</th>
<th>Steel number</th>
<th>50</th>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250a</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2CrNiMoN22-5-3</td>
<td>1.4462</td>
<td>415</td>
<td>360</td>
<td>335</td>
<td>310</td>
<td>295</td>
</tr>
<tr>
<td>X2CrNiN23-4</td>
<td>1.4362</td>
<td>370</td>
<td>330</td>
<td>300</td>
<td>280</td>
<td>265</td>
</tr>
<tr>
<td>X2CrNiMoN25-7-4</td>
<td>1.4410</td>
<td>502</td>
<td>450</td>
<td>420</td>
<td>400</td>
<td>380</td>
</tr>
<tr>
<td>X2CrNiMoCuWN25-7-4</td>
<td>1.4501</td>
<td>502</td>
<td>450</td>
<td>420</td>
<td>400</td>
<td>380</td>
</tr>
</tbody>
</table>

a Up to this temperature, the material should, within 100 000 h, not have changed so as to show susceptibility to intergranular corrosion, when tested in conformity with EN ISO 3651-2. See also Table 7.

8.4 Corrosion resistance

The information given in Tables 6 and 7 refers to the resistance of the steels to intergranular corrosion when tested according to EN ISO 3651-2 to the indicated method A or B or C.

Guideline values for the limit temperature for susceptibility to intergranular corrosion are indicated in Tables 8 and 9.

**Option 13:** A test for the resistance to intergranular corrosion shall be carried out.

If other specific corrosion tests are required, they shall be agreed at the time of enquiry and order.

8.5 Appearance and internal soundness

8.5.1 Appearance

8.5.1.1 The tubes shall be free from external and internal surface defects that can be established by visual inspection.

8.5.1.2 The internal and external surface finish of the tubes shall be typical of the manufacturing process and, where applicable, the heat treatment employed. Normally the finish and surface condition shall be such that any surface imperfections requiring dressing can be identified.

8.5.1.3 It shall be permissible to dress, only by grinding or machining, surface imperfections provided that, after doing so, the wall thickness in the dressed area is not less than the specified minimum thickness. All dressed areas shall blend smoothly into the contour of the tube.

8.5.1.4 Surface imperfections which encroach on the specified minimum wall thickness shall be considered defects and tubes containing these shall be deemed not to conform to this Part of EN 10217.

8.5.1.5 Repairs to the weld are permitted only by agreement with the purchaser. Any repairs shall be carried out before heat treatment and all repaired areas shall be non-destructively tested according to 11.11.

**Option 14:** Repair welding is permitted by agreement by the purchaser.

For tubes welded with or without filler metal, with a diameter greater or equal to 168,3 mm, weld repair may be made with the addition of compatible filler metal. Weld repairs shall not exceed 20 % of the seam length.

The repair welding shall be carried out according to a written welding procedure specification (WPS).
8.5.2 Internal soundness

8.5.2.1 General

The weld area shall be free from cracks, lack of fusion and lack of penetration.

8.5.2.2 Leak-tightness

The tubes shall pass a hydrostatic test (see 11.8.1) or an eddy current test (see 11.8.2) for leak-tightness.

Unless option 15 is specified, the choice of the test method is at the discretion of the manufacturer.

Option 15: The test method for verification of leak-tightness according to 11.8.1 or 11.8.2 is specified by the purchaser.

8.5.2.3 Non-destructive testing

The full length of the weld seam of tubes shall be submitted to a non-destructive testing for the detection of imperfections according to Clause 11.11.1.

Option 16: The tubes of test category 2 shall be submitted to a non-destructive testing for the detection of laminar imperfections at the tube ends according to Clause 11.11.2.

Option 17: The edges of strip or plate used for the manufacture of tubes of test category 2 shall be submitted to a non-destructive testing for the detection of laminar imperfections according to Clause 11.11.3.

8.6 Straightness

The deviation from straightness of any tube length L shall not exceed 0,0015 L. Deviations from straightness over any one meter length shall not exceed 3 mm.

8.7 Preparation of ends

Tubes shall be delivered with square cut ends. The ends shall be free from excessive burrs.

