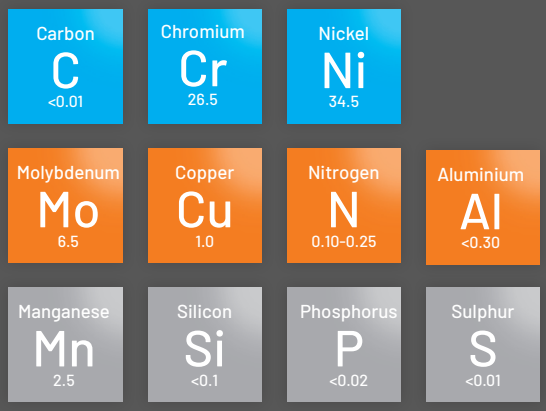
MANNESMANN STAINLESS TUBES
A Member of the Salzgitter Group

DMV 4692

1. Applications

DMV 4692 is used in a wide range of applications requiring corrosion resistance:

- Chemical processes with sulphuric acid
- Treatment of consumed / used sulphuric acid
- Components for flue gas desulphurisation plants
- Plants for the production of phosphoric acid via the wet digestion process
- Ocean Water and brackish water applications
- Evaporation and crystallisation of salts
- Fine chemicals, special chemicals and organic acids
- Components for the pulp and paper industry



Chemical composition nominal %

2. Main Features

DMV 4692 is a Nickel-Iron-Chromium-Molybdenum alloy with a controlled addition of Nitrogen, having a face-centred cubic structure. Designed to fill the gap between existing super austenitic 6Mo type austenitic stainless steels and Nickel alloys. Refining the Nickel and Nitrogen metallurgy reduces the tendency for precipitation of intermetallic phases and stabilizes the austenitic microstructure.

3. Description

3.1 Reference Standards

- NiFeCr27Mo6CuN
- UNS N08034 acc. to ASTM B 622 & ASME SB 622
- 2.4692

3.2 Chemical Composition

	% min.	% max.
Ni	33.5	35.0
Cr	26.0	27.0
Fe		balance
S		0.01
Si		0.1
Mn	1.0	4.0
P		0.02
Mo	6.0	7.0
Cu	0.5	1.5
N	0.10	0.25
C		0.01
Al		0.30

3.3 Mechanical Properties

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

	MPa	ksi
Rp 0.2% min	280	40.6
Rp 1.0% min	310	45
Tensile Rm	650-850	94.3-123
A% min.	40	

3.3.2 Tensile Properties at Elevated Temperatures

Temp. °C	Temp. (°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	(762)	150 (21.8)	180 (26.1)
500	(932)	135 (19.6)	165 (23.9)

3.3.3 Impact Resistance

ISO V-notch impact energy
Average value,
room temperature:>= 150 J
Average value,
-196C (-320.8F): >= 110J
Based on data from sheet thickness <= 30 mm average value from 3 samples.
According to DIN EN ISO 148-1.

3.4 Physical Properties

Density: 8.08 g/cm3 (0.292 lbs/in3).
Relative magnetic permeability at 20°C (68°F): 1.001

Average linear expansion coefficient			
(°C)	(°F)	10^{-6} / K	10^{-6}/°F
20	**(68)**	14.3[1)]	7.94[1)]
100	**(212)**	14.8[1)]	8.22[1)]
200	**(392)**	15.4	8.56
300	**(572)**	16.0	8.89
400	**(762)**	16.3	9.06
500	**(932)**	16.3	9.06

1)Extrapolated

Thermal Conductivity			
(°C)	(°F)	W / (m K)	Btu / (ft h °F)
20	**(68)**	10.3[1)]	5.95[1)]
100	**(212)**	11.6	6.70
200	**(392)**	13.4	7.74
300	**(572)**	14.9	8.61
400	**(762)**	16.3	9.42
500	**(932)**	17.6	10.17

1)Extrapolated

Modulus of Elasticity		
Temperature °C (°F)	10^3 MPa	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)

3.5 Corrosion Properties

The material is resistant to inter-crystalline corrosion in the delivery condition and when welded according to the test procedure according to ASTM-G 28, Method A. The corrosion rate determined via the mass loss according to ASTM-G28, Method A (test period 24 hours), is maximum 0.5 mm/a (0.020 mpy) in the delivered condition and when welded. Very good resistance is also provided against crevice corrosion and pitting. The corrosion resistance is comparable with the grade DMV 931.

