DMV 304HCu

1. Application

DMV 304HCu has been designed for application as superheater and reheater boiler tube grade. DMV 304HCu has proved to be suitable in most advanced coal and lignite fired power stations for steam temperatures of up to approximately 600°C (1112°F) in supercritical and ultra supercritical vessel designs.

Carbon	Chromium	Nickel		
C	Cr	Ni		
0.07-0.13	18	9		
Copper	**Niobium**	**Nitrogen**	**Aluminium**	
Cu	Nb(Cb)	N	Al	
3	0.45	0.05-0.12	0.003-0.03	
Manganese	**Silicon**	**Phosphorus**	**Sulfur**	
Mn	Si	P	S	
<1.00	<0.30	<0.040	<0.010	

Chemical composition nominal %

2. Main Features

- Austenitic stainless steel alloyed with Copper and Boron to increase the creep strength
- Very good high temperature corrosion resistance
- Very good creep resistance at high temperatures, specially in the range of 580°C (1076°F) to 640°C (1184°F)
- Inner surface shot peening treatment possible upon request

3. Description

3.1 Specifications

- 1.4907, X10CrNiCu Nb 18 9 3, European Steel registration
- UNS S 30432, 18Cr-9Ni-3Cu-Nb-N according to ASME SA-213/SA 213M, US Standard
- Cases of ASME Boiler and Pressure vessel Code Case 2328-1, March 6, 2003, United States
- Following VdTÜV Material Data Sheet 550, Federal Republic of Germany

3.2 Available Sizes

DMV 304HCu is produced as seamless austenitic tube, suitable for all recently used austenitic reheater and superheater boiler tube sizes. Following VdTÜV Material Data Sheet 550, the max. outer diameter is 65 mm and the max. wall thickness is 12.5 mm. Other sizes are available upon request.

3.3 Chemical composition

Mass % according ASME Case 2328-1, March 6, 2003.

	%min	%max
C	0.07	0.13
Si		0.30
Mn		1.00
P		0.040
S		0.010
Cr	17.00	19.00
Ni	7.50	10.50
Nb (Cb)	0.30	0.60
Cu	2.50	3.50
N	0.05	0.12
Al	0.003	0.030
B	0.001	0.010

3.4 Mechanical Properties

3.4.1 At Solution Annealed Condition

According ASME Code Case 2328-1.

	MPa	ksi
Y.S. min.	(235)	34
U.T.S. min.	(590)	85
E in 2" min., %	35	

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

Following VdTÜV Material Data Sheet 550.

	MPa	ksi
0.2% Y.S. min.	235	(34.1)
1.0% Y.S. min.	270	(39.2)
U.T.S.	590-850	(85.6-123.3)
A %	35	

( ) = calculated values

3.4.2 Impact Resistance

According VdTÜV Material Data Sheet 550, 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 550.

Temp		0.2% Y.S. min	1.0% Y.S. min
°C	(°F)	MPa (ksi)	MPa (ksi)
100	**(212)**	205 (29.7)	230 (33.4)
200	**(392)**	180 (26.1)	205 (29.7)
300	**(572)**	170 (24.7)	195 (28.2)
400	**(752)**	160 (23.2)	185 (26.8)
450	**(842)**	175 (25.4)	195 (28.2)
500	**(932)**	150 (21.8)	175 (25.4)
550	**(1022)**	145 (21.0)	170 (24.7)
600	**(1112)**	140 (20.3)	165 (23.9)
650	**(1202)**	135 (19.6)	160 (23.2)
700	**(1292)**	135 (19.6)	160 (23.2)
750	**(1382)**	125 (18.1)	150 (21.8)

( ) = calculated values

3.4.4 Creep Strength Values

Average Preliminary creep strength values for 10,000 h and 100,000 h acc. to VdTÜV Material Data Sheet 550. The lower scale band can be estimated as 20% lower than average values.