Option 18: Tubes with wall thickness ≥ 3,2 mm shall be delivered with bevelled ends (see figure 1). The bevel shall have an angle $\alpha$ of $30^\circ \pm 5^\circ$ with a root face C of 1,6 mm ± 0,8 mm, except that for wall thickness greater than 20 mm, an agreed alternative bevel may be specified.
**8.8 Dimensions, masses and tolerances**

**8.8.1 Outside diameter and wall thickness**

Tubes shall be ordered by outside diameter \( D \) and wall thickness \( T \). Preferred outside diameters \( D \) and wall thicknesses \( T \) are given in EN ISO 1127.

**8.8.2 Mass**

For the calculation of mass per unit length the density values given in EN 10088-1 shall be used.

**8.8.3 Lengths**

Unless Option 19 is specified, the tubes may be delivered in random lengths. The delivery range shall be agreed at the time of enquiry and order.

**Option 19:** The tubes shall be delivered in exact lengths and the length shall be specified at the time of enquiry and order. The tolerances on these lengths shall conform to 8.8.4.4.

**8.8.4 Tolerances**

**8.8.4.1 Tolerance on outside diameter and on wall thickness**

The diameter and the wall thickness of the tubes shall be within the relevant tolerance limits given in Table 10. Tolerance classes are according to EN ISO 1127.
8.8.4.2 Height of the weld seam

The height of the external and internal weld seam shall be within the limits indicated in Table 11.

**Table 11 - Maximum height of the weld seam**

<table>
<thead>
<tr>
<th>Route (according to Table 1)</th>
<th>Weld condition</th>
<th>Maximum height of the weld seam</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 and 04</td>
<td>As welded</td>
<td>T ≤ 8: 0,10 T + 0,5, T &gt; 8: T/6</td>
</tr>
<tr>
<td>02 and 05</td>
<td>Welded, outside ground for D ≤ 114,3</td>
<td>T ≤ 8: 0,06 T + 0,3, T &gt; 8: ---</td>
</tr>
<tr>
<td></td>
<td>Welded, outside ground for D &gt; 114,3</td>
<td>T ≤ 8: 0,05 T + 0,5, T &gt; 8: T/10</td>
</tr>
<tr>
<td>03 and 05</td>
<td>Welded, bead worked</td>
<td>T ≤ 8: 0,15, T &gt; 8: ---</td>
</tr>
</tbody>
</table>

8.8.4.3 Radial offset of plate or strip edges at the weld

The radial offset of the abutting plate or strip edges shall be within 10 % of the specified wall thickness.
8.8.4.4 Tolerances on exact lengths

The tolerances for exact lengths shall be as given in Table 12.

Table 12 - Tolerances on exact lengths

<table>
<thead>
<tr>
<th>Length $L$ (mm)</th>
<th>Tolerance on exact length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L \leq 6,000$</td>
<td>+ 5 0</td>
</tr>
<tr>
<td>$6000 &lt; L \leq 12,000$</td>
<td>+ 10 0</td>
</tr>
<tr>
<td>$L &gt; 12,000$</td>
<td>+ by agreement 0</td>
</tr>
</tbody>
</table>
8.8.4.5 Out of roundness

The out-of-roundness \( (0) \) shall be calculated using the following equation:

\[
0 = \frac{D_{\text{max}} - D_{\text{min}}}{D} \times 100
\]  

where:

\( 0 \) = out-of-roundness, in \%;

\( D_{\text{max}}, D_{\text{min}} \) = maximum and minimum outside diameter, measured in the same plane, in mm;

\( D \) = specified outside diameter, in mm.

For tubes of outside diameter \( D \leq 406.4 \) mm, out-of-roundness, shall be included in the limits of the diameter tolerances.

For tubes of outside diameter \( D > 406.4 \) mm and with \( D/T \leq 100 \), out-of-roundness shall not exceed 2 %.

For tubes with a \( D/T \) ratio > 100 the values for out-of-roundness shall be agreed at the time of enquiry and order.

9 Inspection

9.1 Type of inspection

Conformity to the requirements of the order, for tubes according to this Part of EN 10217, shall be checked by specific inspection.

When an inspection document 3.1.B is specified, the material manufacturer shall state in the confirmation of the order whether he is operating according to a “quality-assurance system”, certified by a competent Body established within the Community, and having undergone a specific assessment for materials and processes relevant to manufacture of welded tubes, including welding procedure approvals, welder/weld operator approval and NDT operator approval.

