

# Moda 430/4016

EN 1.4016, ASTM TYPE 430 / UNS S43000

## General characteristics

Moda 430/4016 is a classic 16% chromium ferritic stainless steel. Good corrosion resistance in mildly corrosive environments combined with good formability have made this product one of the most used non-hardenable ferritics, especially in indoor environments.

## Typical applications

- Kitchen equipment
- Household appliances
- Sinks
- Flanges and valves

## Products & dimensions

### Cold rolled products, available dimensions (mm)

| Surface finish |   | Coil / Strip |         | Plate / Sheet |          |
|----------------|---|--------------|---------|---------------|----------|
|                |   | Thickness    | Width   | Thickness     | Width    |
| 2A             | 2A  | 0.50-1.00    | 35-1280 | 0.50-1.00     | 35-1280  |
| 2B             | Cold rolled, heat treated, pickled, skin passed | 0.30-5.00    | 12-1550 | 0.30-5.00     | 18-1550  |
| 2BB            | Bright-pickled                                  | 0.25-3.50    | 30-1524 | 0.25-3.50     | 35-1300  |
| 2C             | Cold rolled, heat treated                       | 0.80-5.00    | 30-1530 |               |          |
| 2E             | Cold rolled, heat treated, mech. desc. pickled  | 0.33-5.00    | 12-1530 | 0.33-5.00     | 18-1530  |
| 2F             | Cold rolled, heat treated, skin passed          | 0.33-3.58    | 12-1524 | 0.33-3.58     | 18-1524  |
| 2G             | Ground  | 0.40-3.58    | 12-1530 | 0.40-3.58     | 18-1530  |
| 2H             | Work hardened                                   | 0.05-5.00    | 3-1530  | 0.30-5.00     | 18-1530  |
| 2J             | Brushed or dull polished                        | 0.40-3.00    | 30-1530 | 0.40-3.00     | 35-1530  |
| 2K             | Satin finish                                    | 0.53-3.58    | 12-1530 | 0.53-3.58     | 18-1530  |
| 2M             | Patterned                                       | 0.40-3.50    | 30-1524 | 0.40-3.50     | 600-1500 |
| 2R             | Cold rolled, bright annealed                    | 0.05-3.00    | 3-1500  | 0.20-3.00     | 18-1500  |

### Continous hot rolled products, available dimensions (mm)

| Surface finish |  | Coil / Strip |         | Plate / Sheet |       |
|----------------|--|--------------|---------|---------------|-------|
|                |  | Thickness    | Width   | Thickness     | Width |
| 1C             | Hot rolled, heat treated, not descaled | 2.00-8.00    | 50-1530 |               |       |

|    |                                       |           |          |           |          |
|----|---------------------------------------|-----------|----------|-----------|----------|
| 1D | Hot rolled, heat treated, pickled     | 2.50-8.00 | 50-1524  | 2.50-8.00 | 350-1524 |
| 1E | Hot rolled, heat treated, mech. desc. | 1.50-3.00 | 50-1530  | 1.50-3.00 | 50-1530  |
| 1G | Ground                                | 2.00-3.00 | 750-1455 | 2.00-3.00 | 750-1455 |
| 1H | Hot rolled, temper rolled             | 2.00-2.50 | 35-1550  |           |          |
| 1M | Patterned                             | 2.00-3.00 | 750-1455 | 2.00-3.00 | 750-1455 |
| 1U | Black hot rolled                      | 2.00-8.00 | 50-1550  |           |          |

## Chemical composition

The typical chemical composition for this grade is given in the table below, together with composition limits given for the product according to different standards. The required standard will be fully met as specified on the order.

The chemical composition is given as % by mass.

|                  | C           | Mn    | Cr          | Ni    | Mo    | N | Other |
|------------------|-------------|-------|-------------|-------|-------|---|-------|
| <b>Typical</b>   | <b>0.05</b> |       | <b>16.2</b> |       |       |   |       |
| ASME II A SA-240 | ≤0.12       | ≤1.00 | 16.0-18.0   | ≤0.75 |       |   |       |
| ASTM A240        | ≤0.12       | ≤1.00 | 16.0-18.0   | ≤0.75 |       |   |       |
| EN 10088-2       | ≤0.08       | ≤1.0  | 16.0-18.0   |       |       |   |       |
| EN 10088-3       | ≤0.08       | ≤1.00 | 16.0-18.0   |       |       |   |       |
| EN 10088-4       | ≤0.08       | ≤1.0  | 16.0-18.0   |       |       |   |       |
| IS 6911          | ≤0.12       | ≤1.00 | 16.0-18.0   | ≤0.75 | ≤0.30 |   |       |

## Corrosion resistance

Moda 430/4016 provides good corrosion resistance in fresh water, steam, mild acids and bases, as well as in oxidizing acids (e.g. nitric acid). It performs best with a smooth surface finish (e.g. polished or buffed).

