

Austenitic Stainless Steel

Aperam 304L/304M Low Carbon

Chemical Composition

| Elements (%) | C | Si | Mn | Cr | Ni |
|--------------|-------|------|------|-------|-------|
| 304L | 0.025 | 0.40 | 1.40 | 18.20 | 8.05 |
| 304M | 0.025 | 0.40 | 1.30 | 18.20 | 10.10 |

Typical values.

| Grade designation | European designation | American designation | IMDS Nr |
|-------------------|---------------------------------------|--|-----------|
| 304L | X2CrNi18-9/ 1.4307 ⁽¹⁾ | UNS 30403/ Type 304L ⁽²⁾ | 336838649 |
| 304M | X2CrNi19-11/ 1.4306 ⁽¹⁾ | UNS 30403/ Type 304L ⁽²⁾ | 336813205 |

⁽¹⁾ According to EN 10088-2

⁽²⁾ According to ASTM A 240

These grades comply with:

- > Aperam Stainless Europe - Safety Information Sheet for Stainless Steel
- > European Directive 2000/53/EC on end-of-life vehicles and later modifications
- > NFA 36 711 standard "Stainless steel intended for use in contact with foodstuffs, products and beverages for human and animal consumption (non packaging steel)"
- > Requirements of NSF/ANSI 51 - 2009 edition international standard for "Food Equipment Materials" and with F.D.A. (United States Food and Drug Administration) requirements regarding materials used for food contact
- > French Decree No. 92-631, dated 8 July 1992, and Regulation No. 1935/2004 of the European Parliament and the Council, dated 27 October 2004, on materials and articles intended to come into contact with food (and repealing Directives 80/590/EEC and 89/109/EEC)

- > French regulatory paper dated 13 January 1976 relating to materials and articles made of stainless steel in contact with foodstuffs
- > Italian Decree of 21 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)
- > Lloyd's Register of shipping

Key Features

- > A general purpose grade
- > Good resistance to pitting and crevice corrosion
- > Very good resistance to intergranular corrosion
- > Good ductility
- > Excellent weldability
- > Can be easily polished
- > 304M offers very good drawability

Applications

- > Chemical engineering equipment
- > Food industry equipment
- > Dairy equipment
- > Piping and tubes
- > Welded structures
- > Cryogenic and food tanks and trailers
- > Storage vessels

Product Range

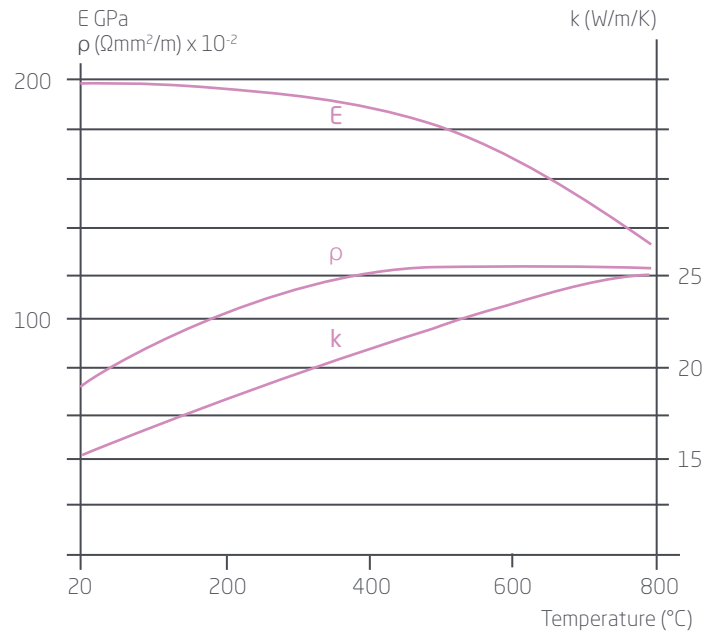
| | Coils | Sheets / Blanks | Discs | Precision Strip | Precision Sheet | Tubes | Flat Bars |
|----------------|-------------------|-------------------|-------------------|------------------------|------------------------|----------------|---------------|
| Thickness (mm) | 0.40 up to 13 | 0.40 up to 13 | 0.38 up to 2.50 | 0.06 up to 2.5 | 0.20 up to 2.5 | 0.80 up to 2.5 | 2 up to 20 |
| Width (mm) | up to 2,000 | 80 up to 2,000 | Ø 15 up to 1,000 | 3 up to 700 | 40 up to 670 | Ø 8 up to 80 | 10 up to 300 |
| Finish | 2R / 2B / 2D / 1D | 2R / 2B / 2D / 1D | 2R / 2B / 2D / 1D | 2R / 2B / 2D / 2H / 2F | 2R / 2B / 2D / 2H / 2F | 2B / 2D / 1D | 1D / Polished |

