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HYDROGENIUS DATABASE

— Fatigue Properties —

No. A97

Database on Fatigue Strength Properties of JIS-SUS304 (304 Type)
Austenitic Stainless Steel in 115 MPa Hydrogen Gas

2022

Edited by
Research Center for Hydrogen Industrial Use and Storage (HYDROGENIUS)
Kyushu University

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1. MATERIALS

Table 1 Production process and related data of SUS304.

Heat	Production process	Product form	Dimensions
d ¹⁾	Hot-rolled	Plate	Length: 7000 mm Width: 3050 mm Thickness: 30 mm

1) As reported by the manufacturer.

Table 2 Chemical compositions of SUS304.

	Heat		Element (mass%)									
			C	Si	Mn	P	S	Ni	Cr	Mo	Cu	N
Product analysis	d ¹⁾		0.046	0.40	0.85	0.030	0.004	8.11	18.10	0.24	0.37	0.060
Ladle analysis	d ²⁾		0.05	0.40	0.83	0.030	0.004	8.10	18.16			
	Requirement ³⁾	max	0.08	1.00	2.00	0.045	0.030	10.50	20.00			
		min						8.00	18.00			

1) As reported by HYDROGENIUS.

2) As reported by the manufacturer.

3) As per JIS G 4304 (2021), "Hot-rolled Stainless Steel Plate, Sheet and Strip".

Table 3 Heat treatment conditions of SUS304.

Heat	Heat treatment	Condition
d ¹⁾	Solution-treatment	1100°C, 3 min, water quenched

1) As reported by the manufacturer.

2. MECHANICAL PROPERTIES

Table 4 Mechanical properties of SUS304.

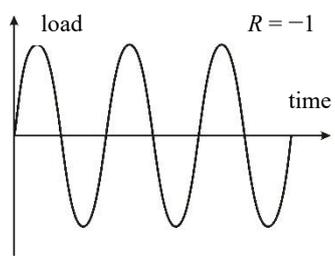
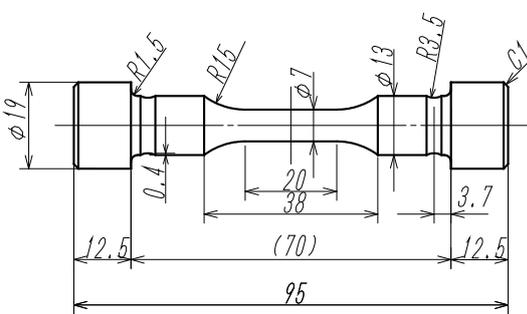
Heat		Tensile Properties			Vickers hardness (HV)
		0.2% proof strength $\sigma_{0.2}$ (MPa)	Tensile strength σ_B (MPa)	Elongation ϵ_f (%)	
d ¹⁾		276	625	64	
Requirement ²⁾	max				
	min	205	520	40	

1) As reported by the manufacturer.

2) As per JIS G 4304 (2021), "Hot-rolled Stainless Steel Plate, Sheet and Strip".

3. FATIGUE STRENGTH PROPERTIES

Table 5 Fatigue test conditions.

Type of test	Uniaxial
Testing machines	<ul style="list-style-type: none"> • 100 kN servo-hydraulic fatigue machine in gaseous hydrogen and nitrogen up to 120 MPa • 50 kN servo-hydraulic fatigue machine in air
Loading condition	Constant stress amplitude test under zero mean stress ($R = -1$)
Waveform	
	Sinusoidal
Frequency ^{1),2)}	1 Hz, 10 Hz
Environment	<ul style="list-style-type: none"> • In 115 MPa hydrogen gas at RT • In air at RT
Gas purity	Hydrogen gas: 99.999%
Specimen ³⁾	

1) Fatigue tests were performed at 1 Hz up to 2.0×10^6 cycles. Frequency was switched from 1 Hz to 10 Hz afterwards.

2) If the temperature at specimen surface exceeded 50°C during fatigue tests, frequency was set to 0.5 Hz.

3) The specimen surface was finished by buffing with a colloidal SiO_2 ($0.04 \mu\text{m}$) solution.