Like all ferritic grades, Moda 430/4016 is not susceptible to chloride-induced stress corrosion cracking. Resistance to pitting and crevice corrosion is lower than that of austenitic chromium-nickel stainless grades. Moda 430/4016 resists intergranular attack only in the as-delivered condition, not after local heat input e.g. through welding.

The relatively high chromium content of Moda 430/4016 contributes to good oxidation resistance, also in intermittent service. In continuous service the maximum scaling temperature is about 815 °C.

| Pitting corrosion resistance |     | Crevice corrosion resistance |
|------------------------------|-----|------------------------------|
| PRE                          | CPT | CCT                          |
| 16                           | <10 | <0                           |

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

Corrosion Pitting Temperature (CPT) as measured in the Avesta Cell (ASTM G 150), in a 1M NaCl solution (35,000 ppm or mg/l chloride ions).

Critical Crevice Corrosion Temperature (CCT) is obtained by laboratory tests according to ASTM G 48 Method F

For detailed information please refer to Outokumpu Corrosion Handbook or contact Outokumpu.

## Mechanical properties

| Cold rolled coil and sheet      | R <sub>p0.2</sub><br>MPa | R <sub>p1.0</sub><br>MPa | R <sub>m</sub><br>MPa | Elongation <sup>1)</sup><br>% | Impact<br>strength J | Rockwell | HB    | HV |
|---------------------------------|--------------------------|--------------------------|-----------------------|-------------------------------|----------------------|----------|-------|----|
| <b>Typical (thickness 1 mm)</b> | <b>365</b>               | <b>390</b>               | <b>520</b>            | <b>50</b>                     |                      |          |       |    |
| ASME II A SA-240                | ≥ 205                    |                          | ≥ 450                 |                               |                      |          | ≤ 183 |    |

|            |       |  |           |      |  |         |       |  |
|------------|-------|--|-----------|------|--|---------|-------|--|
| ASTM A240  | ≥ 205 |  | ≥ 450     |      |  | ≤ 89HRB | ≤ 183 |  |
| EN 10088-2 | ≥ 260 |  | 430 - 600 | ≥ 20 |  |         |       |  |
| EN 10088-4 |       |  |           |      |  |         |       |  |
| IS 6911    | ≥ 205 |  | ≥ 450     |      |  | ≤ 89HRB | ≤ 183 |  |

| Hot rolled coil and sheet       | R <sub>p0.2</sub><br>MPa | R <sub>p1.0</sub><br>MPa | R <sub>m</sub><br>MPa | Elongation <sup>1)</sup><br>% | Impact<br>strength J | Rockwell | HB        | HV |
|---------------------------------|--------------------------|--------------------------|-----------------------|-------------------------------|----------------------|----------|-----------|----|
| <b>Typical (thickness 4 mm)</b> | <b>370</b>               | <b>395</b>               | <b>515</b>            | <b>21</b>                     |                      |          | <b>80</b> |    |
| ASME II A SA-240                | ≥ 205                    |                          | ≥ 450                 |                               |                      |          | ≤ 183     |    |
| ASTM A240                       | ≥ 205                    |                          | ≥ 450                 |                               |                      |          | ≤ 183     |    |
| EN 10088-2                      | ≥ 240                    |                          | 430 - 600             | ≥ 18                          |                      |          |           |    |
| EN 10088-4                      |                          |                          |                       |                               |                      |          |           |    |
| IS 6911                         | ≥ 205                    |                          | ≥ 450                 |                               |                      | ≤ 89HRB  | ≤ 183     |    |