NOTE See Directive 97/23/EC Annex I section 4.3 third paragraph

9.2 Inspection documents

9.2.1 Types of inspection documents

Unless option 21 is specified, an inspection certificate 3.1.B, according to EN 10204, shall be issued.

Option 21: One of the inspection documents 3.1.C or 3.2 according to EN 10204 shall be issued.

If an inspection document 3.1.C or 3.2 is specified, the purchaser shall notify the manufacturer of the name and address of the organization or person who is to carry out the inspection and produce the inspection document. In the case of the inspection report 3.2 it shall be agreed which party shall issue the certificate.

9.2.2 Content of inspection documents

The content of the inspection document shall be according to EN 10168.

In all types of inspection documents a statement on the conformity of the products delivered with the requirements of the specification and the order shall be included.

The inspection certificate or inspection report shall contain the following codes and information:

A commercial transactions and parties involved;
B description of products to which the inspection document applies;

C01-C03 location of the samples and direction of the test pieces and testing temperature;

C10-C13 tensile test;

C40-C43 impact test if applicable;

C60-C69 other tests (e.g. flattening);

C71-C92 chemical composition on cast analysis (product analysis if applicable);

D01 marking and identification, surface appearance, shape and dimensional properties;

D02-D99 leak-tightness, NDT, material identification;
  — Reference to welding procedure approval;
  — Reference to welder and or welding operator approval;
  — Reference to non-destructive testing operators approval;

Z validation.

In addition for inspection document 3.1.B the manufacturer shall state the references to the certificate (see 9.1) of the appropriate "quality-assurance system", if applicable.

9.3 Summary of inspection and testing

The tubes shall be inspected and tested according to test category 1 or test category 2 as specified at the time of enquiry and order (see 6.1).

Inspection and testing to be carried out are summarised in Table 13.

10 Sampling

10.1 Test unit

A test unit shall comprise tubes of the same specified diameter and wall thickness, the same steel grade, the same cast, the same manufacturing process, subjected to the same finishing treatment in a continuous furnace or heat treated in the same furnace charge in a batch-type furnace.

The number of tubes, in random manufacturing lengths\(^1\) per test unit shall be max 100 with a total length of max. 2 000 m.

\(^1\) The random manufacturing lengths may differ from the delivery length (see 8.8.3)
Table 13 - Summary of inspection and testing

<table>
<thead>
<tr>
<th>Type of inspection and test</th>
<th>Frequency of testing</th>
<th>Refer to</th>
<th>Testing standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test category 1</td>
<td>Test category 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>one per cast</td>
<td>one per cast</td>
<td>11.1</td>
</tr>
<tr>
<td>Cast analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile test at room temperature</td>
<td>one per test unit</td>
<td>two per test unit</td>
<td>11.2.1 EN 10002-1</td>
</tr>
<tr>
<td>Flattening test(^\text{a}) or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ring tensile test(^\text{a}) or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drift expanding test(^\text{a}) or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ring expanding test(^\text{a}) or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weld bend test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leak tightness test</td>
<td>each tube</td>
<td></td>
<td>11.8 EN 10246-2</td>
</tr>
<tr>
<td>Dimensional inspection</td>
<td></td>
<td></td>
<td>11.9</td>
</tr>
<tr>
<td>Visual examination</td>
<td></td>
<td></td>
<td>11.10</td>
</tr>
<tr>
<td>NDT of the weld seam (^\text{b})</td>
<td>each tube</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Eddy current</td>
<td></td>
<td></td>
<td>11.11 EN 10246-3</td>
</tr>
<tr>
<td>b) Ultrasonic test</td>
<td></td>
<td></td>
<td>11.11 EN 10246-7</td>
</tr>
<tr>
<td>c) Ultrasonic test</td>
<td></td>
<td></td>
<td>11.11 EN 10246-9</td>
</tr>
<tr>
<td>d) Radiographic test</td>
<td></td>
<td></td>
<td>11.11 EN 10246-10</td>
</tr>
<tr>
<td>Material identification</td>
<td></td>
<td></td>
<td>11.12</td>
</tr>
<tr>
<td></td>
<td>one per cast</td>
<td>one per cast</td>
<td>11.1</td>
</tr>
<tr>
<td>Product analysis (Option 6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile test at elevated temperature (Option 11)</td>
<td>as agreed upon or one per cast and same heat treatment condition</td>
<td>as agreed upon or one per cast and same heat treatment condition</td>
<td>11.2.2 EN 10002-5</td>
</tr>
<tr>
<td>Tensile test of the weld (Option 22)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact test at room temperature (Option 8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact test at low temperature (Option 12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intergranular corrosion test (Option 13)</td>
<td></td>
<td></td>
<td>11.7 EN ISO 3651-2</td>
</tr>
<tr>
<td>Wall thickness measurement away from tube ends (Option 24)</td>
<td>each tube</td>
<td></td>
<td>11.9</td>
</tr>
<tr>
<td>Ultrasonic testing of strip and plate edges for detection of laminar imperfections (Option 17)</td>
<td>each tube</td>
<td></td>
<td>11.11 EN 10246-17</td>
</tr>
<tr>
<td>Ultrasonic testing for laminar imperfections (Option 16)</td>
<td>-</td>
<td></td>
<td>11.11 EN 10246-16</td>
</tr>
</tbody>
</table>