Physical Properties

Cold rolled and annealed sheet

| | | | | |
|------------------------------------|---|-------------------------|----------------------------------|----------------------|
| Density | d | kg/dm ³ | 20°C | 7.9 |
| Melting temperature | | °C | Liquidus | 1,420 |
| Specific heat | c | J/kg.K | 20°C | 500 |
| Thermal conductivity | k | W/m.K | 20°C | 15 |
| Mean thermal expansion coefficient | α | 10 ⁻⁶ /K | 20-100°C 20-200°C 20-400°C | 16.5 16.0 17.5 |
| Electric resistivity | ρ | Ω mm ² /m | 20°C | 0.73 |
| Magnetic resistivity | μ | at 0.8 kA/m DC or AC | 20°C | 1.01 |
| Young's modulus | E | GPa | 20°C | 200 |

Poisson's coefficient: 0.30



Mechanical Properties

Test piece

Length = 50 mm (thickness < 3 mm)
Length = 5.65 √ S₀ (thickness ≥ 3 mm)
Cold rolled

In the annealed condition

In accordance with ISO 6892-1, part 1
Test piece perpendicular to rolling direction

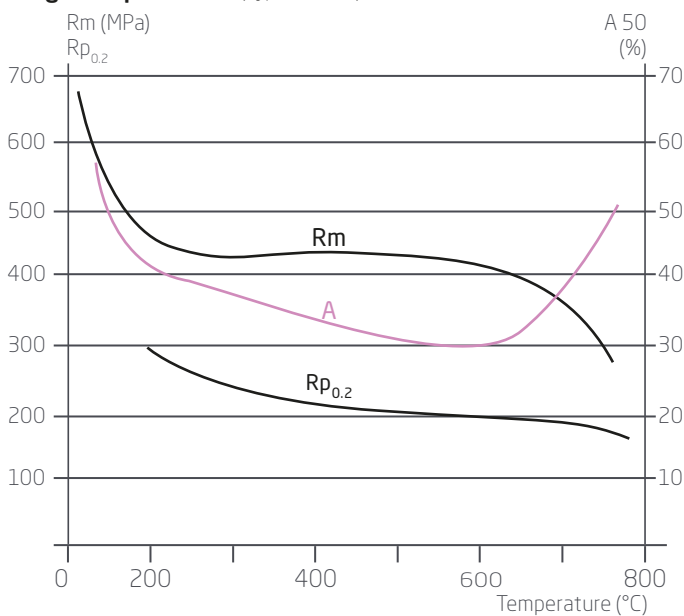
| Grades | European designation | ASTM A240 | Rm ⁽¹⁾ (MPa) | Rp _{0.2} ⁽²⁾ (MPa) | A ⁽³⁾ % |
|--------|-----------------------|--------------------|-------------------------|--|--------------------|
| 304L | 1.4307 | 304L | 630 | 300 | 54 |
| 304M | 1.4306 | 304L | 590 | 260 | 55 |
| 304 | 1.4301 | 304 | 650 | 300 | 54 |
| 201D | 1.4618 | 201.1 | 665 | 320 | 52 |
| K41 | 1.4509 | 441 ^(a) | 480 | 310 | 30 |
| K45 | 1.4621 ^(b) | 445 ^(a) | 510 | 360 | 29 |

