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HYDROGENIUS DATABASE

— SSRT Properties —

No. A81

Database on Slow Strain Rate Test (SSRT) Properties of Hydrogen-Charged JIS-SNCM439 Nickel Chromium Molybdenum Steel in 115 MPa Hydrogen Gas

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1. MATERIALS

Table 1 Production process and related data of SNCM439.

Heat	Production process	Product form	Dimensions
G ¹⁾	Hot-rolled	Plate	Length: 834 mm Width: 130 mm Thickness: 30 mm

1) Reported by the manufacturer.

Table 2 Chemical composition of SNCM439.

	Heat		Element (mass %)							
			C	Si	Mn	P	S	Ni	Cr	Mo
Product analysis	G ¹⁾		0.40	0.22	0.80	0.014	0.002	1.80	0.86	0.26
Ladle analysis	G ²⁾		0.39	0.22	0.79	0.016	0.002	1.80	0.84	0.26
	Requirement ³⁾	max	0.43	0.35	0.90	0.030	0.030	2.00	1.00	0.30
		min	0.36	0.15	0.60			1.60	0.60	0.15

1) Performed by HYDROGENIUS.

2) Reported by the manufacturer.

3) JIS G 4053 (2008), "Low-alloyed steels for machine structural use".

Table 3 Heat treatment condition of SNCM439.

Heat	Shape	Quenching	Tempering
G ¹⁾	Plate	850°C/2 h, Oil-quenched	640°C/4 h, Air-cooled

1) Reported by the manufacturer.

2. MECHANICAL PROPERTIES

Table 4 Mechanical properties of SNCM439.

Heat	Shape	Tensile Properties				Vickers hardness (<i>HV</i>)
		Upper yield strength σ_{UY} (MPa)	Tensile strength σ_B (MPa)	Fracture elongation ε_f (%)	Reduction of area φ (%)	
G ¹⁾	Plate	734	873	23	66	270
Requirement ²⁾	max					
	min	885	980	16	45	

1) Performed by HYDROGENIUS.

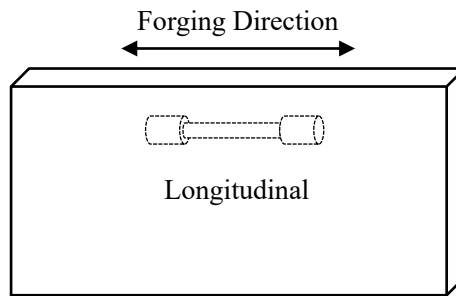
2) JIS G 4053 (2008), “Low-alloyed steels for machine structural use”.

3. SSRT PROPERTIES

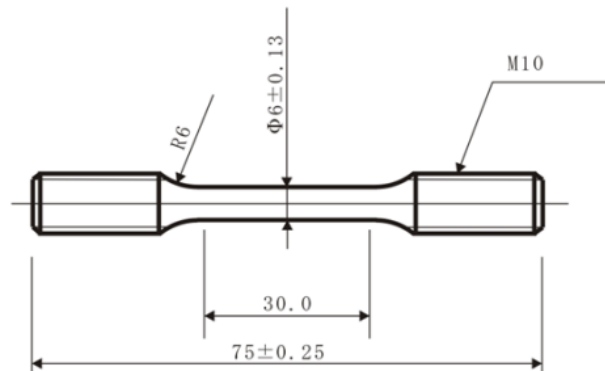
Table 5 SSRT conditions.

Type and capacity of testing machine	Servo-hydraulic, 100 kN	Screw type, 100 kN
Loading condition	Uniaxial, Monotonic	
Environment	In 115 MPa hydrogen gas at RT	In air at RT
Gas purity	Hydrogen gas: 99.999% (5N)	---
Test speed	$2.0 \times 10^{-3} \text{ mm/s}^2$ ($6.7 \times 10^{-5} \text{ s}^{-1}$) ³⁾	

Specimen¹⁾



(a) Sampling of specimen



(b) Shape and dimensions of specimen (in mm)

- 1) Specimen surface was finished by longitudinal polishing with diamond paste.
- 2) Test speed was determined by crosshead speed.
- 3) Estimated from crosshead speed divided by the length of parallel section, i.e. the value of $6.7 \times 10^{-5} \text{ s}^{-1}$ is given by $(2.0 \times 10^{-3} \text{ mm/s}) / 30 \text{ mm}$.

Table 6 Conditions of hydrogen-charging.

Hydrogen exposure	Specimen was exposed to hydrogen gas environment as shown by the figure below.
Hydrogen gas purity	99.999% (5N)
Schematic profiles of hydrogen pressure and temperature	<p>The graph shows the temperature and pressure profiles over a 6-day period. The y-axis represents Temperature [°C] (0 to 200) and Pressure [MPa] (0 to 200). The x-axis represents Days (0 to 6). The red line represents Temperature [°C], and the blue line represents Pressure [MPa]. The red line starts at 0°C, rises to 200°C at approximately 1.5 days, and then drops to 160°C at 2 days, 120°C at 2.5 days, 80°C at 3 days, and finally to RT (Room Temperature) at 6 days. The blue line starts at 0 MPa, rises to 115 MPa at approximately 1.5 days, and then fluctuates between 100 MPa and 120 MPa until 4 days, and finally to 115 MPa at 6 days. The legend indicates that the solid line with arrows represents 'Operation' and the dashed line represents 'Non-operation'.</p>