\(^\text{a}\) Testing method is at the manufacturer’s discretion, in accordance with Table 14.

\(^\text{b}\) Testing method is at the manufacturer’s discretion, but see footnote to Table 16.
10.2 Preparation of samples and test pieces

10.2.1 Selection and preparation of samples for product analysis

Samples for product analysis shall be taken from the test pieces or samples for mechanical testing or from the whole thickness of the tube at the same location as for the mechanical test samples, according to EN ISO 14284.

10.2.2 Location, orientation and preparation of samples and test pieces for mechanical tests

10.2.2.1 General

Samples and test pieces shall be taken at the tube ends and according to EN ISO 377.

10.2.2.2 Test pieces for the tensile test of the base material

The test pieces for the tensile test of the base material at room temperature shall be prepared according to EN 10002-1.

The test pieces for the tensile test of the base material at elevated temperature shall be prepared according to EN 10002-5.

At the manufacturer’s discretion:

— for tubes with an outside diameter \(D \leq 219.1\) mm, the test piece shall be either a full tube section or a strip section and be taken in a direction longitudinal to the axis of the tube;

— for tubes with an outside diameter \(D > 219.1\) mm and \(\leq 508\) mm, the test piece shall be taken in a direction either transverse, where possible, or longitudinal to the axis of the tube. The test piece shall be either a flattened strip or an unflattened and machined round bar specimen;

— for tubes with an outside diameter \(D > 508\) mm the test piece shall be taken in a direction transverse to the axis of the tube;

Strip sections and round bar specimens shall be taken from the side opposite the weld.

10.2.2.3 Test pieces for the tensile test of the weld

The test piece for the tensile test of the weld shall be taken transverse to the weld with the weld at the centre of the test piece. The test piece shall be a strip section with the full thickness of the tube and may be flattened; the weld bead may be removed.

Option 22: For tubes with an outside diameter greater than 219.1 mm a transverse tensile test on the weld is carried out.

10.2.2.4 Test pieces for the flattening, ring tensile, drift expanding and ring expanding tests

The test piece for the flattening, ring tensile, drift expanding and ring expanding tests shall consist of a full tube section according to EN 10233, EN 10237 or EN 10234 or EN 10236 respectively.

10.2.2.5 Test pieces for weld bend test

The test pieces for the weld bend test at the root and face shall be taken and prepared according to EN 910.

10.2.2.6 Test pieces for the impact test

Three standard Charpy V-notch test pieces shall be prepared according to EN 10045-1. If the nominal product thickness is such that standard test pieces cannot be produced without flattening of the section, then test pieces of width less than 10 mm, but not less than 5 mm shall be prepared; the largest obtainable width shall be used.

Where test pieces of at least 5 mm width cannot be obtained, the tubes shall not be subjected to impact testing.
The test pieces shall be taken transverse to the tube axis unless $D_{\text{min}}$, as calculated by the following equation, is greater than the specified outside diameter, in which case longitudinal test pieces shall be used:

$$D_{\text{min}} = (T-5) + \left[\frac{756.25}{(T-5)}\right]$$

(2)

For the location of the test pieces see 8.3, Options 8 and 12.

The test pieces shall be taken and prepared such that the axis of the notch is perpendicular to the surface of the tube, see Figure 2.

Key

1 Longitudinal test piece
2 Transverse test piece
Notch oriented perpendicular to tube axis

Figure 2 — Impact test piece orientation

10.2.2.7 Test pieces for the intergranular corrosion test

The test piece for the intergranular corrosion test shall be taken according to EN ISO 3651-2.

