

# DMV 25.22.2

## 1. Applications

DMV 25.22.2 is specially developed for use in urea applications, which are specified and proved by the main engineering and licensor companies, i.e. Stamicarbon, Snamprogetti or Urea Casale. Straight and U-bent tubes can be delivered for use in carbamate condensers, scrubbers, strippers and associated piping.

Carbon <b>C</b> <0.02	Chromium <b>Cr</b> 25	Nickel <b>Ni</b> 22
Molybdenum <b>Mo</b> 2.3	Nitrogen <b>N</b> 0.12	
Manganese <b>Mn</b> 1.6	Silicon <b>Si</b> <0.50	Phosphorus <b>P</b> <0.02
		Sulphur <b>S</b> <0.02

Chemical composition nominal %

## 2. Main Features

DMV 25.22.2 is a low carbon austenitic stainless steel with an elevated content of chromium and nickel. This leads to a ferrite content of max. 0.6%. Also, approx. 2% molybdenum improves its corrosion resistance in severe atmospheres, especially if urea is present.

## 3. Description

### 3.1 Reference Standards

- UNS S31050 acc. to ASTM A 213 and ASTM A 312
- 1.4466 acc. to EN 10216-5 and EN 10297-2
- 1.4466 acc. to VdTÜV data sheet 415/2

### 3.2 Chemical Composition

DMV 25.22.2 typical values:

	Weight -%
<b>C</b>	< 0.02
<b>Si</b>	< 0.50
<b>Mn</b>	1.6
<b>P</b>	< 0.02
<b>S</b>	< 0.02
<b>N</b>	0.12

<b>Cr</b>	25.0
<b>Ni</b>	22.0
<b>Mo</b>	2.30
<b>Fe</b>	Balance

### 3.3 Mechanical Properties

The following values are guaranteed in the solution annealed condition:

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

UNS S31050 acc. to ASTM A 213 and ASTM A 312:

For wall thickness ≤ 6mm (0.25")

	MPa	ksi
<b>0.2% Y.S. min.</b>	270	39
<b>U.T.S. min.</b>	580	84
<b>E in 2", min., %</b>	25	

1 MPa = 1 N/mm<sup>2</sup> ; 1 ksi = 6.9 MPa

For wall thickness > 6mm (0.25")

	MPa	ksi
<b>0.2% Y.S. min.</b>	255	37
<b>U.T.S. min.</b>	540	78
<b>E in 2", min., %</b>	25	

1 MPa = 1 N/mm<sup>2</sup> ; 1 ksi = 6.9 MPa

Grade 1.4466 acc. to EN 10216-5 and EN 10297-2:

	MPa	ksi
<b>0.2% Y.S. min.</b>	260	(37.7)
<b>1.0% Y.S. min.</b>	295	(42.8)
<b>U.T.S. min.</b>	540	(78.3)
<b>A %</b>	40	

1 MPa = 1 N/mm<sup>2</sup> ; 1 ksi = 6.9 MPa  
( ) = calculated values

#### 3.3.2 Tensile Properties at Elevated Temperatures

Grade 1.4466 acc. to EN 10216-5:

°C	(°F)	0.2 Y.S. min. MPa (ksi)	1.0 Y.S. min. MPa (ksi)
<b>100</b>	(212)	195 (28.3)	225 (32.6)
<b>150</b>	(302)	170 (24.6)	205 (29.7)
<b>200</b>	(392)	160 (23.2)	190 (27.5)
<b>250</b>	(482)	150 (21.7)	180 (26.1)
<b>300</b>	(572)	140 (20.3)	170 (24.6)
<b>350</b>	(662)	135 (19.6)	165 (23.9)

( ) = calculated values

For 1.4466 acc. to VdTUV data sheet 415/2:

For wall thickness ≤ 6mm (0.25")

°C	(°F)	0.2 Y.S. min.		1.0 Y.S. min.	
		MPa (ksi)		MPa (ksi)	
100	(212)	230	(33.3)	260	(37.7)
200	(392)	200	(29.0)	230	(33.3)
300	(572)	175	(25.4)	205	(29.7)
400	(752)	155	(22.5)	185	(26.8)

( ) = calculated values

For wall thickness > 6mm (0.25")

°C	(°F)	0.2 Y.S. min.		1.0 Y.S. min.	
		MPa (ksi)		MPa (ksi)	
100	(212)	215	(31.2)	245	(35.5)
200	(392)	185	(26.8)	215	(31.2)
300	(572)	160	(23.2)	190	(27.5)
400	(752)	140	(20.3)	170	(24.6)

( ) = calculated values

### 3.3.3 Impact Resistance

The notch impact energy at 20°C (68°F) in longitudinal direction must be min. 100 J (average value of three samples, with min. 70 J individual value).