1 MPa = 1 N/mm² - Typical values

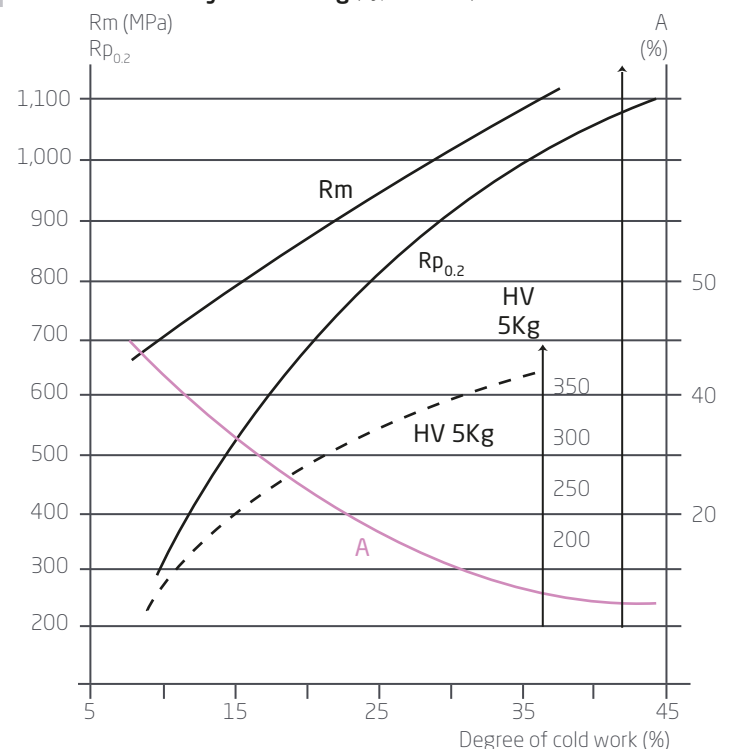
⁽¹⁾ Ultimate Tensile Strength (UTS) - ⁽²⁾ Yield Strength (YS) - ⁽³⁾ Elongation (A)

^(a) Common designation - ^(b) Pending update of the standard

At high temperatures (Typical values)



Work-hardened by cold rolling (Typical values)



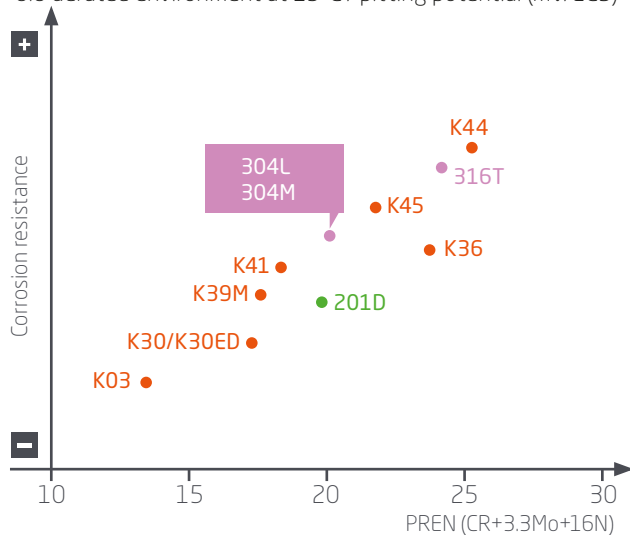
Corrosion Resistance

Our 304L and 304M grades generally exhibit good resistance to wet corrosion, which is ideal for the majority of applications and particularly whenever there is a risk of intergranular corrosion.

These grades meet the requirements of the standard tests defined by EN ISO 3651-2 (sensitizing treatments T1 and T2). They also show excellent behavior in urban and rural atmospheres.

