

DATA SHEET

DMV 316 LUG

1 – Applications

DMV 316 LUG 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.

2 – Main Features

DMV 316 LUG is an austenitic stainless steel with minimum 2.3% molybdenum and max. 0.6% ferrite content.

3 – Description

3.1 Reference Standards

- UNS S31603 acc. to ASTM A 213 and ASTM A 312
- 1.4404 acc. to EN 10216-5 and EN 10297-2
- 1.4435 acc. to EN 10216-5 and EN 10297-2

3.2 Chemical Composition

DMV 316 LUG typical values:

	Weight-%
C	< 0.02
Si	< 0.50
Mn	1.60
P	< 0.04
S	< 0.02
N	0.06
Cr	18.0
Ni	14.0
Mo	2.80
Fe	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 S31603 acc. to ASTM A 213 and ASTM A 312:

	MPa	ksi
0.2% Y.S. min.	170	25
U.T.S. min.	485	70
E in 2", min., %	35	

1 MPa = 1 N/mm²; 1 ksi = 6.9 MPa

Grade 1.4404 and 1.4435 acc. to EN 10216-5 and EN 10297-2:

	MPa	ksi
0.2% Y.S. min.	190	(27.5)
1.0% Y.S. min.	225	(32.6)
U.T.S. min.	490	(71.0)
A %	40	

() = calculated values

3.3.2 Tensile Properties at Elevated Temperature

Grade 1.4404 and 1.4435 acc. to EN 10216-5 and EN 10297-2:

Tem- perature	0.2% Y.S. min.	1.0% Y.S. min.	
			°C
100	(212)	165 (23.9)	200 (29.0)
150	(302)	150 (21.7)	180 (26.1)
200	(392)	137 (19.9)	165 (23.9)
250	(482)	127 (18.4)	153 (22.2)
300	(572)	119 (19.2)	145 (21.0)
350	(662)	113 (16.4)	139 (20.1)
400	(752)	108 (15.7)	135 (19.6)
450	(842)	103 (14.9)	130 (18.8)
500	(932)	100 (14.5)	128 (18.6)
550	(1022)	98 (14.2)	127 (18.4)

() = 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).

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3.4 Physical Properties

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

Coefficient of Thermal Expansion between 20°C (68°F) and ...			
Temperature			
°C	(°F)	10 ⁻⁶ /K	10 ⁻⁶ /°F
100	(212)	16.0	9.2
200	(392)	16.5	9.5
300	(572)	17.0	9.7
400	(752)	17.5	10.0
500	(932)	18.0	10.2

Thermal Conductivity			
Temperature			
°C	(°F)	W / (m K)	Btu / (ft h °F)
20	(68)	14.0	8
100	(212)	14.6	9
200	(392)	17.0	10
300	(572)	18.0	11
400	(752)	20.0	13
500	(932)	21.0	13

Modulus of Elasticity			
Temperature			
°C	(°F)	10 ³ MPa	10 ³ ksi
20	(68)	200	(29.0)
100	(212)	194	(28.1)
200	(392)	186	(27.0)
300	(572)	179	(25.9)
400	(752)	171	(24.8)
500	(932)	164	(23.8)

() = calculated values

3.5 Corrosion Properties

DMV 316 LUG exhibits good resistance to oxidation and a low rate of scaling in air atmospheres.

It should also be mentioned that DMV 316 LUG 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 316 LUG is less susceptible to SCC in halide environments than the 18Cr-8Ni-austenitic stainless steels due to its higher molybdenum content and low ferrite content (< 0.6%).

As unsensitized material, DMV 316 LUG meets the requirements of HUEY test (= ASTM A 262 Practice C).

Stamicarbon, for instance, specifies 5 boiling periods of 48h each with an average corrosion rate of 0.54g/m² h = 3.3µm/48h. This is equivalent to 0.6mm/year (24mpy). Moreover, the maximum selective attack is less than 150µm.

4 – DMV Supply

4.1 Dimensional Range

Outside diameter:
6mm – 250mm (0.236” – 9.843”)
Wall thickness:
1mm – 50mm (0.039” – 1.969”)

4.2 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.

4.3 U-bent

Tubes for urea applications 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.

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5 – Fabrication

5.1 Heat Treatment

Tubes and pipes in DMV 316 LUG are normally solution annealed in the temperature range of 1040°C – 1100°C (1900°F – 2010°F), followed by air cooling or water quenching.

As for other austenitic stainless steels, cleanliness requirements (especially contamination from greases) must be strictly observed. The furnace atmosphere must have very low sulphur content. When 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 316 LUG cannot be hardened by heat treatment.

5.2 Bending

DMV 316 LUG is suitable for further cold or hot forming.

For hot bending the temperature may be 1000°C – 1150°C (1830°F – 2102°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, it is sometimes recommended to perform a new solution annealing even following smaller forming degrees.

5.3 Welding

DMV 316 LUG has a good weldability. Welding is possible with all usual processes 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 precaution 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 316 LUG 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.

Salzgitter Mannesmann Stainless Tubes has delivered DMV 316 LUG 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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QUALITY IN ROUND TERMS.

Contact

Headquarters

Salzgitter Mannesmann Stainless Tubes GmbH

Wiesenstraße 36
45473 Mülheim an der Ruhr
Germany

Tel.: +49 208 458 01
Fax: +49 208 458 2640
www.smst-tubes.com

Sales Contacts

Salzgitter Mannesmann Stainless Tubes Italia S.r.l.

Via Piò 30
24062 Costa Volpino (BG)
Italy
Tel.: +39 035 975 744
Fax: +39 035 975 803
Email: salesitaly@smst-tubes.com

Salzgitter Mannesmann Stainless Tubes Deutschland GmbH

Wiesenstraße 36
45473 Mülheim an der Ruhr
Germany
Tel.: +49 208 458 2611
Fax: +49 208 458 2641
Email: salesgermany@smst-tubes.com

Salzgitter Mannesmann Stainless Tubes France SAS

Route de Semur
21500 Montbard
France
Tel.: +33 3 80 89 52 00
Fax: +33 3 80 89 52 26
Email: salesfrance@smst-tubes.com

Salzgitter Mannesmann Stainless Tubes USA, Inc.

12050 West Little York
Houston Texas 77041
USA
Tel.: +1 713 466 7278
Fax: +1 713 466 3769
Email: salesusa@smst-tubes.com

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