### 3.4 Physical Properties

Density at 20°C (68°F)		
	g/cm <sup>3</sup>	lbs / in <sup>3</sup>
	8	0.29

Coefficient of Thermal Expansion between 20°C (68°F) and ...			
°C	(°F)	10 <sup>-6</sup> / K	10 <sup>-6</sup> / °F
100	(212)	15.7	8.6
200	(392)	16.4	9.0
300	(572)	16.7	9.2
400	(752)	17.1	9.3
500	(932)	17.4	9.5

Coefficient of Thermal Expansion between 20°C (68°F) and ...			
°C	(°F)	W / (m K)	Btu / (ft h °F)
20	(68)	13.0	8
100	(212)	15.0	9
200	(392)	17.0	10
300	(572)	19.0	11
400	(752)	21.0	13

500	(932)	23.0	13
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Modulus of Elasticity			
°C	(°F)	10 <sup>3</sup> MPa	10 <sup>3</sup> ksi
20	(68)	195	(28.3)
100	(212)	190	(27.6)
200	(392)	182	(26.3)
300	(572)	174	(25.5)
400	(752)	166	(24.2)
500	(932)	158	(23.1)

( ) = calculated values

### 3.5 Corrosion Properties

DMV 25.22.2 exhibits excellent resistance to oxidation and a low rate of scaling in air atmospheres.

It should also be mentioned that DMV 25.22.2 is barely susceptible to precipitation of chromium carbides in grain boundaries when exposed to temperatures in the range of 430°C – 820°C (800°F – 1500°F). Such "sensitized" steels are subject to intergranular corrosion when exposed to aggressive environments.

Conditions which produce Stress Corrosion Cracking (SCC) are:

- Presence of halide ions (generally chlorides)
- Residual tensile stress
- Temperature in excess of about 50°C (120°F)

Stresses result from cold deformation or thermal cycles during welding. Annealing or stress relieving heat treatments reduce sensitivity to halide SCC.

Nevertheless, DMV 25.22.2 is less susceptible to SCC in halide environments than other austenitic stainless steel grades used for urea applications.

As unsensitized material, this grade easily meets the HUEY test (= ASTM A 262 Practice C). Stamicarbon specifies 5 boiling periods of 48h each with an average corrosion rate of 0.16 g/m<sup>2</sup> h = 1! m/48h. This is equivalent to 0.18mm/year (7.2mpy). Moreover, the maximum selective attack is less than 70! m.

Snamprogetti extends these requirements to 10 boiling periods of 48h each. The corrosion rate should not exceed 0.18mm/year (7.2mpy) and the maximum depth of selective attack is 70! m.

## 4. Supply Range

DMV 25.22.2 is produced in seamless tubes, pipes and Hollow bar in the size range:

Nominal Dimensional Range		
Cold Finished		
<b>Outside Diameter</b>	mm	inch
<b>min</b>	1.6	0.063
<b>max</b>	244.5	9.626
<b>Wall Thickness</b>	mm	inch
<b>min</b>	0.1	0.004
<b>max</b>	40	1.575
Hot Finished		
<b>Outside Diameter</b>	mm	inch
<b>min</b>	32	1.260
<b>max</b>	280	11.024
<b>Wall Thickness</b>	mm	inch
<b>min</b>	2.8	0.110
<b>max</b>	60	2.362

Specific dimensions by grade available upon request.

### 4.1 Delivery Condition

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

### 4.2 U-bent

Tubes for urea application are also available in U-bent version in lengths of up to 30m (straight). The high deformability of the material allows cold bending down to a very small bending radius.

## 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:

### 5. Fabrication

#### 5.1 Heat Treatment

Tubes and pipes are solution annealed in the range of 1050°C – 1150°C (1920°F – 2100°F) and then rapidly cooled in air or water.

If any additional cold or hot working

operations will be done, holding at temperatures in the range of 500°C – 900°C (930°F – 1650°F) is favourable for the mechanical and corrosion properties. As for other stainless steels, cleanliness requirements (especially contamination from greases) must be strictly observed. The furnace atmosphere must have very low sulphur content. When the tubes will be subsequently used in a moist environment, oxidation must be avoided by:

- use of a highly reducing atmosphere (cracked ammonia, hydrogen...) or
- removal by pickling after heat treatment.

DMV 25.22.2 cannot be hardened by heat treatment.

## 5.2 Bending

DMV 25.22.2 is suitable for further cold or hot forming.

For hot bending, the temperature may be 950°C – 1150°C (1740°F – 2100°F) followed by rapid cooling.

Cold bending of solution annealed tubes and pipes can be handled as with austenitic stainless steels.

Therefore they have to be solution annealed again if the forming degree is > 20% or the R/D ratio is < or equal 2.5. For corrosion reasons, sometimes it is recommended to perform a new solution annealing even following smaller forming degrees.

## 5.3 Welding

DMV 25.22.2 has a good weldability. Welding is possible with all processes usual for stainless steels. Preheating and heat treatment after welding is normally not necessary.

To avoid hot cracks in the weld metal, the processes recommended by the filler producers have to be observed. Only approved filler materials should be used, that have been tested for the expected application temperature. The calculation values for the filler materials should be followed. In all cases the usual cleanliness precautions for welding stainless steels should be observed. Where the subsequent application might be in a moist environment, all oxidation must be avoided or eliminated.

## 6. Standards and References

DMV 25.22.2 may be delivered in accordance with all commonly used European, American and other international standards.

Our specialists are at your service for any guidance on drawing up your specifications.

Mannesmann Stainless Tubes has delivered DMV 25.22.2 tubes and pipes to a wide range of worldwide customers in the urea industry. References are available upon request.

For any specific queries, please contact our sales offices.

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