

# Moda 439/4510

EN 1.4510, ASTM TYPE 439 / UNS S43035

## General characteristics

Moda 439/4510 is a titanium-stabilized 17% chromium ferritic steel with improved corrosion resistance, formability, and weldability compared to Moda 430/4016.

Moda 439/4510 is a medium-chromium ferritic stainless steel, which can be used in many mildly corrosive environments. Because of its titanium alloying, Moda 439/4510 can be welded in all dimensions without becoming susceptible to intergranular corrosion. It is possible to use Moda 439/4510 at elevated temperatures, for instance the cold end of automotive exhaust systems.

## Typical applications

- Automotive exhaust systems
- Sugar industry equipment
- Household appliances

## Products & dimensions

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

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
2B	Cold rolled, heat treated, pickled, skin passed	0.33-3.58	12-1550	0.33-3.58	18-1550
2BB	Bright-pickled	0.30-3.50	30-1530	0.30-3.50	350-1530
2C	Cold rolled, heat treated	0.80-3.00	30-1530		
2D	Cold rolled, heat treated, pickled	0.30-3.50	30-1530	0.30-3.50	350-1500
2E	Cold rolled, heat treated, mech. desc. pickled	0.33-3.58	12-1530	0.33-3.58	18-1530
2F	Cold rolled, heat treated, skin passed	0.33-3.58	12-1524	0.33-3.58	18-1524
2G	Ground	0.30-3.58	12-1530	0.30-3.58	18-1530
2J	Brushed or dull polished	0.30-3.00	30-1530	0.30-3.00	350-1530
2K	Satin finish	0.53-3.58	12-1524	0.53-3.58	18-1524
2M	Patterned	0.30-3.50	30-1530	0.30-3.50	350-1530
2R	Cold rolled, bright annealed	0.05-3.00	3-1500	0.40-3.00	350-1500
2S	Surface coated	0.40-3.00	30-1500		

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1C	Hot rolled, heat treated, not descaled	2.00-10.00	50-1550		
1D	Hot rolled, heat treated, pickled	3.00-6.36	30-1524	3.00-6.36	350-1524
1E	Hot rolled, heat treated, mech. desc.	1.16-4.00	35-1550	1.16-3.00	400-1550
1G	Ground	2.00-3.00	750-1455	2.00-3.00	750-1455
1M	Patterned	2.00-3.00	750-1455	2.00-3.00	750-1455
1U	Black hot rolled	2.00-10.00	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>0.02</b>		<b>17.0</b>				<b>Ti</b>
ASTM A240	≤0.030	≤1.00	17.0-19.0	≤0.50		≤0.030	
EN 10028-7	≤0.05	≤1.00	16.00-18.00				
EN 10088-4	≤0.05	≤1.0	16.0-18.0				
GOST 5632-72	≤0.08	≤0.8	16.0-18.0				
GOST 5632-72 Chemical analysis	≤0.08	≤0.8	16.0-18.0				

## Corrosion resistance

Moda 439/4510 has good corrosion resistance in solutions of many halogen-free organic and inorganic compounds over a wide temperature and concentration range. It can withstand many sufficiently diluted organic and mineral acids depending on the temperature and concentration of the solution. Moda 439/4510 may suffer from uniform corrosion in strong organic and mineral acids, as well as in hot concentrated alkaline solutions.

In aqueous solutions containing halogenides, e.g. chlorides or bromides, pitting and crevice corrosion may occur depending on the halogenide concentration, temperature, pH-value, concentration of oxidizing compounds, or crevice geometry, if applicable. For short periods of time, for instance when cooking food in stainless steel dishes, Moda 439/4510 can tolerate even relatively high chloride concentrations. The presence of corrosion inhibiting or accelerating compounds like transition metal ions or organic compounds may influence the corrosion behavior of Moda 439/4510. Due to its ferritic crystal structure, Moda 439/4510 is not prone to chloride-induced stress corrosion cracking.

Moda 439/4510 can be used for indoor applications in rural areas and urban environments where chloride contamination is low. The best material performance is reached usually with the help of adequate design, correct post-weld treatment, and regular cleaning during use (if applicable).

