DATASHEET

MANNESMANN STAINLESS TUBES
A Member of the Salzgitter Group

DMV 931

1. Applications

DMV 931 is used in a wide variety of applications where general corrosion resistance and resistance to chloride-ion acid is necessary:

- **Pulp and paper industry**
- **Fine chemical synthesis**
- **Phosphoric acid production**
- **Sulphuric acid coolers**
- **Pickling plants with sulphuric acids**
- **Evaporations and crystallisation of salts**
- **Oil and gas production and refining**
- **Sour gas production**

Carbon	C	< 0.015
Chromium	Cr	27
Nickel	Ni	31
Molybdenum	Mo	6.5
Copper	Cu	1.2
Nitrogen	N	0.15 - 0.25
Manganese	Mn	2.0
Silicon	Si	<0.3
Phosphorus	P	<0.020
Sulfur	S	S <0.010

Chemical composition nominal %

2. Main Features

DMV 931 is an austenitic iron-nickel-chromium-molybdenum alloy with nitrogen addition. It was designed to fill the gap between existing super-austenitic stainless steels and nickel based alloys.

3. Description

3.1 Reference Standards

- UNS N08031 acc. to ASTM B 622 and ASME SB 622
- 1.4562 acc. to VdTÜV data sheet 509/2
- 1.4562 acc. to SEW 400

3.2 Chemical composition

DMV 931 contains:

	%min	%max
C		0.015
Si		0.30
Mn		2.00
P		0.020
S		0.010
Cr	26.00	28.00
Ni	30.00	32.00
Mo	6.00	7.00
Cu	1.00	1.40
N	0.15	0.25
Fe	Balance	

3.3 Mechanical Properties

3.3.1 Tensile Properties at 20°C (68°F)

UNS N08031 acc. to ASTM B 622:

	MPa	ksi
0.2% Y.S. min.	276	40
U.T.S. min.	650	94
A% min.	40	

Grade 1.4562 following VdTÜV data sheet 509/2:

	MPa	ksi
0.2% Y.S. min.	276	(40.0)
1.0% Y.S. min.	310	(45.0)
U.T.S min	650	(94.2)

1MPa=1 N/mm2; 1 ksi=6.9 MPa
( ) = calculated values

3.3.2 Tensile Properties at Elevated Temperature

Grade 1.4562 following VdTÜV

Temperature °C	(°F)	0.2 Y.S. min MPa (ksi)	1.0 Y.S. min MPa (ksi)
100	**(212)**	210 (30.5)	240 (34.8)
200	**(392)**	180 (26.1)	210 (30.5)
300	**(572)**	165 (23.9)	195 (28.3)
400	**(752)**	150 (21.8)	180 (26.1)
500	**(932)**	135 (19.6)	165 (23.9)
550	**(1022)**	125 (18.1)	155 (22.5)

( ) = calculated values

For UNS N08031 "maximum allowable stress values" following ASME Section VIII Division 1 are:

Temperature (°C)	°F	Stress value (MPa)	ksi
(38)	**100**	(160)	23.5
(93)	**200**	(150)	22.0
(149)	**300**	(135)	19.7
(204)	**400**	(125)	18.3
(260)	**500**	(120)	17.2
(316)	**600**	(115)	16.4
(371)	**700**	(110)	15.7
(426)	**800**	(105)	15.2

( ) = calculated values

3.3.3 Impact Test at 20C (68F)

Acc. to VdTÜV data sheet, the impact resistance at 20°C is >185 J/cm2 (average value of three samples with min. 130 J/cm2 individual value).

