



UR™ 304LN – UR™ 304N

UR™ 304LN – UR™ 304N: A nitrogen containing 18Cr – 10Ni – 2Mo austenitic stainless steel

UR™ 304LN – UR™ 304N are nitrogen alloyed austenitic stainless steels. Nitrogen increases the yield strength of austenitic grades without impairing their ductility. The properties of UR™ 304LN – UR™ 304N are:

- > high strength and excellent ductility
- > good resistance to intergranular corrosion in the aswelded condition
- > excellent fabrication properties
- > low temperature toughness

UR™ 304LN – UR™ 304N are austenitic in the solution annealed condition (1000°C – 1100°C/1832°F – 2012°F) and rapid cooling in air or water. They contain a small amount of ferrite. UR™ 304LN – UR™ 304N are more stable than standard 304L grades against martensitic transformations induced by deformation at low temperature. The use of UR™ 304LN – UR™ 304N will usually result in notable weight savings in most structural or pressure retaining applications.

PROPERTIES

STANDARDS

- > EURONORM: UR™ 304LN: 1.4311 X2CrNiN18 – 10
UR™ 304N: 1.4315 X5CrNiN19 – 9
- > ASTM: UR™ 304LN: A 240 – TP 304LN – UNS S30453
UR™ 304N: A 240 – TP 304N – UNS S30451

CHEMICAL ANALYSIS – WEIGHT %

Typical values

| C | Cr | Ni | Mo | N | Others |
|-----|------|-----|----|-----|--------|
| .02 | 18.5 | 8.5 | - | .15 | - |

* High carbon content can be available on request

PHYSICAL PROPERTIES

Density: 7900 kg/m³

| Interval temperature (°C) | Thermal expansion ($\alpha \times 10^{-6} \text{ K}^{-1}$) | T (°C) (°F) | Resistivity ($\mu\Omega \cdot \text{cm}$) | Thermal conductivity ($\text{W m}^{-1} \text{ K}^{-1}$) | Specific heat ($\text{J kg}^{-1} \text{ K}^{-1}$) | Young modulus E (GPa) | Shear modulus G (GPa) |
|---------------------------|--|-------------|---|---|---|-----------------------|-----------------------|
| 20 - 100 | 16 | 20 (68) | 73 | 15 | 500 | 200 | 77 |
| 20 - 200 | 16.5 | 100 (212) | 77 | 16 | 500 | 194 | 75 |
| 20 - 300 | 17 | 200 (392) | 84 | 17.5 | 520 | 186 | 71 |
| 20 - 400 | 17.5 | 300 (572) | 91 | 19 | 530 | 179 | 68 |
| 20 - 500 | 18 | 400 (752) | 97 | 20.5 | 540 | 172 | 65 |
| | | 500 (932) | 102 | 22 | 540 | 165 | 62 |

MECHANICAL PROPERTIES

Tensile properties after solution annealing heat treatment - Minimum guaranteed values as per EN10088 - 2 hot rolled plates

| °C | °F | YS 0.2% | | YS 1% | | UTS | | Elongation |
|-----|-----|---------|-----|-------|-----|-----|-----|------------|
| | | MPa | Ksi | MPa | Ksi | MPa | Ksi | % |
| 20 | 68 | 270 | 40 | 310 | 43 | 570 | 83 | 40 |
| 100 | 212 | 205 | 30 | 240 | 32 | 490 | 71 | 35 |
| 200 | 392 | 157 | 23 | 187 | 26 | 430 | 63 | 30 |
| 300 | 572 | 136 | 20 | 167 | 23 | 410 | 60 | 30 |
| 400 | 752 | 125 | 19 | 156 | 21 | 400 | 58 | 25 |
| 500 | 932 | 119 | 18 | 149 | 20 | 390 | 57 | 25 |

The EN guaranteed values are valid for thicknesses from 5 up to 75 mm. Typical Y.S. values may be 20% higher than minimum values of Standards.

Guaranteed Impact values

| °C | - 253 | - 196 | +20 |
|--------------------------|-------|-------|------|
| °F | - 423 | - 320 | + 68 |
| KCV (J/cm ²) | 62 | 85 | 180 |

Typical creep strength values

| Temperature | 600°C (1112°F) | | 650°C (1202°F) | |
|---------------------|-----------------|-----------------|-----------------|-----------------|
| Time to rupture (H) | 10 ³ | 10 ⁴ | 10 ³ | 10 ⁴ |
| σ_R (MPa) | 205 | 160 | 150 | 100 |

IN SERVICE CONDITIONS

CORROSION RESISTANCE

Standardized corrosion tests (special request may be discussed)

| TEST | OTHER NAME | CORROSION | RESULTS |
|----------------------------------|------------|---------------|------------------------------|
| ASTM A262 A | - | Intergranular | Step or dual structure |
| ASTM A262 B | STREICHER | Intergranular | Not recommended |
| ASTM A262 C | HUEY | Intergranular | $\leq 0.6 \text{ mm/year}^*$ |
| ASTM A262 E DIN 50914 RCCM | STRAUSS | Intergranular | No cracking after bending |

*non sensitized sample

DELIVERY CONDITIONS

SIZE RANGE

| | Quarto plates | Clad plates |
|-----------|---------------------------------|----------------------|
| Thickness | 5 up to 150 mm 3/16" to 6" | Consult Industeel |
| Width | Up to 3800 mm* Up to 150" | |
| Length | Up to 16000 mm Up to 52.5 ft | |

Indicative dimensional programme * Width related to thickness; please consult for specific request.
Cut to length plates are available from Aperam.