Due to its titanium and/or niobium content, the risk of sensitization for intergranular corrosion is strongly reduced when compared to non-stabilized ferritic grades. Moda 439/4510 can be used in the temperature range in which chromium carbides would precipitate in non-stabilized ferritic grades. Its maximum service temperature in dry air is 800 °C. The presence of other corrosive compounds in the hot environment, like water and sulfur compounds, reduce the maximum service temperature significantly.

For more information on corrosion resistance, please refer to the Outokumpu Corrosion Handbook or contact the Outokumpu corrosion experts.

Pitting corrosion resistance		Crevice corrosion resistance
PRE	CPT	CCT
17	<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 a more detailed description of their corrosion resistance properties in different environments, see the Outokumpu Corrosion Handbook.

## Mechanical properties

Cold rolled coil and sheet	R <sub>p0.2</sub> MPa	R <sub>p1.0</sub> MPa	R <sub>m</sub> MPa	Elongation <sup>1)</sup> %	Impact strength J	Rockwell	HB	HV
<b>Typical (thickness 1 mm)</b>	<b>285</b>	<b>300</b>	<b>450</b>	<b>31</b>				
ASTM A240	≥ 205		≥ 415			≤ 89HRB	≤ 183	
GOST 5632-72			≥ 460					

Hot rolled coil and sheet	R <sub>p0.2</sub> MPa	R <sub>p1.0</sub> MPa	R <sub>m</sub> MPa	Elongation <sup>1)</sup> %	Impact strength J	Rockwell	HB	HV
<b>Typical (thickness 4 mm)</b>								
ASTM A240	≥ 205		≥ 415				≤ 183	

Hot rolled quarto plate	R <sub>p0.2</sub> MPa	R <sub>p1.0</sub> MPa	R <sub>m</sub> MPa	Elongation <sup>1)</sup> %	Impact strength J	Rockwell	HB	HV
ASTM A240	≥ 205		≥ 415				≤ 183	

<sup>1)</sup>Elongation according to EN standard:

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

A for thickness = 3 mm.

Elongation according to ASTM standard A<sub>2</sub> or A<sub>50</sub>.

## Physical properties

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	11	25	460	0.60	Yes

## Fabrication

### Forming

The formability of Moda 439/4510 is comparable to many high-quality carbon steels. It is well suited for standard cold forming operations like bending, flanging, and drawing. The stabilized product Moda 439/4510 is particularly suitable for deep drawing.

## Machining

Moda 439/4510 is relatively easy to machine. Compared to austenitic grades, it has lower tendency to form edges, which gives a larger machining window. Since the machinability is comparable to that of low-alloyed carbon steels, the same recommendations regarding choice of tool, cutting speed, and cutting feed can be used.

## Welding

Moda 409/4512 has good weldability and can be welded using common fusion and resistance welding methods. Conventional welding methods like MMA, MIG, MAG, TIG, SAW, LBW, or RSW – except gas welding – are applicable. Austenitic 19 9 L (308L) or ferritic 17 Ti (439) or 18 L Nb (430LNb) filler metals can be used.

Low interstitial levels and added stabilizer have made enormous improvements to the welding characteristics of ferritic grades. Heat input should be minimized to reduce the grain growth in the heat-affected zone (HAZ). Titanium stabilization of Moda 439/4510 improves autogenously welded joints by refining the grain structure in the weld metal. Stabilization prevents chromium carbide precipitation, which could otherwise lead to sensitization embrittlement. Consequently, the stabilized grades are practically immune to intergranular corrosion when welded.

Shielding gases should be Ar/He-based, mixed with a maximum of 2% oxygen to improve the arc stability. Hydrogen and nitrogen additions are forbidden.

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

## Standards & approvals

Standard	Designation
ASTM A240/A240M	TYPE 439 / UNS S43035
EN 10028-7, PED 2014/68/EU	1.4510
EN 10088-4	1.4510
GOST 5632-72	08X17T
GOST 5632-72 Chemical analysis only	08X17T

## Contacts & Enquiries

Contact your nearest sales office

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

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