Temp		10,000h	100,000h
°C	(°F)	MPa (ksi)	MPa (ksi)
600	**(1112)**	240 (34.8)	182 (26.4)
610	**(1130)**	222 (32.2)	165 (23.9)
620	**(1148)**	206 (29.9)	152 (22.0)
630	**(1166)**	192 (28.4)	139 (20.2)
640	**(1184)**	174 (25.2)	126 (18.3)
650	**(1202)**	160 (23.2)	116 (16.8)
660	**(1220)**	146 (21.2)	105 (15.2)
670	**(1238)**	134 (19.4)	96 (13.9)
680	**(1256)**	124 (18.0)	86 (12.5)
690	**(1274)**	114 (16.5)	78 (11.3)
700	**(1292)**	101 (14.6)	68 (9.9)
710	**(1310)**	92 (13.3)	61 (8.8)
720	**(1328)**	84 (12.2)	54 (7.8)
730	**(1346)**	76 (11.0)	48 (7.0)
740	**(1364)**	68 (9.9)	42 (6.1)
750	**(1382)**	61 (8.8)	37 (5.4)

( ) = calculated values

3.5 Physical Properties

Coefficient of Thermal Expansion following VdTÜV Material Data Sheet 550.

Coefficient of Thermal Expansion between 20°C (68°F) and...			
Temperature		10^{-6}/°K	10^{-6}/°F
°C	(°F)		
100	**(212)**	16.4	(9.11)
200	**(392)**	17.1	(9.5)
300	**(572)**	17.5	(9.72)
400	**(752)**	17.8	(9.89)
500	**(932)**	18.1	(10.1)
600	**(1112)**	18.4	(10.2)
700	**(1292)**	18.6	(10.3)
750	**(1382)**	18.7	(10.4)

( ) = calculated values

Thermal Conductivity following VdTÜV Material Data Sheet 550.

Thermal Conductivity			
Temperature		W/(m°C)	Btu / (ft h °F)
°C	(°F)		
20	**(68)**	14.5	(8.38)
100	**(212)**	16.2	(9.36)
200	**(392)**	19.4	(11.2)
300	**(572)**	21.5	(12.4)
400	**(752)**	23.0	(13.3)
500	**(932)**	25.2	(14.6)
600	**(1112)**	28.6	(16.5)
700	**(1292)**	31.0	(17.9)
750	**(1382)**	31.0	(17.9)

( ) = calculated values

Modulus of Elasticity following VdTÜV Material Data Sheet 550.

Modulus of Elasticity			
Temperature		10^3 MPa	10^3 ksi
°C	(°F)		
20	**(68)**	189	(27.4)
100	**(212)**	182	(26.4)
200	**(392)**	174	(25.2)
300	**(572)**	165	(23.9)
400	**(752)**	156	(22.6)
500	**(932)**	149	(21.6)
600	**(1112)**	141	(20.5)
700	**(1292)**	134	(19.4)
750	**(1382)**	130	(18.9)

( ) = calculated values

4 Application Properties

4.1 Heat Treatment

The heat treatment of cold finished DMV 304HCu meets the requirement of VdTÜV Material Data Sheet 550, where an annealing temperature of the tubes between 1100°C (2012°F) and 1180°C (2156°F) is required. Additionally, the requirements of ASME Code Case 2328-1 are met where solution-treatment at 2000°F (1093°C) minimum is specified.

4.2 Corrosion Properties

The DMV 304HCu is designed for the application in furnace atmospheres at high temperature 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 304HCu 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 1100°C (2012°F) and 1150°C (2102°F).

Following the VdTÜV Material Data Sheet 550, cold formed tubes have to be newly solution annealed if the forming degree is > 25% or the R/D ratio is < or equal 2.0. 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.

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

DMV
tubes@dmv-tubes.com
Tel. +49 208 458 01
www.dmv-tubes.com

DMV 304HCu EN 09/2024