Pitting corrosion

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



Pitting potential

Pitting potential will vary depending on temperatures and chloride concentrations.

| Grades | NaCl 0.02/23°C | NaCl 0.02/50°C | NaCl 0.05/23°C | NaCl 0.05/50°C |
|--------|----------------|----------------|----------------|----------------|
| 304L | 540 mV | 385 mV | 305 mV | 175 mV |

Typical values

Forming

In the annealed condition, our 304L and 304M grades can be readily cold formed using such standard processes as bending and profiling. These grades are particularly good in stretch forming processes, such as drawing, roll forming, spinning, contour forming, etc. Some forming operations can be performed more easily at higher temperatures. In such cases, subsequent pickling is necessary.

Deep drawing (Swift test)

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

Stretching (Erichsen test)

Stretching behaviour is characterized by the dome height (h) of the Erichsen test (also known as Index 'EI').

Bending

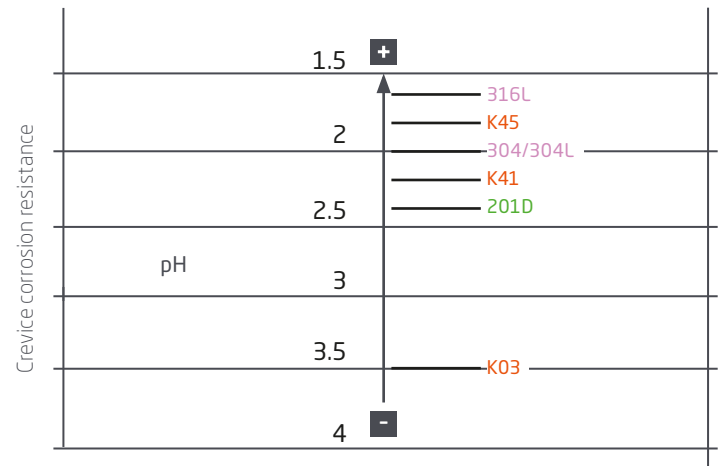
Good bending capacity up to 180°, with very small bending radii for thicknesses below 0.8 mm. For thicker gauges, a bending radius of at least half the thickness of the sheet is recommended.

Flow turning

Our 304ED (1.4301, Type 304) grade is the most suitable for this application. For severe forming operations, our 304D and 304ED grades are recommended.

Crevice corrosion

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

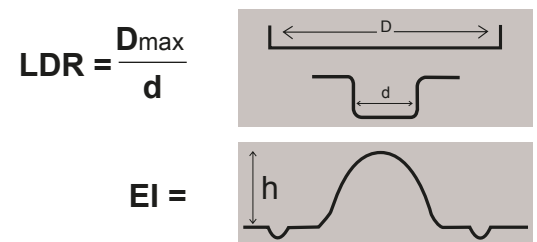


Crevice corrosion occurs in two phases. During the first phase, called initiation, discrete pits are formed locally within the crevice region when the pH is below the grade's depassivation pH. The second phase, called propagation, is when the metal begins to dissolve. This process can be slowed by using grades that contain molybdenum and nickel as both of these elements slow down propagation.

| Grades | European designation | ASTM A240 | LDR* | EI** (mm) |
|--------|----------------------|-----------|------|-----------|
| 304L | 1.4307 | 304L | 1.91 | 11.4 |
| 304M | 1.4306 | 304L | 1.91 | 11.5 |
| 304 | 1.4301 | 304 | 1.96 | 11.6 |
| 201D | 1.4618 | 201.1 | 1.92 | 11.9 |
| K41 | 1.4509 | 441 | 2.29 | 9.4 |
| K45 | 1.4621 | 445 | 2.28 | 9.5 |

