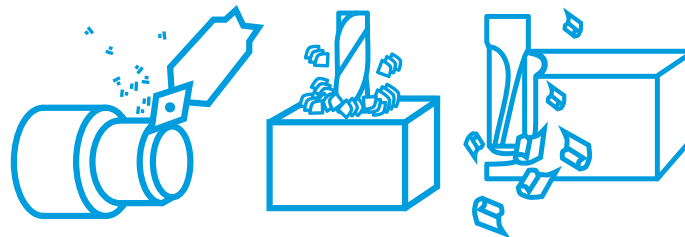


Stainless steel grades optimized for improved machinability

Outokumpu Prodec range datasheet

General characteristics

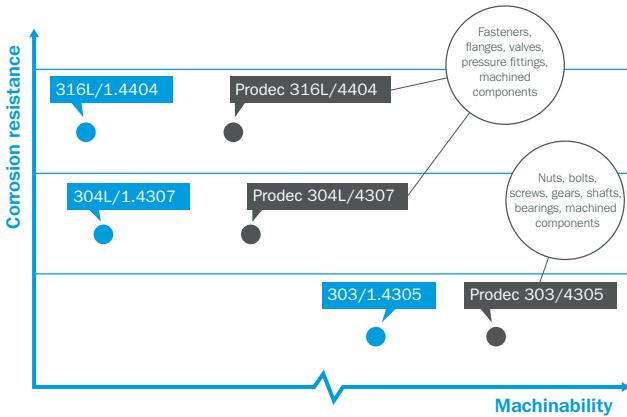
Stainless steel grades optimized for improved machinability with longer tool life and enhanced quality.



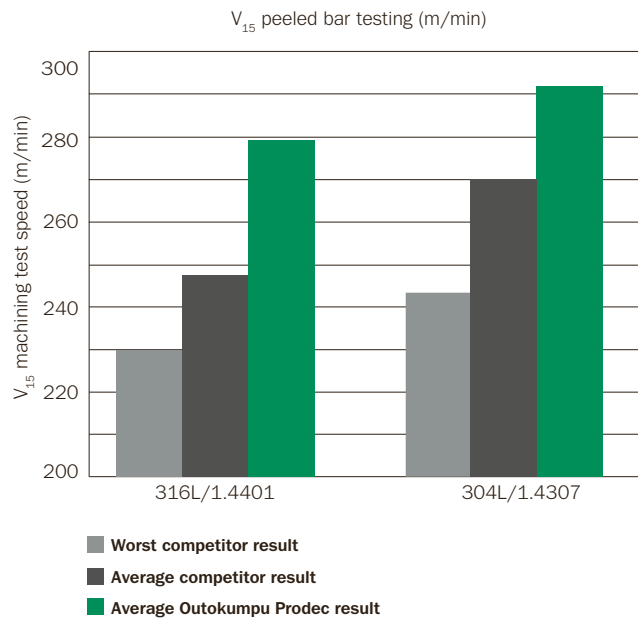
| Outokumpu name | Typical applications | Product forms |
|--|--|---------------------------------------|
| <p>Prodec 304L/4307</p> <p>A version of Core 304L/4307 with improved machinability. Improves productivity with faster machining, longer tool life, better dimensional tolerances, superior machined surface quality, and improved yields compared to conventionally produced Core 304L/4307.</p> | <ul style="list-style-type: none"> • Fasteners • Flanges and valves • Pressure fittings • Machined components | <p>Plate</p> <p>Bar</p> <p>Billet</p> |
| <p>Prodec 316L/4404</p> <p>A version of Supra 316L/4404 with improved machinability. Improves productivity with faster machining, longer tool life, better dimensional tolerances, superior machined surface quality, and improved yields compared to conventionally produced Supra 316L/4404.</p> | <ul style="list-style-type: none"> • Fasteners • Flanges and valves • Pressure fittings • Machined components | <p>Plate</p> <p>Bar</p> <p>Billet</p> |
| <p>Prodec 303/4305</p> <p>For applications that use 303/1.4305. This product gives you faster machining, longer tool life, better tolerances, superior machined surface quality, and reduced scrap losses compared to conventionally produced 303/1.4305.</p> | <ul style="list-style-type: none"> • Nuts, bolts, and screws • Gears • Shafts • Bearings • Machined parts for process equipment | <p>Plate</p> <p>Bar</p> <p>Billet</p> |
| <p>Prodec 17-4PH</p> <p>A martensitic, precipitation hardening stainless steel for applications that use Dura 17-4PH. It improves productivity with faster machining, longer tool life, better dimensional tolerances, superior machined surface quality, and improved yields when compared to conventionally produced Dura 17-4PH.</p> | <ul style="list-style-type: none"> • Fasteners • Flanges • Oil field valve equipment • Pressure fittings • Chemical process equipment • Paper mill equipment • Aircraft parts | <p>Bar</p> <p>Billet</p> |

