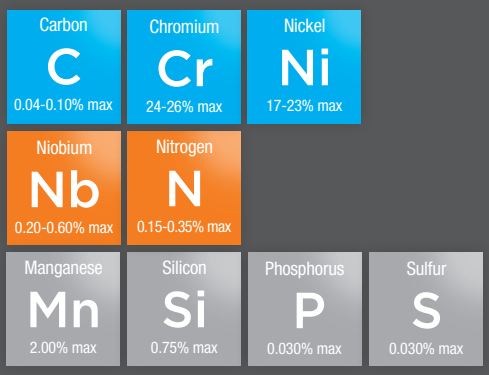
MANNESMANN
STAINLESS TUBES
A Member of the Salzgitter Group

DMV 310 N

1. Application

Designed for application as superheater and reheater boiler tube grade as well as high temperature instrumentation tubing, DMV 310 N has proved to be suitable in most advanced coal and lignite fired power stations using steam temperatures up to approximately 620°C (1148°F) in supercritical and ultra supercritical vessel designs.



2. Main Features

- Austenitic nitrogen alloyed stainless steel
- Very good high temperature corrosion resistance
- Very good creep resistance at high temperatures, especially in the range of 550°C (1112°F) to 670°C (1238°F)

3. Description

3.1 Specifications

- 1.4952, X6CrNiNbN 25 20, European Steel registration
- UNS S 31042, TP310HCbN (25Cr-20Ni-Nb-N according to ASME SA-213/SA 213M, US Standard
- Cases of ASME Boiler and Pressure vessel Code Case 2115-1,
- Following VdTÜV Material Data Sheet 546, Federal Republic of Germany high temperatures, especially in the range of 600°C (1112°F) to 670°C (1238°F)

3.2 Available Sizes

DMV 310 N is produced as seamless austenitic tube, suitable for all recently used austenitic reheater and superheater boiler tube sizes. Following VdTÜV Material Data Sheet 546, the max. outer diameter is 65 mm and the max. wall thickness is 12.5 mm. Other sizes are available on request.

3.3 Chemical composition

Mass % according ASME Case 2115-1.

	%min	%max
C	0.04	0.10
Si		0.75
Mn		2.00
P		0.030
S		0.030
Cr	24.00	26.00
Ni	17.00	23.00
Nb	0.20	0.60
N	0.15	0.35

3.4 Mechanical Properties

3.4.1 At Solution Annealed Condition

According to ASME Case 2115-1.

	MPa	ksi
Y.S. min.	(296)	43
U.T.S. min.	(655)	95
E in 2" min., %	30	

1 MPa=1 N/mm^2 ; 1 ksi=6.9 MPa
( ) = calculated values

Following VdTÜV Material Data Sheet 546.

	MPa	ksi
0.2% Y.S. min.	295	(42.8)
1.0% Y.S. min.	325	(47.8)
U.T.S.	655-900	(95-130.5)
A %	30	

( ) = calculated values

3.4.2 Impact Resistance

According to VdTÜV Material Data Sheet 546, the Impact resistance KV in longitudinal direction is min 85J. (Average value from 3 specimens. The average value may fall short only with one specimen, and only by max. 30%)

3.4.3 At Elevated Temperature

Following VdTÜV Material Data Sheet 546.

Temp		0.2% Y.S. min	1.0% Y.S. min
°C	(°F)	MPa (ksi)	MPa (ksi)
100	**(212)**	240 (34.8)	265 (38.4)
200	**(392)**	205 (29.7)	230 (33.4)
300	**(572)**	190 (27.6)	210 (30.5)
350	**(662)**	190 (27.6)	210 (30.5)
400	**(752)**	180 (26.1)	200 (29.0)
450	**(842)**	175 (25.4)	195 (28.2)
500	**(932)**	170 (24.7)	190 (27.6)
550	**(1022)**	165 (23.9)	185 (26.8)
600	**(1112)**	160 (23.2)	180 (26.1)
650	**(1202)**	160 (23.2)	180 (26.1)
700	**(1292)**	155 (22.5)	175 (25.4)
750	**(1382)**	155 (22.5)	175 (25.4)

( ) = calculated values

3.4.4 Creep Strength Values

Creep Strength Values for 10,000 h and 100,000 h acc. to Material Datasheet VdTÜV 546.