* Limiting Drawing Ratio

** Erichsen Index - Lubricant = Mobilux EP00 - Typical values tests done on 0.8 mm thickness.



Welding

| Welding process | No filler material | With filler metal | | Shielding gas* | |
|------------------------|---------------------|-------------------|-------------------------|------------------------------|---|
| | Typical thicknesses | Thicknesses | Filler material | | * Hydrogen and nitrogen forbidden in all cases |
| | | | Rod | Wire | |
| Resistance: spot, seam | ≤ 2 mm | | | | |
| TIG | < 1.5 mm | > 0.5 mm | ER 308 L ⁽¹⁾ | ER 308 L ⁽¹⁾ | Ar Ar + 5% H Ar + He |
| PLASMA | < 1.5 mm | > 0.5 mm | | ER 308 L ⁽¹⁾ | Ar Ar + 5% H Ar + He |
| MIG | | > 0.8 mm | | ER 308 L (Si) ⁽¹⁾ | Ar + 2% CO ₂ Ar + 2% O ₂ Ar + 2% CO ₂ + 5% H Ar + 2% CO ₂ + He |
| SAW Electrode | | > 2 mm Repairs | E 308 L ⁽¹⁾ | ER 308 L ⁽¹⁾ | |
| Laser | < 5 mm | | | | He Under certain circumstances: Ar |

⁽¹⁾ER 308L (AWS A5.9) = G 19 9 L (NF EN ISO 14343)

Our 304L and 304M grades are designed for welding applications.

Whenever there is a risk of intergranular corrosion, using a low carbon grade such as 304L or 304M is recommended. In general, heat treatment is not required after welding. However, to fully restore the corrosion resistance of the metal, the welds must be mechanically or chemically descaled and then passivated and decontaminated.

Heat Treatment and Finishing

Annealing

After cold forming (work hardening) and welding, using an annealing treatment for a couple of minutes at 1,050°C ±25°C, followed by air cooling or water quenching, restores the microstructure (recrystallisation and dissolution of carbides) and eliminates internal stresses.

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
- > Use descaling pastes for weld areas

Passivation

- > 20-25% HNO₃ solution (36° Baumé) at 20°C
- > Use passivating pastes for weld zones

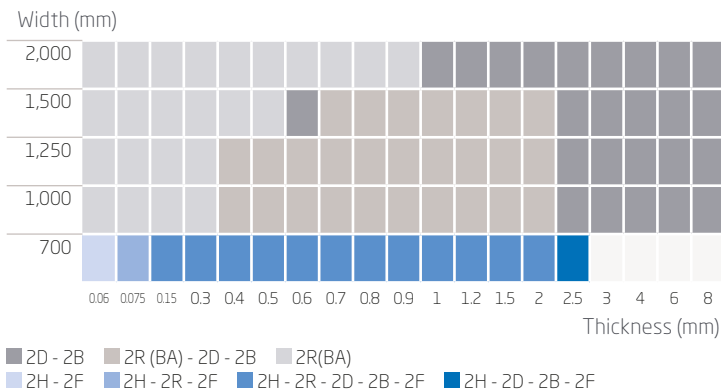
Polishing

Both 304L and 304M grades have surfaces that are suitable for all kinds of polishing (grit, scotch-brite, electro polishing).

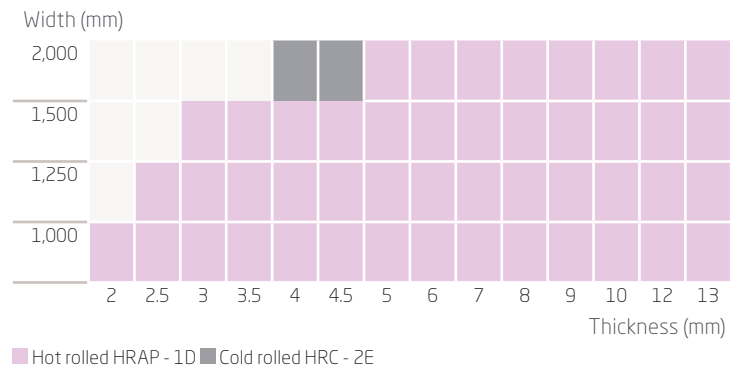
Size Range

Our size range is based on our production capabilities. Please contact us for the latest information per grades on offer.

Cold Rolled



Hot Rolled and HRC



■ 2D - 2B ■ 2R (BA) - 2D - 2B ■ 2R(BA)
■ 2H - 2F ■ 2H - 2R - 2F ■ 2H - 2R - 2D - 2B - 2F ■ 2H - 2D - 2B - 2F

■ Hot rolled HRAP - 1D ■ Cold rolled HRC - 2E



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