Product performance comparison

Corrosion resistance vs machinability



Bar – faster machining with Prodec



Testing done with Outokumpu Prodec and 7 European competitors' bars with improved machinability in grades 316L/4404 and 304L/4307. The tool used for testing was a CNMG 2015 cemented carbide insert.

Bar – cost savings with Prodec

| | | Standard 316L/4404 | Prodec 316L/4404 | Improvement | |
|--------------------------------|-------|--------------------|------------------|-------------|-----|
| Cutting speed | m/min | 92 | 137 | 45 | |
| | sfm | 300 | 450 | 150 | |
| Processing time/component | min | 16.9 | 7.7 | | 54% |
| Total machining cost/component | € | 23.1 | 10.6 | 12.6 | 55% |
| | \$ | 26.6 | 12.1 | 14.5 | 55% |
| Productivity increase | % | | | | 54% |
| Savings/component | € | | | 12.6 | |
| | \$ | | | 14.5 | |

A cost saving example for rough turning a 6" diameter Prodec 316L/4404 peeled bar with a cemented carbide tool.

Plate – real practice results from ring to flange on a CNC turning machine

| | | Supra 316/4404 | Prodec 316L/4404 | Improvement | |
|-----------------|--------|----------------|------------------|-------------|-----------|
| Speed | m/min | 110 | 160 | 50 | 45% |
| Feed | mm/rev | 0.25 | 0.3 | 0.05 | 20% |
| Depth | mm | 1.5 | 2 | 0.5 | 33% |
| Processing time | min | 21.1 | 15.7 | 5.4 | 26% |
| Tool lifetime | pieces | 3–6* | 9 | 3–6 | 150%–300% |

* Depending on material. Tools: CC Sandvik and Sumitomo Electric.

Products and dimensions

To find more information about the Prodec range, please visit steelfinder.outokumpu.com

| Metric | |
|------------|---------------|
| Round bar | Offering (mm) |
| Cold drawn | 6–25.4 |
| Peeled | 12.7–400 |
| Black bar | 30–400 |

| Imperial | |
|------------|---------------|
| Round bar | Offering (in) |
| Cold Drawn | 0.25–1.00 |
| Peeled | 0.50–15.75 |
| Black | 1.19–15.75 |

| Metric | |
|------------------------|---------------|
| Hexagon and square bar | Offering (mm) |
| Hexagon | 8–60 |
| Square | 8–70 |

| Imperial | |
|------------------------|---------------|
| Hexagon and square bar | Offering (in) |
| Hexagon | 0.31–3.00 |
| Square | 0.31–3.00 |

| Metric (Degerfors Sweden) | |
|---------------------------|--------------------|
| Hot rolled plate | Max. offering (mm) |
| Width | 3200 |
| Thickness | 130 |
| Length | 13500 |

| Imperial (New Castle) | |
|-----------------------|--------------------|
| Hot rolled plate | Max. offering (in) |
| Width | 140 |
| Thickness | 6 |
| Length | 420 |

