Austenitic Stainless steel offer grade 304

Chemical composition

<table>
<thead>
<tr>
<th>Grade designation</th>
<th>European designation</th>
<th>American designation</th>
<th>IMDS Nr</th>
</tr>
</thead>
<tbody>
<tr>
<td>304 (18-9E)</td>
<td>X5CrNi18-10 / 1.4301</td>
<td>UNS 30400/ Type 304</td>
<td>336812649</td>
</tr>
<tr>
<td>304H (18-9H)</td>
<td>X6CrNi18-10 / 1.4948</td>
<td>UNS 30409/ Type 304</td>
<td>369292367</td>
</tr>
<tr>
<td>304D (18-9ED)</td>
<td>X5CrNi18-10 / 1.4301</td>
<td>UNS 30400/ Type 304</td>
<td>336812649</td>
</tr>
<tr>
<td>304ED (18-9DDQ)</td>
<td>X5CrNi18-10 / 1.4301</td>
<td>UNS 30400/ Type 304</td>
<td>336812649</td>
</tr>
</tbody>
</table>

Typical values (*) C mini = 0.04

French regulatory paper dated 13 January 1976 relating to materials and articles made of stainless steel in contact with foodstuffs.

Italian Decree of 21st March 1973: a list of stainless steel types appropriate to “Regulations on the hygiene of packaging, receptacles and tools intended to come into contact with substances for food use or with substances for personal use”

PED (Pressure Equipment Directive) according to EN 10028-7 and AD2000 Merkblatt W2 and W10 (TÜV w494).

General characteristics

The principal features of our grades 304 (304, 304H, 304D, 304ED) are:

- A general purpose grade
- Good resistance to pitting corrosion and crevice corrosion
- Good ductility
- Excellent weldability
- Good polish ability
- Very good drawability for 304D (18-9ED) and 304ED (18-9DDQ)

Applications

- Domestic appliances
- Sink units
- Metallic frames for the building industry
- Serving trays and cutlery
- Domestic cooking and catering equipment
- Dairy equipment
- Welded structures
- Decorative tubes
- Exhaust systems

Product range

Forms: Sheets, blanks, coils, strips, tubes
Thicknesses: from 0.3 up to 1.3 mm
Width: up to 2000 mm according to thickness
Finishes: cold rolled, hot rolled, patterned (tear plate), according to thickness
Physical properties

- Cold rolled and annealed sheet.
- **Density**: \( d \) kg/dm\(^3\) 20 °C 7.9
- **Melting Temperature**: °C Liquidus 1450
- **Specific heat**: \( c \) J/kg.K 20 °C 500
- **Thermal conductivity**: \( k \) W/m.K 20 °C 15
- **Mean coefficient of thermal expansion**: \( \alpha \) \(10^{-6}/K\)
  - 20-100 °C 16.0
  - 20-200 °C 16.5
  - 20-300 °C 17.0
  - 20-600 °C 17.5
  - 20-800 °C 18.0
- **Electric resistivity**: \( \rho \) Ω mm\(^2\)/m 20 °C 0.73
- **Magnetic resistivity**: \( \mu \) at 0.8 kA/m DC or AC 20 °C 1.02
- **Young’s Modulus**: \( E \) MPa \(10^3\) 20 °C 200
- **Poisson’s coefficient**: 0.30

Mechanical properties

**In the annealed condition**
In accordance with ISO 6892-1, part 1,
Test piece perpendicular to rolling direction.

**Test piece**
- Length = 80 mm (thickness < 3 mm)
- Length = \(5.65 \sqrt{S_o}\) (thickness ≥ 3 mm)
- Cold rolled

**Work hardened condition 304 (18-9E)**

**Creep properties**

Creep is defined by a slow deformation of the metal as a result from a long term exposure to a certain level of stress below the yield strength. Together with the duration, the temperature is a significant factor to determine the mean stress (MPa) for rupture.