11 Test methods

11.1 Chemical analysis

The elements to be determined and reported shall be those specified in Tables 3 and 4. The choice of a suitable physical or chemical analytical method for the analysis shall be at the discretion of the manufacturer. In case of dispute the method used shall be agreed between manufacturer and purchaser taking into account CR 10261.

11.2 Tensile test on the base material

11.2.1 At room temperature

The test shall be carried out at room temperature according to EN 10002-1, and the following determined:

— the tensile strength ($R_m$);
— the 0.2 % proof strength ($R_{0.2}$) and, where applicable, the 1.0 % proof strength ($R_{1.0}$);
— the percentage elongation after fracture with a reference to a gauge length ($L_0$) of 5.65 $\sqrt{S_0}$; if a non-proportional test piece is used, the percentage elongation value shall be converted to the value for a gauge length $L_0 = 5.65 \sqrt{S_0}$ using the conversion Tables given in EN ISO 2566-2.
EN 10217-7:2005 (E)

11.2.2 At elevated temperature

The test shall be carried out in accordance with EN 10002-5 at the temperature agreed at the time of enquiry and order (see 6.2) and the 0.2 % proof strength ($R_{p0.2}$) and, where applicable, the 1.0 % proof strength ($R_{p1.0}$) shall be determined.

11.3 Transverse tensile test on the weld

The test shall be carried out in accordance with EN 10002-1 at room temperature and the 0.2 % proof strength ($R_{p0.2}$) shall be determined.

11.4 Technological tests

11.4.1 General

Depending on the tube dimensions one of the tests given in Table 14 shall be carried out.

<table>
<thead>
<tr>
<th>Outside diameter D mm</th>
<th>Wall thickness T mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2</td>
<td>≥ 2 ≤ 16</td>
</tr>
<tr>
<td>≤ 18</td>
<td>Flattening test$^a$, $^b$</td>
</tr>
<tr>
<td>18 &lt; D ≤ 150</td>
<td>Flattening test$^a$, $^b$</td>
</tr>
<tr>
<td>≥ 150</td>
<td>Ring tensile test$^c$</td>
</tr>
</tbody>
</table>

- $^a$ Weld alternatively in the horizontal position (3 o’clock position) or vertical position (12 o’clock position).
- $^b$ This test may, at the discretion of the manufacturer, be replaced by drift expanding test.
- $^c$ This test may, at the discretion of the manufacturer, be replaced by flattening test.
- $^d$ This test may, at the discretion of the manufacturer, be replaced by weld bend test.

11.4.2 Flattening test

The test shall be carried out according to EN 10233.

The tube section shall be flattened in a press until the distance $H$ between the platens reaches the value given by the following equation:

$$ H = \frac{1 + C}{C + T/D} \times T $$  \hspace{1cm} (3)

where:

- $H$ is the distance between platens, in mm, to be measured under load;
- $D$ is the specified outside diameter, in mm;
- $T$ is the specified wall thickness, in mm;
- $C$ is the constant factor of deformation, which is 0.07 for austenitic-ferritic steel and 0.09 for austenitic steel.

After testing, the test piece shall be free from cracks or breaks. However, slight incipient cracks at its edges shall not be regarded as justification for rejection.
11.4.3 Ring tensile test

The test shall be carried out according to EN 10237.

The tube section shall be subjected to strain in the circumferential direction until fracture occurs.

After fracture the test pieces shall not show any visible cracks without the use of magnifying aids (excluding the fracture point).

11.4.4 Drift expanding test

The test shall only be carried out for tubes having an outside diameter $D < 150$ mm and a wall thickness $T < 10$ mm.

The test shall be carried out according to EN 10234.

The tube section shall be expanded with a 60° conical tool until the % increase in outside diameter $D$ shown in Table 15 is reached.

After testing, the test piece shall excluding the fracture point be free from cracks or breaks. However, slight incipient cracks at its edges shall not be regarded as justification for rejection.

<table>
<thead>
<tr>
<th>% increase in outside diameter for $d/D$</th>
<th>\leq 0,6</th>
<th>&gt; 0,6 \leq 0,8</th>
<th>&gt; 0,8</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>15</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

Table 15 - Drift expanding test requirements

\[ a \quad d = D - 2T \]

11.4.5 Ring expanding test

The test shall be carried out according to EN 10236.