| Hot rolled quarto plate          | R <sub>p0.2</sub><br>MPa | R <sub>p1.0</sub><br>MPa | R <sub>m</sub><br>MPa | Elongation <sup>1)</sup><br>% | Impact<br>strength J | Rockwell | HB    | HV |
|----------------------------------|--------------------------|--------------------------|-----------------------|-------------------------------|----------------------|----------|-------|----|
| <b>Typical (thickness 15 mm)</b> | <b>365</b>               |                          | <b>505</b>            | <b>20</b>                     |                      |          |       |    |
| ASME II A SA-240                 | ≥ 205                    |                          | ≥ 450                 |                               |                      |          | ≤ 183 |    |
| ASTM A240                        | ≥ 205                    |                          | ≥ 450                 |                               |                      |          | ≤ 183 |    |
| EN 10088-2                       | ≥ 260                    |                          | 430 - 630             | ≥ 20                          |                      |          |       |    |
| EN 10088-4                       | ≥ 260                    |                          | 430 - 630             |                               |                      |          |       |    |
| IS 6911                          | ≥ 205                    |                          | ≥ 450                 |                               |                      | ≤ 89HRB  | ≤ 183 |    |

| Wire rod       | R <sub>p0.2</sub><br>MPa | R <sub>p1.0</sub><br>MPa | R <sub>m</sub><br>MPa | Elongation <sup>1)</sup><br>% | Impact<br>strength J | Rockwell | HB | HV |
|----------------|--------------------------|--------------------------|-----------------------|-------------------------------|----------------------|----------|----|----|
| <b>Typical</b> | <b>280</b>               |                          | <b>450</b>            | <b>25</b>                     |                      |          |    |    |

<sup>1)</sup> Elongation according to EN 10088-2:

A<sub>80</sub> for thickness < 3 mm

A for thickness ≥ 3 mm

Elongation according to ASTM A240:

A<sub>2</sub> or A<sub>50</sub>

# Physical properties

Data according to EN 10088-1.

| Density            | Modulus of elasticity | Thermal exp. at 100 °C | Thermal conductivity | Thermal capacity | Electrical resistance | Magnetizable |
|--------------------|-----------------------|------------------------|----------------------|------------------|-----------------------|--------------|
| kg/dm <sup>3</sup> | GPa                   | 10 <sup>-6</sup> /°C   | W/m°C                | J/kg°C           | μΩm                   |              |
| 7.7                | 220                   | 10                     | 25                   | 460              | 0.60                  | Yes          |

## Fabrication

### Forming

Moda 430/4016 is readily cold formed by, for example, bending, deep drawing, stretch forming, and upsetting. Due to its lower work hardening rate in comparison with austenitic stainless steels, forming requires less force, but severe forming operations should be avoided since ferritic grades are less ductile than austenitics. In some cases an intermediate anneal between forming steps could be required.

Furthermore, the cold formability of ferritics is largely dependent on material thickness and forming temperature because they are subject to low temperature brittleness. Cold forming of flat material thicker than 5 mm or > 15 mm diameter rounds is not recommended.

When bending ferritic sheet material it is advised that the bend radius is at least twice the sheet thickness and the bend axis at right angle to the rolling direction.

### Machining

Moda 430/4016 is relatively easy to machine. Compared to austenitic grades, it has a lower tendency to build up edges, which in turn renders a larger machining window. Since the machinability is comparable to that of structural carbon steels, the same recommendations regarding choice of tool, cutting speed, and cutting feed apply.

### Welding

Moda 430/4016 is considered to be weldable with certain limitations. Basically the common fusion and resistance techniques can be applied, but expert consultation is advised. When cooling down from temperatures above 900 °C sensitization to intergranular corrosion attack is likely. In addition, grain coarsening and martensite formation lead to embrittlement of the weld and HAZ. This is due to the high carbon content of Moda 430/4016 and missing stabilizing elements (Nb, Ti).

More detailed information concerning welding procedures can be obtained from the Outokumpu Welding Handbook, available from our sales offices.

# Standards & approvals

This stainless steel grade is covered by the following standards and approvals:

| Standard                           | Designation           |
|------------------------------------|-----------------------|
| ASME SA-240M Code Sect. II. Part A | TYPE 430 / UNS S43000 |
| ASTM A240/A240M                    | TYPE 430 / UNS S43000 |
| EN 10088-2                         | 1.4016                |
| EN 10088-3                         | 1.4016                |
| EN 10088-4                         | 1.4016                |
| IS 6911, AMENDMENT NO. 2           | ISS 430               |

List is not exhaustive.

## Contacts & Enquiries

**Contact your nearest sales office**

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

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