**Grades**

<table>
<thead>
<tr>
<th>Grades</th>
<th>European designation</th>
<th>ASTM A240</th>
<th>Rm(^{(1)}) (MPa)</th>
<th>Rp₀.₂(^{(2)}) (MPa)</th>
<th>A(^{(3)}) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>304 (18-9E)</td>
<td>1.4301</td>
<td>304</td>
<td>650</td>
<td>300</td>
<td>54</td>
</tr>
<tr>
<td>304H (18-9H)</td>
<td>1.4948</td>
<td>304</td>
<td>670</td>
<td>285</td>
<td>57</td>
</tr>
<tr>
<td>304D (18-9ED)</td>
<td>1.4301</td>
<td>304</td>
<td>630</td>
<td>285</td>
<td>57</td>
</tr>
<tr>
<td>304ED (18-9DDQ)</td>
<td>1.4301</td>
<td>304</td>
<td>610</td>
<td>270</td>
<td>57</td>
</tr>
<tr>
<td>201D (17-4Mn)</td>
<td>1.4618</td>
<td>201</td>
<td>665</td>
<td>320</td>
<td>52</td>
</tr>
<tr>
<td>K41</td>
<td>1.4509</td>
<td>441(^{(4)})</td>
<td>480</td>
<td>310</td>
<td>30</td>
</tr>
<tr>
<td>K45</td>
<td>1.4621(^{(5)})</td>
<td>445(^{(4)})</td>
<td>510</td>
<td>360</td>
<td>29</td>
</tr>
</tbody>
</table>

\( Rm\) \( (%) \): * Typical values.
\( Rp₀.₂ \): \( (%) \): * Typical values.

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\(^{(1)}\) Ultimate Tensile Strength (UTS).
\(^{(2)}\) Yield Strength (YS).
\(^{(3)}\) Elongation (A).
\(^{(4)}\) Common designation.
\(^{(5)}\) Pending update of the standard.
Corrosion resistance

Our grades 304, 304H, 304D, 304ED (18-9E/H/ED/DDQ) steels have good resistance to the common corrosive media, but are not recommended where there is a risk of intergranular corrosion. They are well adapted for exposure in fresh water and urban and rural atmospheres. In all cases, regular cleaning of exposed external surfaces is necessary to conserve their original appearance. Our grades 304, 304H, 304D, 304ED (18-9E/H/ED/DDQ) steels have good resistance to various acids:

- phosphoric acid in all concentrations at ambient temperature
- nitric acid up to 65% (40° Baumé), between 20 and 50°C
- formic and lactic acids at room temperature
- acetic acid between 20 and 50°C.

It is recommended for use in contact with cold or hot foodstuffs, such as wine, beer, milk (curdled or otherwise), natural fruit juices, syrups, molasses, etc.

Pitting corrosion

Pitting potential in a NaCl 0.02M, pH = 6.6 aerated environment at 23°C / pitting potential (mV/ECS)

Crevice corrosion

Depassivation pH in a deaerated NaCl 2M environment at 23°C

Forming

In the annealed condition our 304, 304H, 304D, 304ED (18-9E/H/ED/DDQ) can be readily cold formed by all standard processes such as bending, contour forming, drawing, flow turning, etc. Some forming operations are more readily performed hot. Subsequent pickling is necessary. For severe forming operations, our grades 304, 304H, 304D, 304ED (18-9E/H/ED/DDQ) are to be preferred.

Deep drawing (Swift test)

The Swift test is a method to determine the Limiting Drawing Ratio (LDR). This LDR is defined by the maximum ratio between the blank diameter (variable) and the punch diameter (fixed) for which drawing can be performed successfully in one step.

<table>
<thead>
<tr>
<th>Grades</th>
<th>European designation</th>
<th>ASTM A240</th>
<th>LDR*</th>
</tr>
</thead>
<tbody>
<tr>
<td>304 (18-9E)</td>
<td>14301</td>
<td>301</td>
<td>1.96</td>
</tr>
<tr>
<td>304D (18-9ED)</td>
<td>14301</td>
<td>304</td>
<td>1.98</td>
</tr>
<tr>
<td>304ED (18-9DDQ)</td>
<td>14301</td>
<td>304</td>
<td>2.02</td>
</tr>
<tr>
<td>201D (17-4Mn)</td>
<td>14618</td>
<td>201.1</td>
<td>1.92</td>
</tr>
<tr>
<td>K41</td>
<td>14509</td>
<td>441</td>
<td>2.29</td>
</tr>
<tr>
<td>K45</td>
<td>14621</td>
<td>445</td>
<td>2.28</td>
</tr>
</tbody>
</table>

* Limiting Drawing Ratio - Lubricant = Mobilux EP00

Typical values tests done on 0.8mm thick.

Stretching (Erichsen test)

The stretching behaviour is characterized by the dome height (h) of the Erichsen test which is also known as Index ‘EI’.

