MANNESMANN
STAINLESS TUBES
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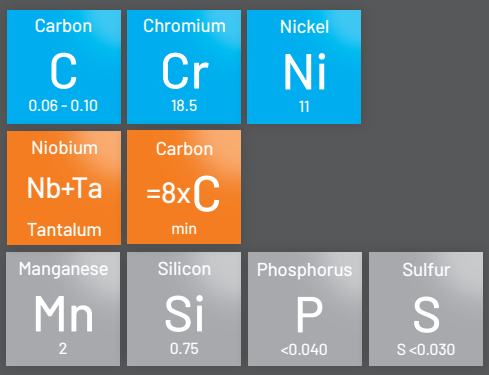
DMV 347HFG

1. Applications

DMV 304HFG is designed for applications such as superheater and reheater boiler tubes.

DMV 304HFG is proven to be suitable in most advanced biomass and coal fired boilers using steam temperatures up to 570°C (1058°F) in supercritical vessel designs.



Chemical composition nominal %

2. Main Features

- Austenitic stainless steel with a fine grain structure of No. 7 – 10 according to ASTM E112 after a thermomechanical treatment of softening, cold finishing and solution annealing
- Very good high temperature fireside corrosion resistance together with good steam oxidation resistance.
- Very good creep resistance at high temperatures, specially in the range of 580°C (1076°F) to 640°C (1184°F)

3. Description

3.1 Specifications

- 1.4908, X8CrNi 19 11, UNS S34710
- European Steel registration
- TP347HFG according ASME SA-213/ SA-213M, Specification for seamless ferritic and austenitic alloy-steel boiler, superheater, and heat-exchanger tubes, United States
- Following VdTÜV Material Data Sheet 547, 06.2003.
- Federal Republic of Germany

3.2 Available Sizes

DMV 304HFG is produced as a seamless austenitic tube with a dimensional range covering all common austenitic reheater and superheater boiler tube sizes. Following VdTÜV Material Data Sheet 547, the max. outer diameter is 65mm and the max. wall thickness is 12.5mm.

Other sizes are available upon request.

3.3 Chemical composition

Mass % according ASME SA-213/ SA-213M.

	%min	%max
C	0.06	0.10
Si		0.75
Mn		2.00
P		0.040
S		0.030
Cr	17.00	20.00
Ni	9.00	13.00
Nb (Cb) + Ta	8xC	1.0

3.4 Mechanical Properties

3.4.1 Tensile Properties at 20C (68F) Annealed Condition

According ASME SA-213/SA-213M.

	MPa	ksi
Y.S. min.	(205)	30
U.T.S. min.	(550)	80
E in 2" min., %	35	

1 MPa=1 N/mm² ; 1 ksi=6.9 MPa ( ) = calculated values

Following VdTÜV Material Data Sheet 547.

	MPa	ksi
0.2% Y.S. min.	205	(29.7)
1.0% Y.S. min.	240	(34.8)
U.T.S.	550-750	(78.8-108.8)
A %	35	

( ) = calculated values

3.4.2 Tensile Properties at Elevated Temperature

Following VdTÜV Material Data Sheet 547.

Temp		0.2% Y.S. min	1.0% Y.S. min
°C	(°F)	MPa (ksi)	MPa (ksi)
100	(212)	182 (24.4)	217 (31.5)
200	(392)	163 (23.6)	198 (28.7)
300	(572)	152 (22.0)	187 (27.1)
350	(572)	148 (21.5)	173 (25.1)
400	(752)	143 (20.7)	173 (25.1)
450	(842)	139 (20.2)	164 (23.8)
500	(932)	136 (19.7)	161 (23.3)
550	(1022)	134 (19.4)	159 (23.1)
600	(1112)	131 (19.0)	156 (22.6)
650	(1202)	126 (18.3)	151 (21.9)
700	(1292)	122 (17.7)	147 (21.3)
750	(1292)	117 (17.0)	142 (20.6)

( ) = calculated values

3.4.3 Impact Test at 20C (68F)

According to VdTÜV Material Data Sheet 547, 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%).

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3.4.4 ASME Code Case 2159-2 maximum allowable stresses at elevated temperatures.