Chemical composition

The chemical composition is given as % by mass.

| Outokumpu name | EN | ASTM | | PRE | Family | C | Cr | Ni | Mo | N | Others |
|------------------|--------|------|--------|-----|--------|------|------|------|-----|---|----------|
| | | Type | UNS | | | | | | | | |
| Prodec 304L/4307 | 1.4307 | 304L | S30403 | 18 | A | 0.02 | 18.1 | 8.1 | – | – | – |
| Prodec 316L/4404 | 1.4404 | 316L | S31603 | 24 | A | 0.02 | 17.2 | 10.1 | 2.1 | – | – |
| Prodec 303/4305 | 1.4305 | 303 | S30300 | 17 | A | 0.05 | 17.2 | 8.1 | – | – | 0.3S |
| Prodec 17-4PH | 1.4542 | 630 | S17400 | 16 | PH | 0.02 | 15.5 | 4.8 | – | – | 3.4Cu Nb |

Chemical compositions and PRE calculations are based on Outokumpu typical values.

For the chemical composition list for different standards by stainless steel product, please see steelfinder.outokumpu.com

Pitting Resistance Equivalent is calculated using the following formula: $PRE = \%Cr + 3.3 \times \%Mo + 16 \times \%N$

Surface finish and other factors determine the actual corrosion resistance of a particular product. Please contact us by outokumpu.com/contacts to discuss which product is right for your next project.

Corrosion resistance

Although improvements in machinability have been associated with reduced corrosion resistance in the past, the Prodec range products have shown corrosion resistance within the range typically expected from comparable stainless steel products.

Prodec 304L/4307 is a versatile, general-purpose stainless steel with good resistance to atmospheric corrosion, many organic and inorganic chemicals, as well as foods and beverages. It has also been used in vacuum-processing equipment and specialized instruments where high integrity is essential.

Prodec 316L/4404 provides improved resistance to pitting and crevice corrosion in environments containing chlorides and other halides.

Prodec 303/4305 is resistant to mildly corrosive environments. In order to achieve the best possible corrosion resistance, all Prodec 303/4305 parts should be chemically treated to remove sulfides from the final surface.

Prodec 17-4PH is a precipitation hardening product with corrosion resistance similar to that of Core 304/4301. It is used in applications where a combination of moderate corrosion performance and high strength is required.

Mechanical properties

| Metric | | | | | | |
|------------------|---------------------|--|--|--|----------------------------------|---------------------------|
| Outokumpu name | Product form | Min. yield strength R _{p0.2} (MPa) | Min. yield strength R _{p1.0} (MPa) | Tensile strength R _m (MPa) | Elongation A ₅ (%) | Hardness (HBW) max. |
| Prodec 304L/4307 | Plate ¹⁾ | 200 | 240 | 500-700 | 45 | – |
| | Hot Rolled Bar | 175 | – | 500-700 | 45/35 ²⁾ | 215 |
| | Cold Drawn Bar | 400/380/175 ³⁾ | – | 600-930/600-930/500-830 | 25/25/30 | – |
| Prodec 316/4404 | Plate ¹⁾ | 220 | 260 | 520-670 | 45 | – |
| | Hot Rolled Bar | 200 | – | 500-700 | 40/30 ²⁾ | 215 |
| | Cold Drawn Bar | 400/380/200 | – | 600-930/580-930/500-830 | 25/25/30 | – |
| Prodec 303/4305 | Plate ¹⁾ | 190 | 230 | 500-700 | 35 | – |
| | Hot Rolled Bar | 190 | – | 500-750 | 35 | 230 |
| | Cold Drawn Bar | 400/400/190 | – | 600-950/600-950/500-850 | 15/15/20 | – |
| Prodec 17-4PH | Hot Rolled Bar | 520 | – | 800-950 | 18 ⁴⁾ | – |
| | Cold Drawn Bar | 600/600/520 | – | 900-1100/900-1100/800-1050 | 10/10/12 ⁴⁾ | 360/360/360 ⁵⁾ |

Minimum values for plate according to EN 10088-2, Hot Rolled Bars and Cold drawn bars according to EN 10088-3.