PLATE PROCESSING

HOT FORMING

Hot forming should be carried out at temperatures between 1150 and 750°C (2102 - 1382°F). Solution annealing is not required if hot forming has been performed above 900°C (1652°F) followed by rapid cooling in air or water. The cleanliness of the surface is very important (avoid contaminations). A neutral or slightly oxidizing atmosphere is required. Due to the low thermal conductivity, the holding time of temperature may be longer than for carbon steel (about 50%).

COLD FORMING

UR™ 304LN - UR™ 304N can be cold formed without problem. Due to the nitrogen addition, it is less susceptible to martensitic transformation than cold formed UR™ 304L or UR™ 316Ti. UR™ 304LN - UR™ 304N may require more powerful equipments than structural steel because of their work hardening properties.

MACHINING

Due to its cold work hardening, the alloy is less machinable than structural steel or than a 13% Cr martensitic stainless steel.

| Operation | Tool | Lubrication | CONDITIONS | | |
|-------------------|------------------|--------------------|-----------------------------|-------------------------------|--------------------------|
| | | | Depth (mm) (inch) | Feed (mm/t) (inch/t) | Speed (m/min) (feet/min) |
| Turning | High speed steel | Cutting oil | 6 (0.23) | 0.5 (0.019) | 10 - 15 (33 - 49) |
| | | | 3 (0.11) | 0.4 (0.016) | 16 - 21 (52 - 69) |
| | | | 1 (0.04) | 0.2 (0.008) | 21 - 26 (69 - 85) |
| | Carbide | Dry or cutting oil | 6 (0.23) | 0.5 (0.019) | 60 - 70 (197 - 229) |
| | | | 3 (0.11) | 0.4 (0.016) | 75 - 85 (246 - 279) |
| | | | 1 (0.04) | 0.2 (0.008) | 90 - 100 (295 - 328) |
| | | | Depth of cut (mm) (inch) | Feed (mm/t) (inch/t) | Speed (m/min) (feet/min) |
| Cutting | High speed steel | Cutting oil | 1.5 (0.06) | 0.03 - 0.05 (0.0012 - 0.0020) | 14 - 19 (46 - 62) |
| | | | 3 (0.11) | 0.04 - 0.06 (0.0016 - 0.0024) | 16 - 21 (52 - 69) |
| | | | 6 (0.23) | 0.05 - 0.07 (0.0020 - 0.0027) | 18 - 23 (59 - 75) |
| | | | Drill Ø (mm) (inch) | Feed (mm/t) (inch/t) | Speed (m/min) (feet/min) |
| Drilling | High speed steel | Cutting oil | 1.5 (0.06) | 0.02 - 0.03 (0.0008 - 0.0012) | 8 - 12 (26 - 39) |
| | | | 3 (0.11) | 0.05 - 0.06 (0.0020 - 0.0024) | 10 - 24 (33 - 46) |
| | | | 6 (0.23) | 0.08 - 0.09 (0.0031 - 0.0035) | 10 - 14 (33 - 46) |
| | | | 12 (0.48) | 0.09 - 0.10 (0.0035 - 0.0039) | 10 - 14 (33 - 46) |
| | | | Feed (mm/t) (inch/t) | | Speed (m/min) (feet/min) |
| Milling profiling | High speed steel | Cutting oil | 0.05 - 0.10 (0.002 - 0.004) | | 9 - 19 (29 - 62) |

PLATE PROCESSING

PICKLING

A nitric - hydrofluoric acid bath (10 - 20% HNO₃ - 1,5 - 5% HF) at 20 - 60°C (68 - 142°F) is used for pickling. A 10 - 20% H₂SO₄ - 1,5 - 5% HF pickling bath may also be used. Decontamination treatments may be performed with a 10 - 20% weight nitric acid solution. Rinsing is necessary after pickling or decontamination.

CUTTING

- > Thermal cutting (plasma, thermal sawing...)
- > Mechanical cutting (shearing, stamping, cold sawing...)

After cutting, pickling or grinding are necessary to eliminate the oxide formed layer.

WELDING

UR™ 304LN - UR™ 304N are readily welded using the same methods as 304L. The alloy is not sensitive to cold cracking phenomenon. All welding processes can be used, including filler less processes.

Filler materials

| | |
|-----------|---|
| Electrode | E308L - 15 or E308L - 16 (ASME Sect II - Part C SFA 5 - 4) |
| Wire | ER 308L or ER 308Si (ASME Sect II - Part C SFA 5 - 9) |

Welds using 308L filler material are generally sufficient to guarantee the same mechanical properties as the base metal. Consult us in case of doubt. A post weld heat treatment is not necessary. 200°C (392°F) is the maximum interpass temperature. Post weld pickling is necessary to restore the corrosion resistance properties of the joints.

Nota: In case of low temperature (down to - 269°C) properties requirements, 308L fillers are not adapted. Please consult us for technical support.

APPLICATIONS

The main applications are:

- > Chemical industry
- > Natural gas denitrogenation and decarburization columns
- > Petrochemical industry
- > Liquid gas production and storage
- > Space equipment testing facilities
- > Tanks and containers for rail or road transportation (higher mechanical properties than 304L)
- > Building infrastructures

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Technical data and information are to the best of our knowledge at the time of printing. However, they may be subject to some slight variations due to our ongoing research programme on steels. Therefore, we suggest that information be verified at time of enquiry or order. Furthermore, in service, real conditions are specific for each application. The data presented here are only for the purpose of description, and considered as guarantees when written formal approval has been delivered by our company. Further information may be obtained from the address opposite.