Temp		MAX allowable stresses		MAX allowable stresses 2)	
°F	°C 1)	ksi	MPa 1)	ksi 2)	MPa 1)
-20 to100	-29 to 38	20	137.9	-	-
200	93	18.1	124.8	20	137.9
300	149	16.9	116.5	20	137.9
400	204	15.9	109.6	19.9	137.2
500	260	15.2	104.8	19.3	133.1
600	316	14.6	100.7	19.1	131.7
650	343	14.4	99.3	19.0	131.0
700	371	14.1	97.2	18.9	130.3
750	399	13.9	95.8	18.8	129.6
800	427	13.8	95.1	18.6	128.2
850	454	13.6	93.8	18.3	126.2
900	482	13.4	92.4	18.1	124.8
950	510	13.3	91.7	17.9	123.4
1000	538	13.1	90.3	17.7	122.0
1050	566	13.0	89.6	17.5	120.7
1100	593	12.8	88.3	16.6	114.5
1150	621	12.6	86.9	12.8	88.3
1200	649	9.7	66.9	9.7	66.9
1250	677	7.3	50.3	7.3	50.3
1300	704	5.4	37.2	5.4	37.2
1350	732	4.0	27.6	4.0	27.6

1) calculated values 2) increased deformation (1%) acceptable

3.4.5 Creep Rupture Strength

Average preliminary creep strength Values for 10,000 h and 100,000 h acc. to Material Datasheet VdTÜV 547.

Temp		10,000h	100,000h
°C	(°F)	MPa (ksi)	MPa (ksi)
600	(1112)	215 (31.2)	159 (23.1)
610	(1130)	197 (28.8)	145 (21.0)
620	(1148)	182 (26.4)	134 (19.4)
630	(1166)	168 (24.4)	120 (17.4)
640	(1184)	155 (22.5)	109 (15.8)
650	(1202)	142 (20.6)	100 (14.5)
660	(1220)	130 (18.9)	90 (13.1)
670	(1238)	119 (17.3)	81 (11.7)
680	(1256)	108 (15.7)	72 (10.4)
690	(1274)	99 (14.4)	65 (9.4)
700	(1292)	90 (13.1)	58 (8.4)
710	(1310)	81 (11.7)	51 (7.4)
720	(1328)	74 (10.7)	46 (6.7)
730	(1346)	66 (9.6)	40 (5.8)
740	(1364)	59 (8.6)	34 (4.9)
750	(1382)	53 (7.7)	30 (4.4)

( ) = calculated values

3.5 Physical Properties

Coefficient of Thermal Expansion following VdTÜV Material Data Sheet 547.

Coefficient of Thermal Expansion between 20°C (68°F) and...			
Temperature		10^{-6}/°K	10^{-6}/°F
°C	(°F)		
100	(212)	16.3	(9.06)
200	(392)	16.9	(9.39)
300	(572)	17.3	(9.61)
400	(752)	17.8	(9.89)
500	(932)	18.21	(10.1)
600	(1112)	18.5	(10.3)
700	(1292)	18.7	(10.4)
750	(1382)	18.8	(10.4)

( ) = calculated values

Thermal Conductivity following VdTÜV Material Data Sheet 547.

Thermal Conductivity			
Temperature		W/(m°C)	Btu / (ft h °F)
°C	(°F)		
20	(68)	14.1	(8.47)
100	(212)	15.4	(8.90)
200	(392)	16.9	(9.77)
300	(572)	18.3	(10.5)
400	(752)	19.7	(11.4)
500	(932)	21.2	(12.3)
600	(1112)	22.6	(13.1)
700	(1292)	23.8	(13.8)
750	(1382)	24.6	(14.2)

( ) = calculated values

Modulus of Elasticity following VdTÜV Material Data Sheet 547.

Modulus of Elasticity			
Temperature		10^3 MPa	10^3 ksi
°C	(°F)		
20	(68)	200	(29.0)
100	(212)	190	(27.6)
200	(392)	185	(26.8)
300	(572)	175	(25.4)
400	(752)	170	(24.7)
500	(932)	160	(23.2)
600	(1112)	155	(22.5)
700	(1292)	145	(21.0)
750	(1382)	140	(20.3)

( ) = calculated values

4 Application Properties

4.1 Heat Treatment

The heat treatment of cold finished DMV 304HFG comprises a softening heat treatment prior to cold finishing, and a solution heat treatment after final cold finishing. During the hot forming process, the softening is performed using a temperature of min. 50°C (90°F) above the final solution annealing temperature.

The solution annealing of the cold finished tube meets the requirement of VdTÜV Material Data Sheet 547, where an annealing temperature between 1180°C (2150°F) and 1250°C (2282°F) is required and also the requirements of ASME SA-213/SA-213M.

4.2 Corrosion Properties

DMV 304HFG is designed for application in furnace atmospheres at high temperatures in the range of 580°C (1076°F) to 640°C (1184°F) and has a good corrosion resistance in such atmospheres.

4.3 Tube Bending

DMV 304HFG 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 1170°C (2138°F) and 1210°C (2210°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 metal, 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.

For further details on DMV 304HFG wwdownload our comprehensive reference booklet DMV 304HFG.

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