For Prodec 17-4PH the values are from +P800 condition.

¹⁾ For thicknesses >110 mm restrictions in mechanical properties

²⁾ d<=160 long/160<d<=250 trans

³⁾ d<=10mm/10<d<=16/16<d<=40

⁴⁾ Elongation A (%)

⁵⁾ HB max

Physical properties

| Metric | | | | | | |
|------------------|----------------------------------|--|--|---|--|--|
| Outokumpu name | Density [kg/dm ³] | Modulus of elasticity at 20 °C [GPa] | Coefficient of thermal expansion 20–100 °C [10 ⁻⁶ /K] | Thermal conductivity at 20 °C [W/(m*K)] | Thermal capacity at 20 °C [J/(kg*K)] | Electrical resistivity at 20 °C [Ω*mm ² /m] |
| Prodec 304L/4307 | 7.9 | 200 | 16.0 | 15 | 500 | 0.73 |
| Prodec 316/4404 | 8.0 | 200 | 16.0 | 15 | 500 | 0.75 |
| Prodec 303/4305 | 7.9 | 200 | 16.0 | 15 | 500 | 0.73 |
| Prodec 17-4PH | 7.8 | 200 | 10.9 | 16 | 500 | 0.71 |

Values according to EN 10088-1.

| Imperial | | | | | | |
|------------------|-----------------------------------|--------------------------------|---|---|-------------------------------------|-----------------------------------|
| Outokumpu name | Density [lbm/in ³] | Modulus of elasticity [psi] | Coefficient of thermal expansion 68-212 °F [μin/(in* °F)] | Thermal conductivity [Btu/(hr*ft* °F)] | Thermal capacity [Btu/(lbm* °F)] | Electrical resistivity [μΩ*in] |
| Prodec 304L/4307 | 0.285 | 29 * 10 ⁶ | 8.89 | 8.7 | 0.119 | 28.74 |
| Prodec 316/4404 | 0.289 | 29 * 10 ⁶ | 8.89 | 8.7 | 0.119 | 29.53 |
| Prodec 303/4305 | 0.285 | 29 * 10 ⁶ | 8.89 | 8.7 | 0.119 | 28.74 |
| Prodec 17-4PH | 0.282 | 29 * 10 ⁶ | 6.06 | 9.2 | 0.119 | 27.95 |

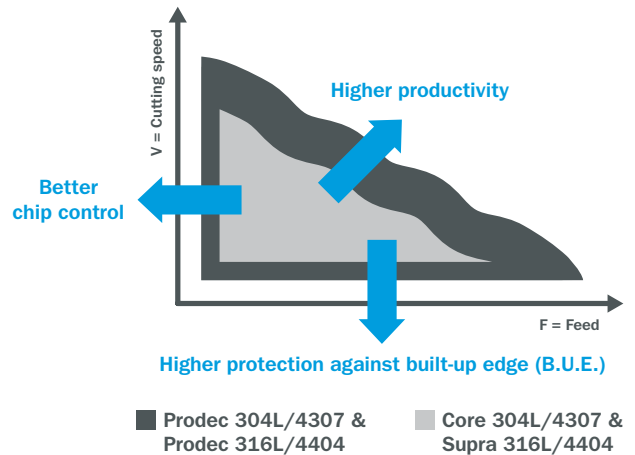
Values according to EN 10088-1.

Fabrication

Machining

Prodec range products enable higher machining speeds, longer tool life, and superior part quality with reduced total cost for finished parts.