NOMINAL DIMENSIONAL RANGE

Cold Finished		
Outside Diameter	mm	inch
min	1.6	0.063
max	244.5	9.626
Wall thickness	mm	inch
min	0.1	0.004
max	40	1.575

Hot Finished		
Outside Diameter	mm	inch
min	32	1.260
max	280	11.024
Wall thickness	mm	inch
min	2.8	0.110
max	60	2.362

3.4 Physical Properties

Coefficient of Thermal Expansion between 20°C (68°F) and...			
Temperature °C	(°F)	10^{-6}/K	10^{-6}/°F
100	**(212)**	14.3	(7.9)
200	**(392)**	14.7	(8.2)
300	**(572)**	15.1	(8.4)
400	**(752)**	15.5	(8.6)
500	**(932)**	15.7	(8.7)

Thermal Conductivity			
Temperature °C	(°F)	W/(mK)	Btu in/ (ft h °F)
20	**(68)**	11.7	(6.76)
100	**(212)**	13.2	(7.63)
200	**(392)**	15.0	(8.67)
300	**(572)**	16.8	(9.71)
400	**(752)**	18.5	(10.7)
500	**(932)**	20.2	(11.7)

( ) = calculated values

Modulus of Elasticity			
Temperature °C	(°F)	10^3 MPa	10^3 ksi
20	**(68)**	198	(28.7)
100	**(212)**	189	(27.4)
200	**(392)**	183	(26.5)
300	**(572)**	176	(25.7)
400	**(752)**	170	(24.6)
500	**(932)**	163	(23.6)

( ) = calculated values

3.5 Corrosion Properties

DMV 931 has high resistance to corrosion in halide media. The alloy also shows outstanding resistance to sulphuric acid, both pure and contaminated, over a wide range of concentrations and at temperatures up to 80°C (176°F).

In the severe erosion-corrosion conditions of wet process phosphoric acid production, DMV 931 has demonstrated that it is a true alternative to nickel based alloys. Extensive testing in chlorine-dioxide bleach media in the pulp and paper industry has shown that DMV 931 withstands the most severe service conditions.

For applications in hydrochloric acids, the temperature and concentration is very decisive. At room temperature and at acid concentrations from 10% up to 30% this grade shows uniform corrosion rates of up to 0.5 mm/a (0.02 "/a).

Therefore, DMV 931 is only suitable for use in organic chemistry and other processes, where the tube material encounters only traces or concentrations below ~ 5% of hydrochloric acid at room- or slightly elevated temperatures.

For hydrochloric acid applications above the room temperature and at higher concentrations, DMV 931 is not considered suitable. For such service conditions other grades, in particular nickel based alloys with high molybdenum content, are usually selected.

4 Supply range

4.1 Delivery Condition

Tubes, pipes & Hollow bar are delivered in the cold or hot finished condition depending on size and specification. Normally they are supplied in the annealed condition.

4.2 Long lengths, 'U' bent

Our tubes are also available in U-bent form from straight lengths up to 43 m (141 ft) straight.

4.3 Components & Profiles

We are able to provide tubes in component or profile form according to Customer drawings.

5. Fabrication

5.1 Heat Treatment

Solution heat treatment of DMV 931 should be carried out in the temperature range of 1150°C to 1180°C (2100 – 2160°F), followed by water quenching or rapid air cooling.

For maximum corrosion resistance, the work piece must be rapidly cooled from the temperature of at least 1100°C (2000°F) down to 500°C (930°F) using a cooling rate > 150°C/min (300°F/min).

5.2 Bending

DMV 931 is generally suitable for further hot or cold forming.

For hot bending, the proposed temperature is 1080°C – 1200°C (1980°F – 2190°F) followed by rapid cooling.

Cold bending of tubes and pipes must respect an elevated work-hardening rate in comparison to austenitic stainless steels. This should be taken in account when selecting forming equipment.

Cold formed tubes and pipes have to be newly solution annealed if the forming degree is > 15 % or the R/D ratio < or equal 2.5. For corrosion reasons, it is sometimes recommended to perform a new solution annealing even following smaller forming degrees.

5.3 Welding

Preheating and heat treatment after welding are normally not necessary.

To avoid hot cracks in the weld metal, processes recommended by the filler producers have to be observed. Only approved filler materials should be considered, that have been tested for the foreseen application temperature. The calculation values for the filler materials should be respected.

In all cases, the usual cleanliness precaution for welding stainless steels should be taken into account. Where the subsequent application might be in moist environment, all oxidation must be avoided or eliminated.

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