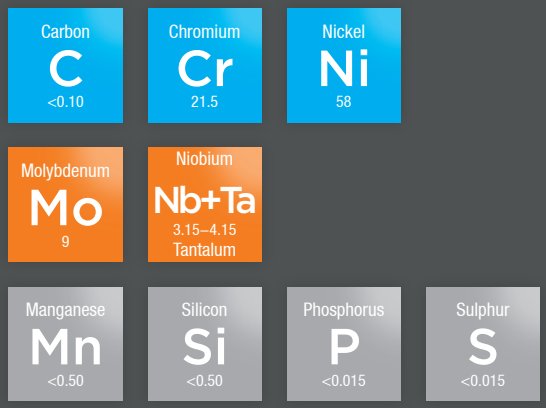
MANNESMANN STAINLESS TUBES
A Member of the Salzgitter Group

DMV 625

DMV 625 is the material of choice in applications like:

- Offshore and marine equipment
- Heat exchangers using sea water as coolant
- Oil and gas production, tubing and casing for deep sour oil and gas wells
- Chemical industry where very aggressive conditions are met like acetic acid, vinyl chloride etc
- Chimney linings
- Flue gas washing
- Superheater tubes and pipes in waste incineration plants



Chemical composition nominal %

1. Applications

DMV 625 exists in two versions:

- DMV 625 as Grade 1 (soft-annealed) is used in a wide variety of applications where general resistance against corrosive media is necessary. The maximum temperature in short term applications is normally limited up to about 600°C (1100°F).
- For short and long-term temperature applications above 600°C (1100°F) Grade 2 as solution annealed version with higher carbon content is normally employed. Long-term thermal exposure above 600°C (1100°F) will result in signifycant embrittlement.

2. Main Features

DMV 625 is a low-carbon nickel – chromium – molybdenum – niobium alloy. For higher temperature the carbon content must be increased.

The mechanical properties can be increased slightly by age-hardening.

3. Description

3.1 Reference Standards

- UNS N06625 Grade 1; UNS N06625 Grade 2 acc. to ASTM B 444 and ASME SB 444
- 2.4856 acc. to DIN 17744, DIN 17751

3.2 Chemical Composition

DMV 625 contains:

	% min.	% max.
C		0.10
Si		0.50
Mn		0.50
P		0.015
S		0.015
Cr	20.0	23.0
Ni	58.0	
Mo	8.0	10.0
Nb (+Ta)	3.15	4.15
Fe		5.0

3.3 Mechanical Properties

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

UNS N06625 Grade 1 acc. to ASTM B 444: Annealed at min. 871°C (1600°F)

	MPa	ksi
0.2% Y.S. min.	414	60
U.T.S. min.	827	120
E in 2", min.	30%	

1 MPa = 1 N/mm² ; 1 ksi = 6.9 MPa

UNS N06625 Grade 2 acc. to ASTM B 444: Solution Annealed at min. 1093°C (2000°F)

	MPa	ksi
0.2% Y.S. min.	276	40
U.T.S. min.	690	100
E in 2", min.	30%	

Grade 2.4856 following DIN 17751 "Soft Annealed" Condition

	MPa	ksi
0.2% Y.S. min.	415	(60.1)
1.0% Y.S. min.	445	(64.5)
U.T.S. min.	830	(120.3)
A	30%	

( ) = calculated values

Grade 2.4856 following DIN 17751
"Solution Annealed" Condition

	MPa	ksi
0.2% Y.S. min.	275	(39.9)
1.0% Y.S. min.	315	(45.7)
U.T.S. min.	690	(100.0)
A	30%	

( ) = calculated values

3.3.2 Tensile Properties at Elevated Temperatures

Grade 2.4856 following VdTÜV data sheet 499 (valid for sheets)

"Soft annealed" Condition

°C	(°F)	0.2Y.S. min. MPa (ksi)
100	(212)	350 (50.7)
200	(392)	320 (46.4)
300	(572)	300 (43.5)
400	(752)	280 (40.6)
450	(842)	270 (39.1)

( ) = calculated values

3.3.3 Impact Resistance

The impact resistance at 20°C is min 125 J/cm^2 in longitudinal direction. (Average value of three samples must be taken. The average value may fall short only with one specimen, and only by max. 30%.)