Prodec 304L/4307 and Prodec 316L/4404 are special variants of standard Types 304 (UNS S30400) / 304L (UNS S30403) and 316 (UNS S31600) / 316L (UNS S31603) respectively with enhanced metallurgy for better machinability. The general rules for machining stainless steel also apply to the Prodec grades. The difference is that Prodec grades enable a longer tool life and/or tougher machining conditions. The machining window illustrated on the right gives a demonstration of this.



Machining guidelines

The cutting parameters in this guideline will work under normal cutting conditions. It is suggested to begin with cutting parameters in the ranges indicated in the tables and then to improve parameters by moving to higher or lower speed, feed or depth of cut until best performance is reached. It is possible to end up in a range somewhat outside the values indicated in the tables depending on the actual machine set-up. A guide for further optimization of cutting parameters can be found in the **Machining Guideline Datasheet**.

Turning

- The machine and setup must be rigid.
- Use shortest possible tool length.
- Use coolant.
- Use smallest possible nose radius to avoid vibrations.

Milling

- Avoid cutting through holes/cavities.
- Ensure good chip evacuation, recutting of chips may cause tool damage.

Drilling – high speed steel twist drills

- Use coolant.
- If possible use internal coolant through drill.
- Use of cobalt high alloyed drills is preferred.
- With PVD-coated HSS drills the cutting speed can be increased by 10%.
- Use as short a drill as possible.

Machining parameters for Prodec 304L/4307 and Prodec 316L/4404

| Turning | Carbide Tooling | | | | HSS Tooling | | |
|-----------|----------------------------|---------------|---------------|------------|-----------------|---------------|------------|
| | Depth of cut or width (mm) | Speed (m/min) | Feed (mm/rev) | Tool Grade | Speed (m/min) | Feed (mm/rev) | Tool Grade |
| Finishing | -2 | 260–280 | 0.10 | M10–15 | 50 ¹ | 0.10 | T15 |
| Medium | 2–5 | 200–260 | 0.25 | M10–25 | 35 | 0.25 | T15 |
| Roughing | 5–10 | 50–220 | 0.40 | M25–35 | 20 | 0.40 | T15 |

¹ Coated tools

| Milling | Carbide Tooling | | | HSS Tooling | | |
|--------------------------|-----------------|---------------|------------|---------------|---------------|------------|
| | Speed (m/min) | Feed (mm/rev) | Tool Grade | Speed (m/min) | Feed (mm/rev) | Tool Grade |
| Face milling | 150–250 | 0.08–0.30 | M10–30 | 24–40 | 0.08–0.20 | T15 |
| Side milling | 180–240 | 0.08–0.30 | M10–30 | 24–40 | 0.08–0.20 | T15 |
| End milling | 150–220 | 0.05–0.20 | M10–30 | 24–40 | 0.025–0.15 | T15 |
| End milling ² | 50–100 | 0.05–0.20 | M35 | – | – | – |

² Solid cemented carbide

| Drilling ³ | HSS Tooling | | | |
|-----------------------|---------------|---------------|---------------|---------------|
| | Diameter (mm) | Speed (m/min) | Feed (mm/rev) | Rpm (rev/min) |
| | 1 | 10–12 | 0.05 | 3200–3800 |
| | 3 | 15–17 | 0.10 | 1600–1800 |
| | 5 | 17–20 | 0.12 | 1080–1270 |
| | 10 | 17–20 | 0.15 | 540–640 |
| | 15 | 17–20 | 0.20 | 360–430 |
| | 20 | 17–20 | 0.30 | 270–320 |
| | 30 | 17–20 | 0.30 | 180–220 |

³ HSS-5%Co

Guidance for other machining operations can be found in our Machining Guidelines. For more information concerning machining, please contact our sales offices.

outokumpu.com/contacts

Forming

Cold forming

Prodec range products can be readily formed and fabricated with the full range of cold forming operations. They can be used in heading, drawing, bending, and upsetting. Cold forming operations will increase the strength and hardness of the material, and may leave it slightly magnetic.