The tube section shall be expanded with a conical tool until it breaks. If an expansion of 40 % of the inside diameter for austenitic steel and of 30 % for austenitic-ferritic steel is reached the test may be considered as finished.

The surface outside the fracture zone shall excluding the fracture point be free from cracks or breaks. However, slight incipient cracks at its edges shall not be regarded as justification for rejection.

11.5 Weld bend test

The test shall be carried out according to EN 910 using a mandrel of a diameter of 3T. After testing the test piece shall show no cracks or flaws but slight premature failure at its edges shall not be regarded as a justification for rejection.

11.6 Impact test

11.6.1 The test shall be carried out according to EN 10045-1 at the temperature specified by the applicable option (see 6.2).

11.6.2 The mean value of the three test pieces shall meet the requirements given in Table 6 or 7. One individual value may be below the specified value, provided that it is not less than 70 % of that value.

11.6.3 If the width ($W$) of the test piece is less than 10 mm, the measured impact energy ($KV_p$) shall be converted to impact energy ($KV_c$) using the following equation:

\[ KV_c = \frac{10 \times KV_p}{W} \]
where:

\[ KV_c \] is the calculated impact energy, in J;
\[ KV_p \] is the measured impact energy, in J;
\[ W \] is the width of the test piece, in mm.

The calculated impact energy \( KV_c \) shall comply with the requirements given in 11.6.2.

11.6.4 If the requirements of 11.6.2 are not met, then an additional set of three test pieces may be taken at the discretion of the manufacturer from the same sample and tested. To consider the test unit as complying, after testing the second set, the following conditions shall be satisfied simultaneously:

- the average value of six tests shall be equal to or greater than the specified minimum average value;
- not more than two of six individual values may be lower than the specified minimum average value;
- not more than one of the six individual values may be lower than 70 % of the specified minimum average value.

11.6.5 The dimensions in millimetres of test pieces, the measured impact energy values and the resulting average value shall be reported.

11.7 Intergranular corrosion test

The intergranular corrosion test shall be carried out according to EN ISO 3651-2 to the specified method (A or B or C).

11.8 Leak tightness test

11.8.1 Hydrostatic test

The hydrostatic test shall be carried out at a test pressure of 70 bar\(^2\) or at a test pressure calculated using the following equation, whichever is lower:

\[
P = 20 \frac{S \times T}{D}
\]

where:

\[ P \] is the test pressure, in bar;
\[ D \] is the specified outside diameter, in mm;
\[ T \] is the specified wall thickness, in mm;
\[ S \] is the stress, in MPa, corresponding to 70 % of the specified minimum proof strength (see Tables 6 and 7) for the steel grade concerned.

The test pressure shall be held for not less than 5 s for tubes with an outside diameter \( D \leq 457 \text{ mm} \) and for not less than 10 s for tubes with an outside diameter \( D > 457 \text{ mm} \).

The tube shall withstand the test without showing leakage or visible deformation.

NOTE This hydrostatic leak-tightness test is not a strength test.

**Option 23:** A test pressure different from that specified in 11.8.1 and corresponding to a stress below 90 % of the specified minimum proof strength \( (R_{p0.2}) \) (see Tables 6 and 7) for the steel grade concerned is specified.

\(^2\) 1 bar = 100 KPa.
11.8.2 Eddy current test
The test shall be carried out according to EN 10246-2.

11.9 Dimensional inspection
Specified dimensions, including straightness, shall be verified.

The outside diameter shall be measured at the tube ends. For tubes with a \(D \geq 168.3\) mm, the diameter may be measured using a circumference tape.

Unless Option 24 is specified, the wall thickness shall be measured at both tube ends.

**Option 24:** *The wall thickness shall be measured away from the tube ends according to an agreed procedure.*

11.10 Visual examination
Tubes shall be visually examined to ensure conformity to the requirements of Clause 8.5.1.

11.11 Non-destructive testing

11.11.1 The full length of the weld seam of tubes shall be tested in accordance with the testing method and acceptance level given in Table 16.