4. Supply Range

DMV 4692 is produced in seamless tubes, pipes and Hollow bar in the size 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.

4.1 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 U-bent

Our tubes are also available in long lengths, 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

Heat Treatment Solution annealing should take place at temperatures between 1,140 and 1,170 °C (2,084 and 2,138 °F). The retention time during annealing depends on the semi-finished product thickness and can be calculated as follows:

- For thickness d ≤ 10 mm (0.39 in), the retention time is t = d * 3 min/mm
- For thickness d = 10 to 20 mm (0.39 to 0.79 in), the retention time is t = 30 min + (d – 10 mm) * 2 min/mm
- For thickness d > 20 mm (0.79 in), the retention time is t = 50 min + (d – 20 mm) * 1 min/mm

The retention time commences with material temperature equalization; longer times are generally considerably less critical than retention times that are too short.

The calculation of the period for the heat treatment depends on the wall thickness and is independent from the inside and outside diameter.

For maximum corrosion resistance, the workpieces must be quickly cooled from the annealing temperature particularly through the range of 1,100 to 500 °C (2,012 to 932 °F) with a cooling rate of >150 °C/min (>302 °F/min). The material must be placed in a furnace that has been heated up to the maximum annealing temperature before any heat treatment.

5.2 Bending

DMV 4692 is generally suitable for further cold or hot forming.

- For hot bending, the suggested temperature is 1000C to 1150C (1832F – 2102F) followed by rapid cooling.
- Cold bending or pipe or tube should take into consideration a significantly increased work-hardening rate compared to common 300 series stainless steels. This should be taken into account during the design and selection of forming equipment.

Cold formed pipe and tube should be re solution annealed if the forming degree is >15% or if the R/D ratio is =<2.5. For corrosion reasons, it should also be considered to perform a re-solution anneal for smaller bending ratios.

5.3 Machining

DMV 4692 should be machined in the heat-treated condition. Because of the considerably elevated tendency toward work hardening in comparison with low-alloy austenitic stainless steels, a low cutting speed and a feed level that is not too high should be selected and the cutting tool should be engaged at all times. An adequate depth of cut is important in order to cut below the previously formed strain-hardened zone. Optimum heat dissipation through the use of large quantities of suitable, preferably aqueous, lubricants has considerable influence on a stable machining process.

5.4 Welding

Welding technique

DMV 4632 can be welded in most applications using conventional processes. This includes TIG and MAG welding. Pulsed arc welding is preferred for gas-shielded welding processes. For welding, DMV 4692 should be in a solution-annealed condition and free of scale, grease and markings. When welding the root, care should be taken to achieve best quality root protection using pure argon, purity 99.99% or better so that the welding edge is free of oxides after welding the root. Root protection is also recommended for the first and, in certain cases depending on the welded construction, also for the second intermediate layer weld after root welding. Any tempering colours must be removed while the welding edge is still hot, preferably using a stainless steel brush.

Post-treatment

For the optimal performance of the work, insert the brush immediately after welding, i.e., while still warm, without additional pickling to the desired surface condition, i.e., discoloration can be removed completely. Pickling, if required, should generally be the last operation in the welding process. Heat treatment is not normally required before or after welding.

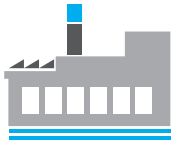
6. Standards and References

DMV 4692 can be supplied in accordance with commonly used EU, US and other international standards. Our specialists are at your service to assist in creating individual specifications to meet your individual requirements.

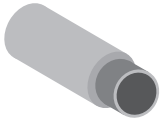
For any specific queries please contact your local sales office.

Visit our Tech Centre for full product range details, calculators and learning.

OIL & GAS



GENERAL INDUSTRY



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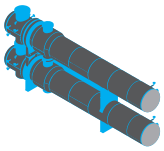
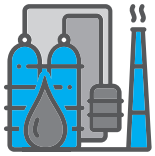


HEAT EXCHANGERS

FERTILISER



PETROCHEMICAL

Acknowledgement to VDM Metals for supporting technical data. DMV 4692 is derived from VDM Alloy 31 Plus, Nicrofer 3426 hMo.

Mannesmann Stainless Tubes
tubes@mst.mannesmann.com
Tel. +49 208 458 01
www.mannesmann-stainless-tubes.com

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