Bending

Our grades 304, 304H, 304D, 304ED (18-9E/H/ED/DDQ) have a good bending capacity up to 180°, with very small bending radii for thicknesses below 0.8 mm. For thicker gauges, a bending radius of at least half the thickness of the sheet is recommended. When bending the material, the elastic springback always has to be taken into consideration.

Flow turning

Our grades 304, 304H, 304D, 304ED (18-9E/H/ED/DDQ-1.4301) are the most suitable for this application.

<table>
<thead>
<tr>
<th>Grades</th>
<th>European designation</th>
<th>ASTM A240</th>
<th>EI* (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>304 (18-9E)</td>
<td>14301</td>
<td>304</td>
<td>11.6</td>
</tr>
<tr>
<td>304D (18-9ED)</td>
<td>14301</td>
<td>304</td>
<td>11.8</td>
</tr>
<tr>
<td>304ED (18-9DDQ)</td>
<td>14301</td>
<td>304</td>
<td>12.0</td>
</tr>
<tr>
<td>201D (17-4Mn)</td>
<td>14618</td>
<td>201.1</td>
<td>11.9</td>
</tr>
<tr>
<td>K41</td>
<td>14509</td>
<td>441</td>
<td>9.4</td>
</tr>
<tr>
<td>K45</td>
<td>14621</td>
<td>445</td>
<td>9.5</td>
</tr>
</tbody>
</table>

* Erichsen Index – Lubricant = Mobilux EP00

Typical values tests done on 0.8mm thick.
Welding

<table>
<thead>
<tr>
<th>Welding process</th>
<th>No filler material</th>
<th>With filler metal</th>
<th>Shielding gas*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typical thicknesses</td>
<td>Thicknesses</td>
<td>Filler material</td>
</tr>
<tr>
<td>Resistance: spot, seam</td>
<td>&lt; 2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIG</td>
<td>&lt; 1.5 mm</td>
<td>&gt; 0.5 mm</td>
<td>ER 308 L(1) ER 347L (1)(2)</td>
</tr>
<tr>
<td>PLASMA</td>
<td>&lt; 1.5 mm</td>
<td>&gt; 0.5 mm</td>
<td>ER 308 L(1) ER 347L (1)(2)</td>
</tr>
<tr>
<td>MIG</td>
<td>&gt; 0.8 mm</td>
<td></td>
<td>ER 308 L(1) ER 347L (1)(2)</td>
</tr>
<tr>
<td>S.A.W.</td>
<td>&gt; 2 mm</td>
<td></td>
<td>E 308 L(1)</td>
</tr>
<tr>
<td>Electrode</td>
<td></td>
<td>Repairs</td>
<td>E 308L (1) E 347L(2)</td>
</tr>
<tr>
<td>Laser</td>
<td>&lt; 5 mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*ER 308L (AWS A5.9) = G 19 9 L (NF EN ISO 14343) ER 347 (AWS A5.9) = G 19 9 Nb (NF EN ISO 14343) ER308L (AWS A5.9) = E 19 9 L (EN1600) ER347 (AWS A5.9) = E 19 9 Nb (EN1600)

In general heat treatment is not required after welding. However, in order to fully restore the corrosion resistance of the metal, the welds must be mechanically or chemically descaled, then passivated and decontaminated. If there is a risk of intergranular corrosion, a solution annealing treatment at 1075 ± 25°C must be carried out. However, in this case a low carbon grade such as our 304 (18-9L) (1.4307, Type 304L) or titanium stabilized grades such as our 321 (18-10T) (1.4541, Type 321) are recommended.

Heat treatment and finishing

Annealing
After cold forming (work hardening) and after welding (risk of intergranular corrosion in the weld joint), an annealing treatment for a couple of minutes at 1075 ± 25°C followed by air cooling restores the microstructure (recrystallisation and dissolution of carbides) and eliminates internal stresses. After annealing, pickling followed by passivation is necessary.

Pickling
- Nitric-Hydrofluoric acid mixture (10% HNO₃ + 2% HF) at ambient temperature or up to 60°C.
- Sulfuric-nitric acid mixture (10% H₂SO₄ + 0.5% HNO₃) at 60°C.
- Descaling pastes for weld areas.

Passivation
- 20-25% HNO₃ solution (36° Baumé) at 20°C.
- Passivating pastes for weld zones.

Polishing
The surface of our 304 ED (18-9DDQ) is suitable for all kinds of polishing (grit, scotch-brite, electro polishing).

Size range

Our size range is based on our production capabilities. For the latest information per grades on our offer, please consult us.