3.4 Physical Properties

Coefficient of Thermal Expansion between 20°C (68°F) and …			
°C	(°F)	10^{-6} / K	10^{-6} /°F
100	**(212)**	12.8	(7.0)
200	**(392)**	13.1	(7.3)
300	**(572)**	13.4	(7.4)
400	**(752)**	13.7	(7.6)
500	**(932)**	14.1	(7.8)
600	**(1112)**	14.6	(8.0)
700	**(1292)**	15.2	(8.4)

Thermal Conductivity			
°C	(°F)	W / (m K)	Btu / (ft h °F)
20	**(68)**	9.8	(5.66)
100	**(212)**	11.2	(6.47)
200	**(392)**	12.8	(7.40)
300	**(572)**	14.4	(8.32)
400	**(752)**	16.3	(9.42)
500	**(932)**	17.3	(10.0)
600	**(1112)**	18.3	(10.6)
700	**(1292)**	20.0	(11.6)

Modulus of Elasticity			
°C	(°F)	GPa	10^3 ksi
20	**(68)**	209	(30.3)
100	**(212)**	202	(29.3)
200	**(392)**	195	(28.3)
300	**(572)**	190	(27.5)
400	**(752)**	185	(26.8)
500	**(932)**	178	(25.8)
600	**(1112)**	170	(24.6)
700	**(1292)**	162	(23.5)

( ) = calculated values

3.5 Corrosion Properties

Like mentioned above, DMV 625 Grade 1 – the "Soft annealed" condition – is used for its good corrosion resistance. Being free from all contaminations and clean, this version exhibits excellent behaviour as

- Very good resistance to pitting and crevice corrosion in chloride bearing media
- Essential resistance to chloride – induced stress corrosion cracking
- High resistance against impingement and erosion corrosion
- High resistance to corrosive attack by mineral acids, such as nitric, phosphoric, sulphuric and hydrochloric acids, as well as to alkalis and organic acids in both oxidizing and reducing conditions
- Nearly no corrosive attack in marine and industrial atmospheres and high resistance to sea-water and brackish water, even at higher temperatures.

If the application concerns higher temperatures, the "solution annealed" version of DMV 625 Grade 2 shows good resistance in many corrosive gas atmospheres, like

- Carburization and oxidation under static and cyclic conditions, suitable for use in air up to 1000°C (1830°F)
- Resistance to nitridation
- Good resistance to halogen containing gases and hydrogen chloride

For design calculations, the loss in ductility resulting from prolonged exposure within the temperature range of approximately 600°C – 900°C (1100°F – 1650°F) must be respected.

4. DMV Supply

4.1 Dimensional Range

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

Specific dimensions by grade available upon request.

4.2 Delivery Condition

Tubes and pipes are delivered in cold or hot finished condition depending on size and specification. Normally they will be supplied in annealed condition.

4.3 U-bent

Our tubes are also available in U-bent version in lengths of up to 30 m (straight); the high deformability of the material allows cold bending down to a very small bending radius.

5. Fabrication

5.1 Heat Treatment

There are two versions of heat treatment used for DMV 625.

DMV 625 Grade 1 has low carbon content and is (soft) annealed at 950°C – 1050°C (1740°F – 1920°F). Due to these two characteristics the alloy shows little tendency to sensitization and is used for applications involving wet corrosion.

For high-temperature applications as atmospheres above 600°C (1100°F) where high strength and resistance to creep and rupture are required, the solution annealed version DMV 625 Grade 2 with higher carbon content is normally employed. The solution temperature is in the range of 1100°C – 1200°C (2000°F – 2200°F). Frequently, a subsequent stabilization annealing at about 980°C (1800°F) is performed to increase resistance to sensitization.

5.2 Bending

DMV 625 is generally suitable for further cold or hot forming.
For hot bending, the proposed temperature is 980°C – 1150°C (1800°F – 2100°F) followed by rapid cooling from 1000°C (1832°F).

Generally speaking, cold bending of DMV 625 tubes and pipes can be carried out in the “soft annealed” condition. But the grade has a higher work-hardening rate than classical austenitic stainless steels.
This should be taken into account when selecting the forming equipment. Interstage annealing may be necessary with high degrees of cold forming.

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 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.

6. Standards and References

DMV 625 may be delivered in accordance with the commonly used European, American and other national standards. In other cases, our specialists are at your service for any guidance on drawing up your tube specifications.
Mannesmann Stainless Tubes has delivered DMV 625 tubes and pipes to a wide range of worldwide customers in the chemical, petrochemical industries and oil exploration.

For any specific queries, please contact our sales offices.

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