For Prodec 17-4PH, cold forming or fabrication should be completed prior to the final solution annealing and age hardening treatments.

Hot forming

Prodec 303/4305, Prodec 304L/4307, and Prodec 316L/4404 can be forged in the 925–1200 °C/1700–2200 °F range. For maximum corrosion resistance, forgings should be annealed at a minimum temperature of 1030°C/1900 °F and then water quenched or rapidly cooled by other means after hot forming operations.

Prodec 17-4PH should be uniformly heated to 1175–1200 °C /2150–2200 °F for a minimum of one hour. It should not be forged below about 1000 °C/1850 °F. Forgings must be solution annealed before the final aging treatment.

Welding

Prodec 304L/4307 is readily weldable with the full range of conventional welding methods with the exception of oxyacetylene. AWS E308/ER308 or E308L/ER308L filler metals should be used, but molybdenum-containing austenitic stainless steel filler metals may also be considered. After welding, it may be necessary to fully anneal to restore the corrosion resistance lost by sensitization to intergranular corrosion when chromium carbides were precipitated in the grain boundaries in the weld heat-affected zone (HAZ).

Prodec 316L/4404 is readily welded with the full range of conventional welding methods with the exception of oxyacetylene. AWS E316L/ER316L and other low-carbon filler metals with a molybdenum content higher than that of the base metal should be used.

Prodec 303/4305 stainless steel is not recommended for applications requiring welding. When welding is necessary, AWS E312 filler metal may be considered. An alternative product for parts requiring welding is Prodec 304L/4307.

Prodec 17-4PH can be satisfactorily welded with either 630 or AWS E308L/ER308L welding consumables. However, the 308L filler metal cannot be heat treated to the same mechanical properties as the base metal. The thermal cycle associated with welding can substantially alter the condition of Prodec 17-4PH. To obtain the properties considered characteristic of Prodec 17-4PH, the material should be solution annealed and aged after welding.

For more information, see the Outokumpu Welding Handbook, available from our sales offices.

[outokumpu.com/contacts](https://www.outokumpu.com/contacts)

Standards and approvals

The most commonly used international product standards are given in the table below. For a list of standards by product, see [steelfinder.outokumpu.com](https://www.outokumpu.com/steelfinder)

Standards

EN10088-2
EN 10088-3
EN 10088-4
EN 10088-5
EN 10272
ASME SA479
ASTM A479/479M
ASTM A276
ASTM A555
ASTM A493

Certificates and approvals

Outokumpu meets the most common certifications and approvals, including:

- AD 2000 Merkblatt
- Approval of Material Manufacturers
- Factory Production Control Certificate
- ISO 9001
- ISO 14001
- ISO 50001
- ISO/TS 16949
- NORSOK
- OHSAS 18001
- Pressure Equipment Directive (PED)

For the list of certificates and approvals by mill, see [outokumpu.com/certificates](https://www.outokumpu.com/certificates)

Contacts and enquiries

Contact us

Our experts are ready to help you choose the best stainless steel product for your next project.

[outokumpu.com/contacts](https://www.outokumpu.com/contacts)

Own notes

A series of horizontal dotted lines for taking notes.

Working towards forever.

We work with our customers and partners to create long lasting solutions for the tools of modern life and the world's most critical problems: clean energy, clean water, and efficient infrastructure. Because we believe in a world that lasts forever.

| outokumpu classic | | | outokumpu pro | | | | | | |
|--|---------------------------------------|---|--|--|------------------------------|--|---|---------------------------------|--|
| Moda Mildly corrosive environments | Core Corrosive environments | Supra Highly corrosive environments | Forta Duplex & other high strength | Ultra Extremely corrosive environments | Dura High hardness | Therma High service temperatures | Prodec Improved machinability | Deco Special surfaces | |

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