Temp		10,000h	100,000h
°C	(°F)	MPa (ksi)	MPa (ksi)
600	(1112)	284 (41.2)	265 (38.4)
610	(1130)	260 (37.7)	170 (27.7)
620	(1148)	238 (34.5)	154 (22.3)
630	(1166)	212 (30.7)	140 (20.3)
640	(1184)	190 (27.6)	126 (18.3)
650	(1202)	171 (24.8)	114 (16.5)
660	(1220)	154 (22.3)	102 (14.8)
670	(1238)	142 (20.6)	90 (13.1)
680	(1256)	130 (18.9)	82 (11.9)
690	(1274)	118 (17.1)	73 (10.6)
700	(1292)	108 (17.7)	66 (9.6)
710	(1310)	98 (14.2)	59 (8.6)
720	(1328)	89 (12.9)	53 (7.7)
730	(1346)	79 (11.5)	48 (7.0)
740	(1364)	71 (10.3)	43 (6.2)
750	(1382)	64 (9.3)	39 (5.7)

( ) = calculated values

3.4.5 Max. Allowable Stress Values

According ASME Case 2115-1.

Temperature		Stress value	
°C	(°F)	MPa	(ksi)
-28 – 37.8	(-20 to 100)	187	(27.1)
93.3	(200)	165	(24.0)
149	(300)	150	(21.7)
204	(400)	138	(20.2)
260	(500)	132	(19.2)
316	(600)	128	(18.5)
343	(650)	126	(18.3)
371	(700)	125	(18.1)
399	(750)	123	(17.8)
427	(800)	121	(17.6)
454	(850)	120	(17.4)
482	(900)	118	(17.1)
510	(950)	117	(16.9)
538	(1000)	114	(16.6)
566	(1050)	112	(16.3)
593	(1100)	111	(16.1)
621	(1150)	94	(13.6)
649	(1200)	70	(10.1)
677	(1250)	52	(7.6)
704	(1300)	39	(5.7)
732	(1350)	30	(4.3)

( ) = calculated values

3.4 Physical Properties

Coefficient of Thermal Expansion following VdTÜV Material Data Sheet.

Coefficient of Thermal Expansion between 20°C (68°F) and...			
Temperature		10^{-6}/°K	10^{-6}/°F
°C	(°F)		
100	(212)	13.38	(7.43)
200	(392)	15.58	(8.66)
300	(572)	16.01	(8.89)
400	(752)	17.03	(9.46)
500	(932)	17.18	(9.54)
600	(1112)	17.51	(9.73)
700	(1292)	17.86	(9.92)
750	(1382)	18.02	(10.01)

( ) = calculated values

Thermal Conductivity following VdTÜV Material Data Sheet 546.

Thermal Conductivity			
Temperature		W/(m°C)	Btu / (ft h °F)
°C	(°F)		
20	(68)	12.1	(6.99)
100	(212)	13.4	(7.74)
200	(392)	15.1	(8.73)
300	(572)	16.7	(9.65)
400	(752)	18.2	(10.5)
500	(932)	19.8	(11.4)
600	(1112)	21.2	(12.3)
700	(1292)	24.0	(13.9)
750	(1382)	24.4	(14.1)

( ) = calculated values

Modulus of Elasticity following VdTÜV Material Data Sheet 546.

Modulus of Elasticity			
Temperature		10^3 MPa	10^3 ksi
°C	(°F)		
20	(68)	193	(28.0)
100	(212)	191	(27.7)
200	(392)	184	(26.7)
300	(572)	175	(25.4)
400	(752)	167	(24.2)
500	(932)	161	(23.3)
600	(1112)	150	(21.8)
700	(1292)	144	(20.9)
750	(1382)	141	(20.5)

( ) = calculated values

4 Application Properties

4.1 Heat Treatment

The solution annealing of the cold finished DMV 310 N meets the requirement of VdTÜV Material Data Sheet 546, where an annealing temperature between 1180°C (2156°F) and 1270°C (2318°F) is required. Additionally, the requirements of ASME Code Case 2115-1 are met where solution-treated at 2000°F (1093°C) minimum is specified.

4.2 Corrosion Properties

The DMV 310 N is designed for the application in furnace atmospheres at high temperature in the range of 600°C (1112°F) to 670°C (1238°F) and has a good corrosion resistance in such atmospheres.

4.3 Tube Bending

DMV 310 N is generally suitable for further cold or hot forming.

After hot forming a new solution annealing is necessary, in case the hot forming has not followed a controlled temperature process between 1175°C (2147°F) and 1250°C (2282°F).

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

4.4 Welding

Pre-heating and a heat treatment after welding are not necessary. To avoid hot cracks in the weld, the 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 considered.

Details on our extensive customer and project references available upon request.

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