<table>
<thead>
<tr>
<th>Testing method (^a)</th>
<th>Acceptance level for test category 1</th>
<th>Acceptance level for test category 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 10246-3(^b)</td>
<td>E1H or E2</td>
<td>E1H or E2</td>
</tr>
<tr>
<td>EN 10246-7</td>
<td>U3, sub-category C</td>
<td>U2, sub-category C</td>
</tr>
<tr>
<td>EN 10246-9(^c)</td>
<td>U3</td>
<td>U2</td>
</tr>
<tr>
<td>EN 10246-10</td>
<td>image class R2(^d)</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Unless Option 25 is specified, the test method used shall be at the discretion of the manufacturer.

\(^b\) Only for tubes with wall thickness not greater than 6 mm.

\(^c\) For submerged arc-welded tubes.

\(^d\) **Option 26:** *The image quality class R1 of EN 10246-10 shall be applied for the radiographic inspection of the weld seam*

Weld seam at the tube ends not automatically tested shall either be subjected to manual/semi-automatic ultrasonic testing according to EN 10246-7 to acceptance level U3, sub-category C for test category 1 and U2, sub-category C for test category 2 or be cropped off.

11.11.2 If Option 16 (see 8.5.2.3) is specified, the tubes of test category 2 shall be submitted to an ultrasonic testing for the detection of the laminar imperfections at the tube ends according to EN 10246-17.

11.11.3 If Option 17 (see 8.5.2.3) is specified, the strip/plate edges used for the manufacture of tubes of test category 2 shall be submitted to an ultrasonic testing for the detection of laminar imperfections according to EN 10246-16 to acceptance level U2.

11.12 Material identification
Each tube shall be tested by an appropriate method to ensure that the correct grade is being supplied.
11.13 Retests, sorting and reprocessing

See EN 10021.

12 Marking

12.1 Marking to be applied

Depending on the size of the tubes, the following marking shall either be applied on a label attached to the bundle or the box of tubes, or be marked indelibly on each tube at least at one end.

The marking shall include the following information:

— the manufacturer's name or trade mark;
— the dimension of the tubes;
— the number of this Part of EN 10217 and the steel name (or number) (see 5.2);
— the cast number or a code number;
— the category if applicable (see 7.2.1 and 7.2.3);
— the mark of the inspection representative;
— an identification number (e.g. order or item number) which permits the correlation of the product or delivery unit to the related document.

and at the discretion of the manufacturer:

— the symbol identifying the delivery condition (see Table 2).

Example of marking:

\[ X \quad 168,3 \times 4,5 \quad EN \, 10217-7 \quad X5CrNi18-10 \quad TC1 \quad W1 \quad Y \quad Z1 \quad Z2 \]

where:

\[ X \] is the manufacturer's mark;
\[ TC1 \] is the designation of the test category 1;
\[ W1 \] is the identification of the delivery condition as welded;
\[ Y \] is the cast number or a code number;
\[ Z1 \] is the mark of the inspection representative;
\[ Z2 \] is the identification number.

12.2 Additional marking

Option 27: Additional marking, as agreed upon at the time of enquiry and order, shall be applied.

13 Handling and packaging

The tubes shall be protected from carbon steel strapping, which shall not come into contact with the tubes.

Option 28: A special protection, as specified at the time of enquiry and order, shall be applied.
Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 97/23/EC

This European standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association in order to support essential safety requirement(s) (ESR) of the Pressure Equipment Directive 97/23/EC by providing technical solutions for specific ESRs.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the Clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

<table>
<thead>
<tr>
<th>Clauses/sub-Clauses of this EN</th>
<th>Pressure Equipment Directive 97/23/EC Annex I</th>
<th>Content</th>
</tr>
</thead>
<tbody>
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<td>7.2.3</td>
<td>3.1.2</td>
<td>Welding</td>
</tr>
<tr>
<td>7.2.1</td>
<td>3.1.3</td>
<td>NDT</td>
</tr>
<tr>
<td>8.3</td>
<td>4.1a</td>
<td>Appropriate material properties</td>
</tr>
<tr>
<td>8.2 and 8.3.2 Table 3, Table 4 and Table 8</td>
<td>4.1c</td>
<td>Ageing</td>
</tr>
<tr>
<td>7.2 and 8.5</td>
<td>4.1d</td>
<td>Suitable for the processing procedures</td>
</tr>
<tr>
<td>9 and 10</td>
<td>4.3</td>
<td>Documentation</td>
</tr>
</tbody>
</table>

Warning: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this European Standard.