



Corrosion

Corrosion resistance of the martensitic CHRONIFER® M-15X stainless steel produced by the powder metallurgy route compared with other stainless steels.

Comparative tests of the corrosion resistance

This data sheet gives the results of comparative corrosion tests made on the martensitic CHRONIFER® M-15X stainless steel with other stainless steels currently used to make medical, surgical and dental instruments and for high precision micro-engineering parts.

Salt spray test 5% NaCl, 35°C, according to EN ISO 9227

*Rating:
 excellent 6
 good 5
 satisfactory 4
 fair 3
 poor 2
 unsatisfactory 1

Steel	Condition	Rating*			
		Test length	Observation sites		
		Day(s)	Free surface	Laser welding	Laser marking
CHRONIFER® M-15X	annealed	1	6	4	4.5
		4	6	3.5	4
	Q & T 140°C	1	6	3	3.5
		4	5	2	3
	Q & T 354°C	1	5	3	3.5
		4	5	2	3
1.4197	Q & T 140°C	1	5	3	5
		4	5	2	4
1.4057	Q & T 140°C	1	5	3	3.5
		4	5	2	3
1.4034	Q & T 140°C	1	4	3	3
		4	3	2	2
1.4112	Q & T 140°C	1	4	3	3.5
		4	3	1	2
1.4441	cold worked Rm > 1400 MPa	1	6	6	6
		4	6	6	6
1.4435	cold worked	1	6	6	6
		4	6	6	6
1.4310	cold worked	1	6	6	4.5
		4	5	5	4
1.4301	cold worked	1	5	4.5	4.5
		4	4.5	4	4

Severity of the salt spray test

The 5% NaCl, 35°C, EN ISO 9227 salt spray test is severe. It permits a fast screening of steels grades and conditions.

Prior to testing, all ø 6 mm x 50 mm probes have been ground and polished, then pickled, electropolished and passivated before being tested all together.

Rating of the corrosion resistance and behavior of the CHRONIFER® M-15X steel in salt spray test

The rating of the corrosion resistance of the martensitic CHRONIFER® M-15X stainless steel in salt spray test is good to satisfactory. Its behavior is similar to this of the cold worked 1.4310 (AISI 301) steel grade.

The best mechanical properties and salt spray corrosion resistance of this steel are obtained in the gas quenched and tempered 100-170°C condition (140-170°C for applications which have to be sterilized in saturated water steam at 134°C). Tempering above 170-200°C reduces the corrosion resistance as well as the mechanical properties.



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Corrosion resistance of the martensitic CHRONIFER® M-15X stainless steel produced by the powder metallurgy route compared with other stainless steels.

Corrosion résistance in saturated water steam at 134°C.
Simulation of a saturated water steam sterilization at 134 °C

*Rating:
excellent 6
good 5
satisfactory 4
fair 3
poor 2
unsatisfactory 1

Steel	Condition	Corrosion rating*				
		Site of observation		Number of 20 minutes sterilization cycles		
		Free surface	Laser welding	1	2	3
CHRONIFER® M-15X	annealed	xxx		6	6	4.5
	Q & T 140°C	xxx	xxx	5	3.5	3.5
1.4197	Q & T 140°C	xxx	xxx	6	6	4.5
	Q & T 140°C	xxx	xxx	4.5	4	4.5
1.4057	Q & T 140°C	xxx	xxx	6	6	5
	Q & T 140°C	xxx	xxx	5	4.5	3.5
1.4034	Q & T 140°C	xxx	xxx	6	6	5.5
	Q & T 140°C	xxx	xxx	5	4.5	4
1.4112	Q & T 140°C	xxx	xxx	6	6	4.5
	Q & T 140°C	xxx	xxx	4.5	3.5	3
1.4441	cold worked Rm > 1400 MPa	xxx	xxx	6	6	5
		xxx	xxx	5	4.5	4.5
1.4435	cold worked	xxx	xxx	6	6	5
		xxx	xxx	5	3	3

The comparative martensitic stainless steels are listed in order of increasing C content.

Severity of the simulated sterilization at 134°C

The simulated sterilization test does correspond to the 134°C saturated water steam sterilization practice in health centers as well as medical and dental (i.e. implantology) practices.

Prior to testing, all ø 6 mm x 50 mm probes have been ground and polished, then pickled, electropolished and passivated before being tested all together.

Rating of the corrosion resistance and behavior of the CHRONIFER® M-15X steel in salt spray test

The adequacy of the martensitic CHRONIFER® M-15X stainless steel compared to other stainless steels currently used, is well demonstrated and proved. This steel has a similar corrosion resistance as the austenitic 1.4435 (AISI 316L) steel grade. Which is quite remarkable for a martensitic stainless steel.

The CHRONIFER® M-15X steel gas quenched and tempered above 170 – 200°C loses progressively its good corrosion resistance in saturated water steam at 134°C.

Influence of welding

Welds and their HAZ (Heat Affected Zones) reduce considerably the corrosion resistance in saturated water steam at 134°C.

Influence of laser marking

A too contrasted laser marking with formation of metal evaporation bubbles on the surface of the marked dots, can reduce considerably the corrosion resistance during sterilization in saturated water steam at 134°C.

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